PROCEEDINGS OF THE 31st ANNUAL

GOAT FIELD DAY

April 30, 2016

Agricultural Research and Extension Program
Langston University
Langston, Oklahoma 73050

WELCOME

We deeply appreciate your attendance at this 31st Annual Goat Field Day of the E (Kika) de la Garza American Institute for Goat Research of Langston University. Goat Field Day is one of the most important things we do each year. The primary purpose of Goat Field Day is for education and extension in areas of greatest interest to stakeholders of the Institute. Thus, please share your thoughts with us on today's activities and suggestions for Goat Field Day next year. In addition to extension and education, Goat Field Day provides an excellent opportunity for the staff of the Institute to meet other people who work with goats. Such interaction helps make our program the most appropriate it can be for the people it serves. The proceedings of Goat Field Day is a very useful tool for the Institute beyond impact realized from the program today. First, there are reports on Goat Field Day presentations. After this information, there are highlights of research, extension, and international activities of the Institute in the past year. This section is an aid to assess our recent progress, display current activities, and contemplate future directions to be followed. This year's general theme for Goat Field Day is "Keeping Your Goats Healthy".

Here is the exciting program planned for today that has developed from your input.

The morning program consists of:

- **Preventative Medicine 101 for Your Goat** — *Dr. Lionel Dawson*
- **What to Do When Your Goat Is Sick** — *Dr. Katie Simpson*

The afternoon workshops are:

- **Common Abortions in Goats** — *Dr. Lionel Dawson*
- **Extra-label Drug Use** — *Dr. Lionel Dawson*
- **CAE and Mastitis** — *Dr. Katie Simpson*
- **CL and Urinary Calculi** — *Dr. Katie Simpson*
- **The Art of cheesemaking** — *Ms. Gianaclis Caldwell*
- **Internal Parasite Control** — *Dr. Barry Whitworth*
- **Basic Goat Husbandry** — *Mr. Jerry Hayes*
- **Nutrition for Health and Production** — *Dr. Steve Hart*
- **Goat Farm Budgeting** — *Mr. Brent Ladd*
- **Pack Goats** — *Mr. Dwite Sharp*
- **DHI Training** — *Ms. Eva Vasquez*
- **USDA Government Programs**
  - **USDA/APHIS: Animal ID** — *Dr. Michael Pruitt*
  - **USDA/WS: Wildlife Programs** — *Mr. Kevin Grant*
  - **USDA/NRCS: Conservation Programs** — *Ms. D'Ann Peterson*
  - **USDA/FSA: Farm Loans** — *Mr. Phil Estes*
  - **USDA/NASS: Animal Inventories** — *Mr. Wil Hundl*
  - **Perry Livestock: Livestock Auctions** — *Mr. Travis Perrin*
- **Fitting and Showing for Youth and Adults** — *Mr. Coleman Sanders*
- **Old-Fashioned Fun** — *Ms. Shirlene Hurte*

On behalf of the staff of E (Kika) de la Garza American Institute for Goat Research, we thank you for your continuing interest and support.

Tilahun Sahlu

Director, E (Kika) de la Garza American Institute for Goat Research

Table of Contents

Preventative Medicine 101 for Your Goat

Dr. Lionel Dawson

Oklahoma State University

Introduction

The goal of a herd health program is to improve the goat herd's productivity through general husbandry, nutrition, parasite control, vaccination, and environmental management. An understanding of various management practices and common diseases on the farm is necessary to accomplish this goal. An effective herd health program is an essential part of a successful goat management program. Good feeding and breeding will not result in maximum production if goats are not kept in good health. Conversely, good nutrition and herd management will greatly reduce the complexity and cost of the herd health program.

Herd health programs are always described in very general terms and then modified to fit individual herds. The exact makeup of any program depends on the herd size, purpose of having the herd, and the production goals of the owner. For the most part, goats are managed as small groups of five to a hundred animals per herd. There are relatively very few large commercial goat herds with numbers above 500 head in the United States. Large herds may have problems associated with high density of animals and continuous turn over. Small herds tend to have higher nonproductive/productive ratios than do larger herds. This is because small herd owners often keep animals that would normally be culled in large commercial herds. Often, the net result is the maintenance of animals with chronic illnesses that may serve as reservoirs of disease.

Since each herd is different, each owner should work with his/her veterinarian to create an individual herd health plan. Keep good records for each animal regarding medications, vaccinations, dewormers, diseases, breeding, culling etc., and use this information to plan your herd health program. Preventive medicine is usually less expensive than treating the disease as the highest economic returns are realized when disease problems are at a minimum. Many diseases have similar symptoms and a producer should work with a veterinarian familiar with common goat diseases. A veterinarian familiar with goats has the training and experience needed to provide diagnosis and recommend animal health products used in goats to treat these conditions.

Common Herd Health Procedures

In the normal course of herd health management it will be necessary to perform different herd health procedures. Some of these procedures are performed to collect information on an animal's condition that can be relayed to a veterinarian. Others are needed in the course of disease prevention or treatment. A producer should only attempt those procedures in which they feel comfortable and sufficiently proficient so that no harm can come to the animal. If there is any doubt, consult a veterinarian. The most common procedures done by producers are listed below with a brief explanation of correct methods.

Taking temperature – rectally

The first procedure usually performed on an animal suspected to be ill is to take its temperature. In goats, this is performed rectally. Either a digital or mercury thermometer can be used. Plastic digital thermometers do not break and may be considered as safer to use than a mercury thermometer. A small amount of lubricant may be put on the thermometer and it should be inserted with a twisting motion. A normal goat's temperature should be 103 - 104ºF (39 - 40ºC).

Pulse or heart rate

There are several places on the goat where the pulse or heartbeat can be felt and measured. Heartbeat can be felt by placing one's fingertips between the ribs behind the elbow. Pulse can be measured using the femoral artery on the inside of the rear leg roughly ⅓ of the way down. Pulse may also be detected by placing the index and middle fingers on the artery located below and slightly inside of the jaw roughly two-thirds to the rear of the muzzle. A normal range is 70 to 90 beats per minute.

Respiration

Respiration is detected by watching movement of the flank or chest. A normal range is 12 to 20 per minute.

Rumen movements

Adequate rumen function is essential for a goat's health. One sign of adequate function is regular ruminal movement. This can be detected by placing the hand on the left flank of the animal. If the rumen feels soft and water-filled this should be noted and reported to your veterinarian. Rumen contractions should be easily felt and should occur 1-2 times per minute.

Checking mucous membranes

Paleness of the mucous membranes in the mouth (gums), vagina and prepuce can be an indicator that the animal is in hypovolemic shock, meaning that there is a decrease in the blood volume circulating in the animal. The color of the conjunctiva around the eyes can be an indicator of anemia that could be caused by a heavy internal parasite burden. Roll down the lower eyelid to look at the color. A pale, whitish color indicates anemia. This color can be scored using the FAMACHA system which is described in the section on Parasites of Goats. Remember that irritation of any type causes membranes to turn red. This means that an anemic goat with pinkeye may still have red membranes.

Drenching and dosing

Drenching or dosing an animal entails the oral administration of a liquid. The obvious goal of this procedure is to ensure that the animal swallows the full amount given. Grasp the animal under the jaw to raise its head. Raising the head of the animal will assist in ensuring the liquid is swallowed. A finger or thumb can be put into the mouth where there are no teeth (goats lack canine teeth as do all ruminants) to assist in opening the mouth for the drenching equipment. Generally a bottle with a tube over the end or a drenching gun is used. Liquids should be given slowly to allow time for the animal to swallow. Dewormers must be given using appropriate drenching equipment ensuring that they are given over the back of the tongue and swallowed.

Tubing an animal

In some cases it may be necessary to pass a tube down the mouth directly into the stomach in order to administer a large volume of a liquid. This could also be used to feed a young animal incapable of nursing or to either sample rumen contents or insert rumen contents into an animal having severe digestive problems. The size of the tube passed should be appropriate for the animal's size. Generally, a ½ to ¾ inch (1 to 2 cm) diameter tube should be used for adult goats. A short metal or PVC pipe (speculum) larger in diameter than the tube to be inserted is placed in the mouth to prevent the goat from biting or chewing the plastic tube. Some people prefer to use a "Harp" speculum instead. The hard-sided tube or speculum is inserted into the mouth of the goat and holds their mouth open while you pass the tube. The plastic tube is then passed down the throat and into the stomach. Administer liquids slowly. Have a veterinarian or person trained in this technique instruct you before attempting it the first time.

The procedure for tubing a neonatal kid is similar to that for adult animals with a few distinctions. For kids, one does not need to use a PVC tube or speculum. The size tube used is smaller for baby goats (12 to 14 French or roughly ¼ inch inner diameter). The tube should be flexible without any hard edges to harm the kid's mouth or throat. Hold the kid's mouth open and pass the tube gently over the hump or base of the tongue at the back of the mouth and into the stomach.

There are some precautions to take in tubing an animal to ensure that liquids are not inadvertently administered into the lung. The first precaution is to always hold the goat's head in its normal flexed position. If you extend the head and throat, your tube has a straight shot down the trachea. When doing this, preferably have the goat standing. As the tube is inserted, watch and feel the throat area. The tube needs to enter the esophagus and not the trachea or windpipe. The esophagus is a smooth, flexible tube leading to the stomach and one can feel or see the stomach tube sliding downwards. The trachea is a rigid tube and the stomach tube can neither be seen nor felt from outside the animal. When the tube is in the esophagus, feel the bottom of the neck. You should feel "two tubes." One will be the trachea and the other will be the rigid tube inside the esophagus.

Another check can be done while midway down the trachea/esophagus is to suck on the end of the tube. If you are in the esophagus, it will collapse on the tube and you will create a vacuum. Alternatively, blow in the tube and you will see a bolus of air go down the esophagus. If using a stethoscope applied to the goat's rumen on the left side of the body, you will hear air bubbling. Sucking on the tube while it is in the rigid walled trachea will not create a vacuum. One can also check for the smell of rumen fluid to ensure correct placement. To ensure proper depth of penetration, place the tube along the outside of the animal stretching from the mouth to the last rib, a point that would be inside the stomach, and put a mark on the tube. Use this as a guide when inserting the tube. Never rely on the goat coughing as a guide to proper tube placement. It is not a reliable test.

Bolus administration - "Balling"

A "balling gun" is used to administration tablets or boluses to an animal. A balling gun has a holder for the tablet in the end and a plunger to expel the tablet into the throat. Large boluses should be lubricated with vegetable or mineral oil for easier swallowing. Pass the balling gun over the hump of the tongue and press the plunger while holding and tilting the goat's head upwards. Ensure the tablet is swallowed by holding the mouth shut. Stroking the throat can also elicit a swallowing reflex.

Be very gentle in placing the balling gun into the mouth and expelling the pill. The tissues of the throat are very delicate and pills and guns have sharp edges. This can result in serious damage to your goat or minimally a goat with a very sore throat that will not eat. Newer model balling guns have soft plastic heads that reduce the potential for injury.

Paste administration

Dewormers, rumen pastes, and the like may come in a tube and are given through the use of an instrument resembling a caulking gun. Hold the animal as described for "balling," insert the end of the tube into the mouth and squeeze the handle the correct number of "clicks" to deliver an appropriate dose. Again, holding the goat's mouth shut will assist in swallowing.

Giving injections

Administering drugs via injection is a common herd health procedure routinely practiced by almost all producers. Following proper guidelines for each type of injection and using proper equipment will ensure that injections are done correctly and inflict minimum stress on an animal. Proper sanitation will ensure that you don't inject bacteria into your goat and cause an infection. Dirty needles and syringes should never be

used. Using needles and syringes on multiple animals can transmit disease. After making six to ten injections with a needle it will be dull and should be changed and disposed of properly.

Needle selection

Proper injection technique includes selection of an appropriate size syringe and needle. Syringes should have volume markers that would ensure administration of the correct amount of drug. Needle gauge should be considered as it relates to injection type and thickness or viscosity of drug. In general, 18 to 20 gauge needles (as gauge number increases, needle diameter decreases) are sufficient.

Proper injection sites

Live animals are considered unprocessed food, especially if those goats are intended for slaughter and later used in the food chain. Injection site lesions should be a major product quality concern for goat producers raising goats for meat. Injection-site defects are lesions or scars found in cuts of meat that result from tissue irritation caused by the administration of intramuscular or sometimes subcutaneous injections. In addition to the scarred tissue, tenderness of the meat is also significantly reduced in the affected area surrounding the site. Proper injection sites are described for each type of injection described.

Common injection methods

The three most common injection methods are subcutaneous (SQ, under the skin), intramuscular (IM, in the muscle), and intravenous (IV, into a blood vessel, usually the jugular vein). Subcutaneous injections are the easiest to give and intravenous the most difficult. Whenever a drug or vaccine lists SQ as an option for injection use the SQ route. Only experienced personnel should attempt to give an intravenous injection and professional assistance should be used in most instances. Intravenous injections provide the fastest absorption of a drug by the animal while subcutaneous the slowest.

Subcutaneous injections

To inject subcutaneously, pull up a pinch of skin making a tent. Insert the needle into the tent taking care not to pierce through the other side. Depress the plunger slowly. Injecting with the needle pointing towards the ground will lessen the likelihood of the material leaking out of the hole left by the needle. Massage the injected area. If administering large amounts of a drug, over 3 milliliters (ml or cc), it is best to divide the dose among two or more sites not giving more than 2 or 3 cc per site. The preferred site for SQ injections is the skin just behind the elbow, although they can also be given in the triangular area in front of the shoulders between the top and bottom of the shoulder blade and corner of the jaw. Vaccines often cause swellings or "knots" and a knot behind the elbow indicates an injection site whereas a knot in the neck in front of the shoulder could possibly be confused with a caseous lymphadenitis abscess.

Intramuscular

An intramuscular injection calls for the needle to be inserted into a muscle. Intramuscular injections are commonly given in the triangular area of the neck, in front of the shoulder. Do not give intramuscular injections in the loin or hind leg of goats that are used for meat purposes to prevent injection site blemishes from occurring that lowers the value of the meat. Volume given in the muscle should not be more than 3 ml per site.

After inserting the needle, pull back on the plunger slightly to make sure a blood vessel has not been penetrated. Administer the drug slowly. If a blood vessel has been pierced, the needle can be withdrawn slightly, repositioned, and checked again. Never give an injection near the spine to prevent accidentally causing nerve damage.

Intravenous

An intravenous injection requires skill to locate a vein, usually the jugular vein in the neck, insert the needle, and ensure that the needle remains in the vessel while the drug is given. Prior to attempting this, it is best to receive training from a veterinarian. Animals may react quickly to drugs given in this fashion due to rapid absorption. Very few drugs need to be given intravenously; however, blood samples often need to be collected and the technique is the same. The easiest approach is to have someone straddle the goat to hold it securely. The holder will elevate the goat's head up and to the side. If you have clippers, clip all of the hair off the bottom third of the neck. Feel for the trachea on the neck and move towards the top of the neck. The area between the trachea and the muscles of the neck is the "jugular groove" and is where the jugular vein lies. Put pressure at the bottom of the groove and you will see the groove swell from your finger up to the jaw of the goat. The vein is now filled with blood. Using an 18 to 20 gauge needle, direct it at an angle of 45 degrees then stab through the skin. Pull back on your syringe and see if there is blood present. If not, adjust the depth (deeper or more shallow) or move up or down the side of the groove until blood is obtained.

When you are injecting drugs IV, it is important to ensure that all of the drug enters the vein. Give the drug slowly. The jugular vein will take the administered drug straight to the heart and at high concentrations many drugs can cause problems with the heart. IV drugs given around the vein instead of in the vein can cause an irritation or inflammation of the vein.

Minor Surgical Procedures

Castration

Males not wanted as replacement bucks should be castrated. Castration can be done by various mean as early as between 2 to 4 weeks of age. There are several methods of castration and the method selected will depend upon the age of the animal. The most common methods are elastrator band, Burdizzo® or other clamp, or surgical methods. General sanitation and vaccination precautions should be followed. Additional information on castration procedures can be found in the Meat Goat Management section.

Some producers may delay castration until bucks are 2 to 3 months of age. This may lessen the incidence of urinary calculi or bladder stones (see the Goat Diseases section) in animals on a high grain or concentrate diet. Also, remember that intact bucks have high levels of testosterone which acts as a growth promotant and stimulates the production of lean muscle mass. Many goat meat consumers that eat young goats do not care if the meat comes from intact or castrated males. There are some ethnic markets that actually prefer meat from mature bucks. Know the market in your area. The point being that if it is not necessary to castrate goats for marketing purposes, then don't. However for breeding purposes realize that some bucks are fertile and ready to breed by 3 months of age and unwanted males should be castrated or separated from fertile females. In most climates photoperiod effects keep this from being a practical problem until kids are 9 to 12 months of age. In general, castration at an early age is the normal practice to reduce shock to the animal. Older animals should receive some type of anesthesia prior to castration and a veterinarian consulted.

Dehorning

Most meat goat producers will elect not to dehorn their goats. If the decision is made to raise goats without horns then kids should be disbudded in the first two weeks of life. Buck kid horns grow faster than doe horns. Some large single buck kids should be disbudded within the first week after birth. Disbudding a buck kid is the true test of proficiency of the person doing the dehorning and many fail, judging by the number of scurs seen on adult bucks. If you try to disbud a buck kid whose horn base is wider than a regular disbudding iron, you will get regrowth of the horn in a crown outside the burned area. If you try to disbud a small kid with a wide calf dehorner, you may get regrowth of the horn from the center of the ring. If one person

is doing the job, a disbudding box offers the best and safest restraining device. Approximate dimensions are given the accompanying illustration.

The use of a local anesthetic is commonly advocated; however, the actual technique is not easy and the baby goat will scream while being held in preparation for a ring block or a cornual nerve block. One week old kids are small animals and cannot be given large doses of lidocaine or toxicity will result. A one week old kid should get no more then 1 cc total of lidocaine. One technique used is to dilute the lidocaine with distilled water allowing a larger volume to be injected into the locations shown below. Have a veterinarian administer the anesthetic or train you in the procedure.

Veterinarians typically use systemic anesthetics to anesthetize the goat for dehorning. The commonly used drugs are xylazine (Rompun) and ketamine (Vetalar). These can only be administered by a veterinarian.

The disbudding equipment most commonly used is an electric-heated metal rod with a hollowed-out end. Newer cordless, butane gas powered dehorners are available. Some disbudding irons have problems in maintaining a constant temperature, and it is extremely important to match temperature and time. Under-burning of the horn bud will result in scurs while over-burning will lead to brain damage or death. The horn buds can generally be felt in young kids to ensure proper location to burn. After the disbudding iron is hot, apply it firmly over the horn area and rock it around slowly for 3.5 to 4 seconds. Remove the iron and repeat if necessary and do the other side. Evaluate the success of the procedure by its appearance. The goal is to have the area look like "chrome tanned leather." Black color represents burned hair and is indicative of inadequate burning. Clipping the site prior to burning will eliminate the problem of burned hair. Scent glands are located near the base of the horn and descenting could be done at the same time if desired. Inject the kids with 150 IU tetanus antitoxin. Although the risk of tetanus after disbudding is not great, it is a good practice to administer tetanus antitoxin.

An alternate disbudding method is the use of a caustic paste. The hair around the horn bud should be clipped and the paste applied. A ring of petroleum jelly around the horn bud may help prevent the paste from burning other skin tissue. Caustic paste sounds more benign than burning horn tissue; however, the paste has a bad habit of causing chemical burns on other parts of the goat or on his/her pen mates. To use caustic paste, make sure the kid is kept by itself so that it doesn't rub the chemical on the udder of its mother or the faces of its friends (not practical with most meat goat kids) and that it is kept out of the rain so that rain water doesn't wash the chemical into the goat's eyes.

Lancing abscesses

Goats get a variety of swellings or "knots" at various locations on their bodies. Some of these are cysts (fluid filled structures) and some of these are abscesses (puss filled structures). There is a disease of goats called caseous lymphadenitis (CL) that causes abscesses in the lymph nodes of goats. See the section on Meat Goat Herd Health - Common Diseases for more details.

One way of speeding the healing of an abscessed goat and of containing all of the infectious material from the abscesses is to lance it. This is usually a very simple and safe procedure. The first thing to do is be patient. Wait until the abscess comes to a "head." This is when the abscess is attached to the skin and the hair has begun to come off at the top of the abscess. The center of the abscess will soften. At this point, there are no vital blood vessels or other structures between the puss in the abscess and the outside of the goat.

Since pus is infectious to other animals and humans, wear gloves when performing this procedure. Remove any remaining hair from the region. Scrub the area with disinfectant soap (Betadine Scrub®) and restrain the goat. If this is done correctly it is not a painful procedure for the goat. Take a pinch of skin in the center of the abscess with your gloved hand or a surgical tool (such as a towel clamp) and stab a scalpel or sharp, sterilized knife blade deeply into the abscess and cut out a circle of skin. Just slashing the abscess

Recommended needle sizes and lengths used in goats			
Age	Gauge	Needle length	
		Intramuscular injection	Subcutaneous injection
< 4 weeks old	20	½ inch	½ inch
4 to 16 weeks	20	⅝ to ¾ inch	½ inch
4 to 6 months	20	1 inch	½ inch
> 6 months	18 to 20	1 inch	½ inch

may allow the cut to seal over before the abscess has healed from the inside out. There will be some white, or greenish white, odorless puss come out of hole created in the abscess. Catch it in a disposable bag and dispose of it where other goats can't get into it. Caseous lymphadenitis is a contagious disease. It is also a zoonotic disease, meaning it can be transmitted to humans, so wear gloves and sanitize your hands and equipment used after this procedure.

After lancing the abscess flush the area with diluted Betadine Solution® (10:1, 10 parts water to 1 part solution) to flush out any residual puss or bacteria. Make sure you keep the goat away from other goats until the lesion has completely healed.

Normal Range for Goat Physiological Parameters

Temperature, rectal	103–104° F (39–40° C)
Heart rate	70–90 beats per minute
Respiration	12–20 per minute
Rumen movements	1–2 per minute
Puberty	4–10 months
Estrous cycle	21 days
Estrus (standing heat)	12–48 hours
Gestation	150 days

Herd Health at Different Production Stages

Goats have different health needs according to their stage of production. Providing for these health needs will increase your chances of having a healthy, productive herd.

Pre-breeding

Breeding does

Thirty to sixty days before the breeding season does should be examined for their udder and teat conformation, dentition (teeth), musculo-skeletal problems, and feet and body condition. Culling decisions should be made. Some common conditions seen in does include lameness, chronic mastitis, bad teats, and poor body condition due to a chronic disease, parasitism, old age, or other cause. Doelings should be at least 65 to 70% of their mature weight before their first breeding.

Prebreeding vaccination for *Chlamydia* should always be given. *Leptospirosis* and *Campylobacter* are less common causes of reproductive failure and abortion and vaccinations may be done, if the disease is present. Monitor fecal egg counts and deworm if needed. Does can be supplemented (flushed) with grain 2 to 4 weeks before breeding this will improve their fecundity (number of kids born per doe). Abrupt fence

line exposure to bucks in the late transition period in the fall when does can begin to come into heat can help bring about cycling.

Breeding bucks

Bucks are too often neglected and omitted from herd health management practices. Some of the common conditions seen in bucks are urinary calculi (stones), lameness, urine scalding around the prepuce, and front leg injury due to a dominant buck in the pen. In the case of urinary scald, wash the affected area. Application of petroleum jelly can help protect the affected areas. Maintain a 2:1 ratio of dietary calcium to phosphorous and provide a high level of salt (up to 4%) and 1 to 2% ammonium chloride in the diet to prevent urinary calculi. Bucks should be vaccinated at the same time as the does and for the same diseases. Body condition and breeding soundness should be evaluated at least 4 weeks before the breeding season and adjustments made to prevent bucks from becoming overly thin or obese. As breeding season approaches, extremely aggressive and dominant bucks may need to be penned separated to prevent injury. Monitor fecal egg counts in bucks or FAMACHA score and deworm as needed.

Breeding Season

Watch does and bucks carefully during the breeding season. This is a particularly strenuous time for bucks. Lame or sick bucks will not be able to breed adequate numbers of does. Fertility is drastically decreased by hot weather. Do everything you can to cool the buck off. This may include shade and fans during the day in very hot climates.

Gestation

Pre-parturition

A kid health and management program should actually begin prior to parturition with attention to the nutritional needs of the gestating doe in late lactation and during the dry period. An adequate diet for dry does is essential to produce healthy kids. Pregnant does should be fed to have a good body condition (score of 3.0 to 3.5 just prior to kidding). Does should be scored in early pregnancy and again six weeks prior to kidding. Remember that most fetal growth occurs in the last one-third of gestation and feed quantity and quality may need to be increased during this time. Clean, cool water and free choice trace-mineralized salt should be available.

Booster vaccinations for Clostridium perfringens C and D and tetanus toxoid should be given not less than 3 weeks prior to kidding. Vitamin E/selenium injections may be given during the dry period to prevent white muscle disease in kids, especially in areas where soils are selenium deficient and supplementation is inadequate. However, a nutrition program designed to provide adequate dietary selenium is preferable to providing injections. Provide other vaccinations or boosters for diseases causing abortion. Monitor fecal egg counts or FAMACHA score and deworm as needed.

Parturition (kidding)

While most meat goat does kid on pasture, there may be times when animals are brought indoors for kidding. The doe should kid in a clean environment; either a well-drained clean pasture or a stall bedded with straw or other absorbent material. The kid prior to birth has been existing in a germ-free environment and parturition represents exposure to common disease organisms to which the mature animal has developed resistance. The kidding stall or pasture should be located near a well-traveled area so that the doe can be frequently observed for kidding difficulties. Few adult does require assistance at the time of kidding though problems are always a possibility. First-freshening does should be closely watched, especially if bred to bucks known to sire large kids.

Signs of impending kidding include udder engorgement, swelling of the vulva, restlessness, and mucous discharge. The ligaments in the pelvic area will relax and the udder secretion's will change from clear honey-like to thick white milk (colostrum). The doe may also lose appetite. There are three stages of parturition. Stage 1 consists of uterine contraction and cervical dilation. This stage may last from three to six hours or more. The water bag ruptures at the end of this stage. Abdominal contractions will occur in Stage 2 and the fetus should be born within one hour. If the doe is having to provide undue straining or birth is delayed then examination and assistance may be needed; particularly if the doe is straining hard for 15 minutes or more. A veterinarian may need to be called. Stage 3 consists of expulsion of the placenta and usually occurs within a few hours after the last fetus is born.

Problems in parturition

Most does will kid with little to no assistance required; however, problems can occur. Many of these problems revolve around either incorrect presentation of the fetus or a kid that is to large for the mother's pelvis. In a normal birth presentation the forefeet will enter the birth canal first, the hooves will be pointed downwards, and the head will be between the legs. Another presentation that is sometimes seen that usually causes little problem is when the rear legs enter the birth canal first. In this case, the kid's hooves will be pointed upwards. Abnormal presentations include the rump first (breech) or any of the legs or the head bent backwards. In these cases, assistance is required.

When assisting birth, it is important to clean the area around the vulva with disinfectant soap and warm water and to have clean hands. Wear gloves. There are certain diseases that can be transmitted to humans during this time period. Pregnant women should not assist with the kidding process. Lubricate the hand prior to entering the vagina. Feel and identify the parts of the kid. Try to ensure that all body parts felt belong to the same kid and not to two separate bodies. If you feel only one leg or no legs at all, reach further and try to determine the exact position of the fetus. Arrange the legs and/or head gently in a proper position for birth. The fetus may have to be pushed forward towards the doe's head until a leg can be grasped and repositioned. Once the limbs are in a proper position, the kid should be gently pulled out and downwards using only your hands. Clear the mouth and nasal passages of the kid with straw or a towel and ensure it is breathing. Rubbing the body with a piece of cloth can sometimes stimulate breathing. Never pull on any presentation other than a normal presentation of two front legs and a head or a presentation of two hind legs and a tail. Pulling on any other arrangement of limbs and body parts will only make the problem worse.

If the anticipated kidding problems appear severe, call for a veterinarian immediately.

Kid management at birth

At birth two management practices are critical to the future health and survival of the newborn kid. The navel cord should be dipped in a solution of tincture of iodine (7% iodine solution) to prevent entry of disease-causing organisms through the navel cord and directly into the body of the kid. Make sure the entire cord is immersed in the iodine solution. If necessary, a long navel cord can be cut to 3 or 4 inches in length. Dipping the cord in iodine not only prevents entry of organisms but promotes rapid drying and the eventual breaking away of the cord from the navel.

Another critical practice is the feeding of colostrum as soon after birth as possible. The colostrum, or first milk, contains antibodies, which the doe does not pass to the fetal kid in the womb. Consumption of colostrum must occur as early as possible, ideally within 2-4 hours of birth. At 24 hours after birth there is a rapid reduction in the permeability of the intestinal wall to colostral antibodies. If a newborn kid does not or cannot nurse, the colostrum should be bottle-fed or the kid should be tube fed to insure adequate consumption. Excess colostrum can be frozen for use in orphan or bonus kids. Recent research indicates that disease organisms, especially caprine arthritis encephalitis (CAE), may pass from doe to kid through milk

and transmission might be avoided through the use of extra colostrum frozen from does tested and shown to be CAE-free or by feeding pasteurized colostrum. CAE is not considered to be a problem on most meat goat farms.

Kids should receive colostrum equal to 10% of their body weight during the first 24 hours of life. For example a six pound kid (96 ounces) should receive 10 ounces (roughly 300 ml) of colostrum within 24 hours of birth. This should be divided into at least 3 feedings. If fresh or frozen goat colostrum is not available, a commercial goat, sheep or cow colostrum replacement could be used. Fresh cow colostrum may also be used if necessary.

Under certain conditions newborn kids may benefit from injections of vitamins A and D approximately four days after birth. An iron dextran injection can be given but care is needed as iron is potentially toxic. A vitamin E/selenium injection may be beneficial in areas of selenium-deficient soils. These injections should be planned with your veterinarian as part of your herd health calendar. In general injection of vitamins and minerals is not necessary. If supplementation is necessary it is done more safely by dietary supplements. Realize that the fat soluble vitamins and minerals are toxic if given in excess.

Kids should be checked carefully at birth for any physical deformities or abnormalities. Pneumonia is a major killer of young kids. A clean, dry, draft-free environment is an excellent preventative measure.

Artificial raising of kids

Milk is the principal component of the diet of the pre-weaning kid. Most meat goat kids will nurse their dam until weaning. However, for orphaned kids or for kids of does that have lactation problems it may be necessary to use a milk replacer. Goat milk replacers are commercially available. If necessary, a lamb milk replacer may be used as a substitute for goat milk. Typical lamb milk replacers contain 22 to 24 % protein and 28 to 30% fat (on a dry matter basis). If no other milk replacer is available whole cows milk or calf milk replacers can be used. Maintaining milk replacer quality after mixing is particularly important when kids are fed ad libitum (all they can consume).

Milk can be fed by using bottles, pails, or self-feeder units. The method chosen will depend upon such factors as the size of the herd and available labor, as well as personnel preference. With any system, the health of the kid, sanitation, and available labor are the major factors to consider.

Under natural suckling, kids consume small amounts of milk at very frequent intervals. Ideally, artificial rearing should mimic natural suckling but the constraint of available labor precludes frequent feeding. Nevertheless, kids should be fed 4 to 5 times daily for the first and second week and 2 to 3 times daily thereafter. Bottle feeding is more labor intensive but kids receive more individual attention and are easier to handle post-weaning than kids that are allowed to suckle does. Pail or pan feeding may reduce labor somewhat but bodyweight loss and need for extra "training sessions" at the beginning must be expected.

For larger herds, self-feeder units such as a "lamb bar" may successfully reduce labor. The key to use of the system is the maintenance of a low temperature of the milk (40°F) that will limit intake by the kid at any one time. Small, frequent feedings increase digestibility and decrease digestive disturbances. Rapid consumption of large quantities of milk may lead to fatal bloat due to entry of milk into the reticulo-rumen. Rapid passage of milk through the abomasum and small intestines can result in diarrhea or nutritional scours.

The biggest problem with kids bottle fed lamb milk replacer occurs with the feeding schedule. Frequently kids become "pets" and there is a tendency to feed them as much milk as they will consume each feeding. Unfortunately, this may result in bloat and sudden death due to enterotoxemia or diarrhea. A restricted feeding schedule and amount is necessary.

Feeding schedule and amount for bottle fed kids.

Age	Amount of Fluid/Feeding	Feeding Schedule
1 to 3 days	4 ounces	5 times a day
3 days to 2 weeks	8 to 12 ounces	4 times a day
2 weeks to 3 months	16 ounces	3 times a day
3 months to 4 months	16 ounces	2 times a day

Dam raised kids

Most meat goat kids will be raised with their dams on pasture. While this removes the need for feeding milk replacer, these kids should not be forgotten in terms of nutritional and health needs. Producers must remember that since these kids are raised in the same environment as their dams, they are also exposed to the same health, disease, management, and grazing conditions. If internal parasites are a problem in the dams, expect the same in the kids and take management steps to reduce exposure to internal parasites through pasture rotation or other means. Crowding should be avoided and, if housed at any time, clean bedding and adequate ventilation are a must. Kids are naturally curious and will begin nibbling on items in their surroundings early in life. If there are toxic substances or plants, plastic, or other harmful materials lying about chances are some kids will eat them. If pasture is of very poor quality, kids beginning to nibble on grass or hay will not receive much nutritional benefit. This can slow down early growth.

Early access to a creep feed or creep pasture containing lush, nutritious forage will benefit kids becoming accustomed to solid feed, the development of their gastrointestinal tract, and in their early growth. Entry into the area containing creep feed or pasture should be restricted to kids by fencing or gates that prevent the entry of adult animals.

Weaning

In raising goat kids, increases in size and weight are not the only measure of success. A well-formed skeleton and proper development of internal organs are often neglected when the emphasis is on rapid gains. Dry feed consumption is important in developing body capacity. By increasing body capacity, feed intake and digestion increase.

In bottle fed kids over two weeks of age, limiting daily milk consumption to about 48 ounces will encourage daily consumption of dry feed. No later than three to four weeks of age a goat/lamb creep feed, other suitable creep feed, or even a calf starter should be offered. As the hay and grain consumption increases, gradually reduce the milk being fed. When the kid is eating ¼ pound of grain per day plus some hay and is drinking water from a bucket, it is time for weaning. Research has shown that at two months of age a weaned kid has a reticulo-ruminal capacity 5 times as large as suckling kids of the same age.

Kids on pasture should be consuming forages such as pasture grass or hay by two weeks of age and grain within four. Careful attention needs be given to formulation of a concentrate supplement for the pre-weaning kid. Palatability is of primary concern. Molasses at the rate of 10% of the total dry matter, corn (preferably chopped or rolled) and whole or rolled oats make up the energy "core" of a good pre-weaning diet. Balance the crude protein needs by adding cottonseed or soybean meal or another high protein source. Though few studies with kids have been done, crude protein contents of the pre-weaning ration should be within the range of 14-18%. Ground alfalfa may be added at 5% or less to provide additional stimulation for reticulo-ruminal development.

Several factors need to be considered when making the decision as to weaning. The most important consideration is whether or not the average daily consumption of concentrate and forage is adequate for growth and development to continue in the absence of milk. Fixed weaning ages are less desirable than weight goals such as 2.0 to 2.5 times birth weight.

Vaccination Schedule for Meat Goats

Other disease preventive measures

Dam – 1 month prior to kidding

- CDT vaccine to help increase antibodies against enterotoxemia and tetanus in the colostrum. In areas deficient in Se and where supplementation is inadequate, BoSe® to raise selenium levels and prevent white muscle disease in kids and retained afterbirth in dam. Providing a proper mineral nutrition program to ensure adequate consumption of all minerals is preferable. Get local veterinary advice on selenium injections as the need and dosage level depend upon how much selenium is in the soil in the region, as well as on the dietary supplementation.

Kid – birth to first week

- BoSe® + vitamins A&D – use depends on soil in the region and the diet of the dam.

Kid – 3 weeks – begin coccidiosis prevention

- 4 and 8 weeks – CDT series.
- 4 to 8 weeks - BoSe® - repeat if in selenium deficient area.
- 6 to 8 weeks – begin monitoring for parasites and deworm as needed, especially if kid has access to outdoors.

Period	Time to Vaccinate	Disease	Booster
Kids	4 and 8 weeks of age.	C. perfringens C&D*. C. tetanus – toxoid.	Prebreeding.
	Between 8 and 12 weeks of age (single vaccination).	Contagious ecthyma.	If a problem in herd.
	8 and 12 weeks of age.	Caseous lymphadenitis.	If a problem in herd.
	16 weeks of age.	Rabies.	Given if there is a rabies concern. Yearly booster.
Prebreeding			
Doelings and bucklings	60 and 30 days prior to breeding.	Chlamydia. Campylobacter. Leptospirosis.	If a problem in herd.
Does and bucks	30 days prior to breeding.	Chlamydia. Campylobacter. Leptospirosis. C. perfringens C&D*. C. tetanus - toxoid.	If a problem in herd.
Gestation			
Does	30 days prior to kidding.	C. perfringens C&D*. C. tetanus - toxoid.	

***-8-way clostridials like Covexin 8 could be used instead of C. perfringens C, D & T.**

Herd Health Calendar

A custom designed calendar is an excellent way to ensure the health of the herd is maintained. A calendar can be designed based upon your specific herd's production cycle. Consult with a veterinarian on the timing and need for vaccinations and other management procedures related to the health and well-being of your herd.

Planning Calendar for Meat Goat Herd Health

Stage	Suggested Health Practices	Additional Practices
Pre-breeding (30-60 days)	*Bucks* • Be aware of heat stress. • Breeding Soundness Evaluation done. • Vaccinate for Clostridium perfringens type C&D, plus Tetanus Toxoid. • Vaccinate for Chlamydia, Campylobacter and Leptospirosis, if necessary. • Trim feet. • Body Condition Score and adjust management accordingly. • Deworm based upon fecal egg counts or FAMACHA score. *Does* • Vaccinate for Chlamydia, Campylobacter, and Leptospira if necessary. • Vaccinate for Clostridium perfringens type C&D, plus Tetanus Toxoid. • Trim feet. • Body Condition Score and adjust management accordingly. • Deworm based upon fecal egg count or FAMACHA score at least two weeks before breeding. • Final cull of does based on production records, udders, feet, and type.	• Vitamin E and selenium given to does 30-45 days before breeding in selenium-deficient areas. • See Vaccination Schedule for Meat Goats • Put bucks next to doe pens. The "buck effect" will bring transitional does into heat.

Breeding	*Bucks* • Provide additional feed. • Be aware of heat stress, provide shade. *Does* • Observe for heat or use marking harness on bucks • If desired, check for pregnancy at 45-60 days with ultrasound.	• Make sure cats are not defecating in feed to prevent Toxoplasmosis. • Perform fecal egg count or check FAMACHA score and deworm if necessary. • Treat for flukes if a problem in the herd.
Pre-kidding (15-30 days)	*Does* • Booster Clostridium perfringens type C&D, plus Tetanus Toxoid. • Deworm based upon fecal egg counts or FAMACHA score. • Body Condition Score, adjust management accordingly • Watch for pregnancy toxemia.	• Perform fecal egg count or check FAMACHA score and deworm if necessary. • Begin to collect supplies for kidding.
Kidding	*Does* • Observe 3-5 times per day. • Assist if needed. *Kids* • Clip, dip, and strip: • Clip navel cord to 2-4”, • Dip navel in 7% iodine, • Strip small amount of milk to make sure teat ends are open.	

Nursing/Lactation	*Does* • Feed extra feed to does with multiple kids. *Kids* • Observe daily for signs of diarrhea or respiratory disease. • Vaccinate – Clostridium perfringens type C&D and Tetanus, revaccinate at four weeks after first injection. • Castrate males before three months of age. • Start creep feeding by two weeks of age.	• See Vaccination Schedule for Meat Goats
Weaning	• Weaning at three to five months or when marketed as young kids. • Check for internal parasites and deworm if needed.	• May want to use coccidiostat in creep feed and post-weaning feed.
Post-weaning/Drying	• About every four weeks, check for internal parasites and deworm as needed. • Reduce feed to does just before weaning. • May want to reduce water availability for a day or two after weaning.	

Common Abortions in Goats

Dr. Lionel Dawson

Oklahoma State University

Introduction

Abortions or premature kidding in does are caused by different factors. Most common causes are infectious, malnourishment, environment, stress, hormonal and trauma. Late term abortions are usually due to stress or infectious. It is important to remember that many of the infectious causes of abortions in goats are zoonotic and can be transmitted to humans. Gloves, protective clothing, and boots should always be worn when collecting samples from the abortion and hands should be cleaned carefully after handling potentially infectious material. Pregnant women or immune compromised people should not assist with kidding or handling of aborted material. Always isolate the doe and dispose of all aborted material (fetus, placenta and fluids) by burning or burying them.

Chlamydophilosis is the most common cause of infectious abortion in goats, and the causative agent is *Chlamydophila abortus*. Clinical signs are late term abortions, high number of stillbirths and weak kids. Naive yearling does that have been recently introduced into an infected herd are usually the animals that abort. *Chlamydophila* can also cause conjunctivitis (pink eye), and polyarthritis (arthritis in multiple joints). And they are usually shed in the feces. The exact strains of the *Chlamydophilosis* bacteria causing these diseases differ from those causing abortions. Does exposed to the abortive strain through direct contact with the aborted fetuses, placenta, infected vaginal discharge, or orally ingesting contaminated feed. After ingestion, the bacteria colonize intestinal epithelium, spread systematically to the uterus. Infected bucks may transmit the infection through natural service.

A history of late term abortions, stillbirths and birth of weak kids is suggestive of Chlamydophilosis. The aborted fetus may be fresh or decomposed in appearance. Female kids infected with the organism at birth may abort in their first pregnancy. Does exposed to this bacteria during the first half of gestation, may abort in the last trimester of that pregnancy. Does exposed in the last half of gestation may abort in the subsequent pregnancy or have high incidence of stillbirths or weak kids. Once abortion has occurred, does appear to have immunity as affected animals seldom abort more than once due to Chlamydophilosis. Although immune, they can shed the bacteria in the vaginal secretions when in heat, potentially infecting the other does that may be pregnant at the time.

Isolate aborting does from the herd for at least 3 weeks. Placentas and fetuses should be removed, burned or buried. To minimize exposure, ensure that all feed and water sources are protected from contamination. Treating all does in an abortion outbreak with tetracycline may reduce additional abortions by up to 50%. There is a vaccine approved for use in sheep in the US. Vaccine should be administered four weeks before breeding.

Toxoplasma gondii is a protozoan parasite that can infect goats, and is second in importance only to Chlamydophila as a major cause of infectious abortion in the mid-west. Cats are the primary or definitive host for toxoplasmosis, becoming infected by eating infected rats or mice. Most warm blooded animals (birds and mammals) are intermediate host. The parasite matures in the intestine of the cat and infective eggs or oocytes are passed in the feces which can infect goats and other animals if consumed. Other than cat feces, the only source of infection for does is by consuming the infected placenta or birth fluids from aborting does. Younger cats are more of a threat to spread the disease than older cats. Less than 4% of persistently infected

animals will transmit the parasite vertically through transplacental transmission. Cats develop immunity as they get older, neutered adult males and adult females are less likely to be a source of infection.

Does infected early in gestation, fetal death and resorption usually occur. Infection late in gestation results in mummification, stillbirths, and birth of weak neonates. Not all fetuses presented from the infected dam may demonstrate the organism. Aborted fetuses do not have significant lesions. Presentation of twin and triplet abortions often reveals fetuses in variable postmortem conditions - mummified to fresh. Diagnosis maybe based on the appearance of the placenta, small greyish white foci of necrosis, "rice gain" lesions typically found on the cotyledons. Another common finding is focal necrosis in the cerebral white matter in the brain of stillborn and weak kids.

During gestation, all cats should be kept away from pregnant does. Remove all feed which may have been contaminated with cat feces and prevent cats from defecating in feeders, on hay bales, water trough, bedding, etc. There are no vaccines available in the U.S. for toxoplasmosis. Feeding decoquinate or monensin throughout pregnancy has been shown to have some protective effect and may reduce the incidence of abortion.

Q-fever is a bacterial infection (*Coxiella bumetti*) that causes fetal resorption, stillbirths, and late term abortions (5% to 35%). Abortions tend to occur in naive animals. Transmitted through the air and inhaled or is consumed via infected aborted material, feces, urine, milk, or grazing contaminated pastures. Tick bites may also be a source of transmission. *Coxiella burnetti* remains viable in the phagosome of free living amoeba. The ability of this organism to survive in the protozoa, along with the organism's resistance to dessication, may play a role in maintaining the organism in the environment. Q-fever's primary significance is its zoonotic potential. Q fever infects a wide range of hosts including cattle, goats, sheep, pig, cats, dogs, and wildlife.

Some does will be carriers of the disease without showing any signs. Carrier animals will shed the disease in milk, feces and uterine fluid at the time of parturition. Intense agriculture practices that place large numbers of naive animals in small compact areas can result in exposure and reinfection of pregnant animals. Signs include stillbirths and late term abortion. Aborted fetuses are often fresh with little evidence of in utero autolysis. The placenta is often the only tissue affected and is extremely useful in confirming a diagnosis. Cotyledons are often diffusely thickened and multiple areas thickened, leathery, covered with greyish/white to brownish/red exudate. Some aborted goats will have a retained placenta. There has been conflicting information on whether treatment of pregnant does during a Q fever abortion storm has an effect on the course of the disease. Manure should be composted for at least 5 months and spread only on still, non-windy days. The organism is resistant to drying which means it aerosolizes and can be inhaled. This is a zoonotic disease meaning it can be contracted by humans so a mask should be worn when scraping manure or sweeping the area. Colostrum and milk have high levels of organisms so all milk should be pasteurized before drinking. There is currently no effective vaccine available.

Brucellosis can cause abortions in does and orchitis in bucks. While brucellosis in goats is usually caused by *Brucella melitensis*, they can also become infected with *Brucella abortus*. Historically, the number of *Brucella melitensis* abortions has been extremely low in North America, but more recently, sporadic outbreaks have been reported in goats in Texas and Colorado. *Brucella abortus* is rare in the United States, but can cause late term abortions, stillbirths and weak kids. Does may develop systematic illness and show fever, depression, diarrhea, lameness, mastitis, and weight loss. There is no effective treatment and infected animals should be slaughtered. Wear protective gloves, clothing, and boots when assisting with birthing problems or abortions. Any brucellosis cases must be reported to state veterinarians. The disease is spread to humans by direct contact or by drinking unpasteurized milk or consuming products made from infected milk.

Camylobacter fetus subsp. Fetus, *Camplobacter jejuni subsp.Jejuni*, and *Campylobacter lari* can infect goats. *Campylobacter* (vibriosis) can cause late-term abortions; however they are rare in goats. The organism colonizes the intestinal tract of the adult animal usually without showing any signs of diarrhea. A bacteremia

may occur in susceptible pregnant animals leading to infection of the uterus, fetal septicemia prior to abortions. *Campylobacter* is transmitted via ingestion of feces, vaginal discharge, aborted fetus and placenta of infected does. A common sign is a bloody, pus-like vaginal discharge before or after abortion. Cotyledons are enlarged, yellowish, and covered with a brownish/red suppurative exudate. Intercotyledonary areas are often edematous and hyperemic and usually lack any exudate. Variable amounts of serosangunious fluid with fibrin are present in both the thoracic and peritoneal cavities. Liver may show multiple multi focal areas of necrosis. Diagnosis is cultures of the internal organs. There is a vaccine available labeled for sheep.

Other bacteria can cause abortions like Leptospira, Listeria,and Salmonella etc. *Leptospira hardjo*, *Letospira pomona*, *Leptospira castellonis* and *Leptospira icterohaemorhagiae* have caused abortions in goats. Leptospira is usually subclinical in goats. But during the bacteremic phase they may show fever and develop a renal disease. Leptospira is usually transmitted by the urine of infected does. Ensure that feed and water sources are not contaminated with feces or urine. Control rodents and other animals may be a source for these diseases. Listeriosis caused by *Listeria monocytogenes* can cause mid-to late-term abortions. They are mainly spread by ingestion and inhalation. Metritis and septicemia is seen does after abortions. Salmonellosis can cause mid to late term abortions. They can cause systemic signs and uterine infection after abortions. Does become infected following ingestion of the bacteria which is shed in the feces of various animals including cattle, bird, dogs, cats, rodents, and some wildlife.

Viruses can also cause abortions in goats. Viruses causing abortions in does are BVD, Caprine Herpes, Blue tongue and Cache Valley Virus. See the table for their clinical signs, diagnosis, prevention and control.

Summary

Late term abortions are usually due to stress or infectious in nature. It is important to remember that many of the diseases causing abortion in goats are zoonotic and can be transmitted to humans. Good management practices of the pregnant does, with adequate housing, good nutrition.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
1. Enzootic Abortion (EAE, Chlamydial or Chlamydophila abortion): Caused by *Chlamydophila abortus* that affects sheep, goats, occasionally cattle and humans. They cause late term abortions. Abortion strains differ antigenically from strains producing polyarthritis (sheep and cattle) and conjunctivitis in sheep and goats (pinkeye).	Transmission is mainly by ingesting contaminated feed, water and the environment with vaginal secretions, placenta and aborted fetuses. Spread is more rapid when does are confined. Many carriers are seen in endemic herds. Infection at birth in kids kept as replacement does may be carriers through to their first pregnancy.	Late term abortions, stillbirths and birth of weak infected progeny are the most common clinical sign seen. Fetal mummification is occasionally seen. Female fetuses exposed in utero may abort during their first pregnancy; does infected in the last month of pregnancy may not abort until the next gestation period. Does seldom abort more than once.	A chorionitis with chlorionic epithelial cells packed with elementary bodies appears to be the essential lesion. Cotyledons are pale, greyish white and are necrotic with a dark brown exudate. Intercotyledonary areas are necrotic, thickened, opaque and leathery.	Impression smears of the cotyledon, placenta and vaginal discharge (but not fetal stomach) stained by the modified Ziehl-Nielsen or Gimenez stain. Organisms can be cultured in yolk sac of embryonating chicken eggs. PCR techniques on placental trophoblasts, spleen and liver are useful. Serology on the dam is unrewarding. But detecting antibodies in the fetal fluids is also useful.	Vaccine available; must be given to breeding, or use 150 mg of tetracyclines per head per day in the feed for 2-3 weeks prior to breeding: may continue this in their feed through the first half of gestation. Controlling abortion outbreak with tetracyclines (limited success): (1) 400 mg/head/day in feed or water for the last 60 days of gestation. (2) Use slow-release tetracycline (LA 200) 20mg/kg injectable to start during the last 60 days of gestation. Owing to their long incubation period, once-a-week protocol may be adequate to decrease losses and is much less expensive. (3) Treat weak newborns with tetracycline. (4) Isolate aborting females and also those with weak born kids. Prevention: 1)LA oxytetracycline, 90 days and 120 days of gestation is very effective in preventing abortions. Onset of therapy after the start of abortions will only reduce abortion rate. 2) OTC or Aureomycin 4 gm Crumbles at the rate of 1 lb/8 ewes (500 mg/hd/day).

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
2. Toxoplasmosis: *Toxoplasma gondii* affects a wide range of animals as well as man. It is widespread and has been reported in Australia, New Zealand, Britain, Turkey, USSR, and North America. Cats and other Felidae are considered the primary host and excrete oocysts; species such as goats and man are regarded as secondary hosts. In these species, the organism is found in two forms: tachyzoites, which are actively multiplying and invasive, and found in the acute state of the disease, and cysts containing bradyzoites found in the chronic phase of the disease.	Oocysts excreted in cat feces are thought to provide the major source of infection. Congenital transmission from does to kids is also established. Further epidemiologic knowledge is required to establish how the disease spreads during an epidemic.	Does infected in the earlier stages of pregnancy either resorb the embryo, or fetal death and under-go mummification (often only one of a twin pair) may occur. Twin or triplet abortions, have variation in fetal ages —mummification to fresh fetus. Infection in late pregnancy leads to abortion and perinatal losses of kids. Many congenitally affected kids survive. Disease in the adult is generally asymptomatic, occasionally CNS signs develop. In endemic areas only younger does usually are affected, and may show the above clinical signs.	Placental changes may be the only gross lesions observed. Gross lesions of the cotyledons (numerous grey-white foci 1 to 3 mm in diameter) are indicative of the disease. Not all cotyledons are equally affected, and such lesions should be differentiated from nonspecific calcification. Focal leukoencephalomalacia in the CNS of stillborn kids, or kids dying shortly after birth is a common fmding.	Histology of the cotyledon to demonstrate local areas of necrosis, mineralization and the organisms. Histology of fetal brain to demonstrate foci of glial cells and leukoencephalomalacia. Microscopy of the brain and cotyledonary villi sections to see tachyzoites and immuno histochemistry for antibodies is necessary to confirm your diagnosis. Precolostral serology of the kids is useful. But maternal serology is unrewarding.	Prevent exposure to barn cats. Don't allow cats to consume aborted fetuses in a Toxoplasma abortion. Treatment: Decoquinate 2mg/kg/day or Monensin 15-30 mg/kg/head/day throughout gestation

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
3. Salmonellosis (Paratyphoid Abortion): *Salmonella abortus ovis, S. typhimurium and S. dublin* has been associated with abortion in does.	Ingestion of contaminated food and water usually shed from carrier animals. Does in later pregnancy appear more susceptible? Overcrowding and other forms of stress favor an outbreak. Unless the infecting dose is large or the strain exceptionally virulent, infection seldom causes clinical disease in the absence of some other predisposing factors resulting in stress.	Abortions, stillbirths, births of weak infected progeny that usually die within 7 days of birth. Does may show high fever before aborting; most recover, but some die from metritis and/ or septicemia. Some does and newborn kids show diarrhea; in the kids this is usually fatal. Kids up to two weeks of age may show bronchopneumonia. When infection is endemic, abortions tend to be confmed to the younger does.	No specific placental lesions seen. Swollen, pale hemorrhagic cotyledons with necrosis. Aborted fetuses show usual signs of intrauterine death. Septicemia lesions may be seen in those kids dying during or shortly after birth.	Culture of organisms from fetus, placenta and uterine discharge.	Antibiotic treatment on flock basis is not effective and is very expensive. Avoid overcrowding or stressing of does. Do not feed on the ground unless a new area can be used each day. For valuable individuals, supportive therapy (fluids) and antibiotics are recommended.
4. Brucellosis: *Brucellosis melitensis* affects goats and sheep and other species including man. It is seen in Europe, Mediterranean countries, Africa, Central America and rarely in the United States. *B. abortus* occasionally affects does. *B.ovis* affects rams – epididymitis, can cause infertility, early and late term abortions, still births and weak kids.	Ingestion is the main method of transmission, especially during the kidding period. Droplet inhalation and entry both through the conjunctival membrane and broken skin occasionally occurs. Venereal transmission following natural mating is rare.	Abortions in late pregnancy, stillbirths and birth of weak infected kids may occur. Congenital infections may persist throughout life (especially B. melitensis). Systemic effects may be seen in the dam with fever, lameness (associated withjoint swellings), sometimes central nervous system (CNS) signs.	The essential lesion is placentitis, with edema and necrosis of cotyledons. The intercotyledons membrane may be thickened, yellow-brown necrotic areas, often with adjacent hemorrhage. Mucopurulent material may be adherent to the allantochorion. Fetus shows usual signs of intrauterine death.	Culture and direct microscopy are used to identify organisms that are plentiful in the placenta, fetal stomach and vaginal discharge of the doe. Modified Ziehl- Nielsen technique is satisfactory for staining for direct microscopy. Complement fixation ELISA, CF and PCR are available on sera of aborting does.	Test and slaughter policy can be used when the disease is prevalent. Testing of replacement animals. General hygiene at kidding.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
5. **Listeriosis** (*L. monocytogenes* or *L. ivanovii*)	Mainly ingestion.	Abortion,stillbirths and weak kids Autolysed fetuses seen. Abortion occurs from day >50 of gestation. Some born alive but die. Metritis and septicemia common in females. Placentitis, around the cotyledon and intercotyledon areas. Kids grafted to the borting females can contract Listeriosis through the milk, develop septicemia and die.	Necrotic, greyish white foci (1 or 2 mm diameter) is seen in in the liver, spleen, kidneys, lungs, heart and adrenals. Leathery placenta.	Culture from fetal stomach, liver and placenta. Fluorescent antibody test on the placenta.	**Isolation** of aborting females. Do not feed spoiled silage or poorly fermented silage. During outbreak administration of long acting tetracycline at 20 mg/kg every 72 hours. Chlortetracycline in the feed
6. **Leptospirosis** (*L. icterohaemorrhagiae*, *L. grippotyphosa*, *L. pomona*, *L. hardjo*, *L.canicola*, *L.castellonis* and *L. bratislava*) Have been reported as primary causes of abortions in goats.	Secreted in the urine. Transmission is through skin or mucousal abrasions.	Clinical signs seen primarily in primiparous does. They include metritis after abortions, anorexia, anemia, jaundice, hemoglobinuria and death.	Fetal organs will be hemosiderin stained due to autolysis. Some edema of the intercotyledonary regions.	Dark field microscopy, Immunofluorescence testing and silver stains on placenta, fetal tissue and fluids. FA on the kidney. PCR on the urine. Paired serum samples from aborting does.	**Vaccine** **Rodent control** **clean water supply** **Isolation** of aborting females. During outbreak administration of long acting tetracycline at 20 mg/kg every 72 hours. **Chlortetracyclin in the feed** 300 to 500 mg/herd/day during the outbreak.
7. **Q-Fever** (*Coxiella burnetii*): It affects sheep, goats, cattle and other wild life. This organism is shed heavily in placentas, birth fluid, colostrum and milk.	Inhaling dust, grazing contaminated pastures and tick bites Infected does can shed in the feces after parturition.	Abortion primarily in the naive animals. Late term abortions. Fresh fetuses. Some kids born alive. Aborting does usually retain their placenta.	Late term abortion and stillbirth. Placentitis with intercolyedonary areas thickened and leathery. Cotyledons are diffusely thickened with multiple areas of necrosis, covered with grayish/ white to brownish/ red exudate.	Serological testing is of little use. Paired serum samples may give a retrospective study of the flock. IFA is commonly used. ELISA along with IFA would strongly suggest Coxiella infection.	Producers should burn or bury the placenta. **Oral chlortetracycline** 200 mg/head/day for 3 weeks. Long acting tetracycline 20 mg / kg given s/c or ilm every 3 days for 5 treatments.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
8. Caprine Herpes Virus	Direct – nasal and genital routes. Latent infection in adults and spread during stress.	Kids – viremia and enteritis. Ulceratic and necrotic lesions the entire GI tract. Adults -Vulvovaginitis, balanoposthitis, respiratory disease and abortions.	Clinical signs. Multifocal white necrosis in liver, spleen, kidney and lungs, mesenteric lymph nodes, thymus and liver.	BoHV-1 positive virus isolation on nasal and vaginal swab. PCR- Blood and swabs. Intranuclear iclusion bodies in the placenta and internal organs of the aborted fetus.	Avoid stress. Buy animals from a clean herd. Avoid commingling with calves and sheep. BoHV-1 Infect sheep and goats but they are subclinical. CpHv-1 can infect sheep and calves and become latent. Reactivation has not been successful in sheep and calves.
9. Border Disease (Hairy Shaker Disease). The cause is infection of the pregnant ewe and doe with a pestivirus closely related to, if not identical with bovine viral diarrhea (BVD) virus. The disease has been described in Britain, North America, New Zealand, Austrailia, Greece and Ireland. Several strains appear to be involved.	Vertical transmission from ewe to lamb during gestation is well established, and venereal spread of the disease seems likely. Surviving lambs can transmit the virus both vertically and laterally for years. Most of the more obvious clinical signs result from infection of pregnant ewes in the first half of gestation. Severe loss is likely if susceptible pregnant ewes are introduced to infected flocks or if infected ewes are mixed with resident ewes having no immunity to the disease.	A loss of potential progeny at any stage during pregnancy and in the postnatal period occurs. Infertility with a marked increase in barren ewes, fetal mummification and/or maceration, abortions, stillbirths and losses of lambs born alive are all features of the disease. When the fleece has developed, it tends to be hairy and may be pigmented. If born alive, lambs may show muscular tremors causing incoordination and difficulty in nursing.	Cotyledons tend to be small for fetal age; they occasionally show areas of focal necrosis (1 to 3 mm). Fecal mummification; hairy pigmented coats if the wool has developed; fetus small for gestational age; muscular tremors and incoordination if lambs are born alive. When late gestation fetuses or young lambs encounter the disease, nodular periarteritis, which is slow to resolve, may occur.	CNS shows hypomyelinogenesis and the skin shows characteristic lesions on histologic studies. BVD- neutralizing antibodies in the serum of dam or lamb to virus isolation PCR.	Prevent commingling of pregnant does and ewes with cattle.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
10. Bovine Viral Diarrhea A pestivirus has been implicated pigs, alpacas, sheep, goats and deer. Causes abortion in sheep and goats.	Commingling with cattle. Persistent infection of lambs, kids and calves born when mothers were infected during pregnancy.	Still births. Weak kids do not survive. Shaker kids with no changes in hair coat. Abortions at any stage. Skeletal defects on aborted fetus - arthrogyposis, anasarca and mummified fetuses. PI kids possible when a pregnant doe exposed to PI calf- Swiss symposium.	Necrotizing placenta	Virus isolation PCR Serology – ELISA or SN	Prevent commingling of pregnant does with cattle.
11. Cache Valley Virus and Akabane Virus Cache Valley Virus is common in the U.S.	Arthropod borne disease – mainly by mosquitoes and flies (Culicoides)	Infection in early pregnancy can result in wide range of deformities in the fetus, microencephaly, hydrocephalus, arthrogryposis and muscle atrophy. Joint malformation may cause dystocia. Late gestation can cause premature and stillborn kid.	Clinical signs Serology_ precolostral serum or fetal serum for antibodies.	Serology on the doe. Virus isolation on the aborted kids may be difficult.	Control. Fly and mosquito control.

Extra-label Drug Use

Dr. Lionel Dawson

Oklahoma State University

Introduction

There are few drugs for use in goats that have Food and Drug Administration (FDA) approval. Administering any drug not specifically labeled for use in goats or any product, either prescription or over the counter, that is not used as directed on the label is considered "Extra-label" or "off-label" drug use. Only veterinarians may prescribe or use products "off-label" or "Extra-label" provided they have a valid veterinarian - client - patient relationship (VCPR) with the producer.

The issue of "extra label" use also applies to feed medications not approved for use in goats. While extra-label use of medications in or on animal feed is prohibited, in 2001 the FDA provided guidance on extra-label use of medicated feeds in minor species such as goats. In brief, extra-label use of medicated feed in minor species is limited to treatment of animals whose health is suffering or is threatened or whose death may result from failure to treat. If medicated feed is to be used in a food producing minor species, the product used must be approved for use in a food producing major species. The FDA discourages use of medicated feed in an extra-label manner for improving rates of weight gain, feed efficiency, or other production purposes.

Most goat producers are unaware that they do NOT have "extra-label" drug use privileges. Only veterinarians who have established a VCPR with a particular client may prescribe or use drugs in an extra-label manner on that client's animals if the animal health is threatened and suffering or death may result from failure to treat. To establish a VCPR, the veterinarian should have visited the farm, and have a thorough knowledge of the management of these animals, or has recently seen the animal to be treated. Once a VCPR has been established, the veterinarian may use drugs in an extra-label manner provided that the client has agreed to follow his or her recommendations.

Three conditions of extra-label drug use:

1. The veterinarian has examined the animal(s) in question recently and has made a diagnosis and a determination that products with proper labeling will not work in this instance.
2. The client has been instructed by the veterinarian in the proper use and administration of the product, a withdrawal period has been determined, and the client is willing to follow the instructions given by the veterinarian.
3. The veterinarian is available to respond to any adverse reaction or follow up examination and treatment that may occur to the animal due to the administration of the drug or failure of the drug to work.

FDA criteria for Using Pharmaceuticals Extra-Label

The FDA has also established five criteria that must be met before any drug may be used in a food-producing animal in a manner different from that product's label.

1. The veterinarian must first examine the animal and assumes responsibility for making clinical decisions regarding the health and treatment of the animal within the guidelines of a VCPR. Often a goat owner will not have the animal examined by a veterinarian, but will telephone a veterinarian, who may never have visited the farm, with a list of symptoms and ask for a recommended treatment. This does not qualify as VCPR!

2. The second criterion requires that the veterinarian determine there is no marketed drug specifically labeled to treat the diagnosed condition, or that the recommended dosage on the label for that product is clinically ineffective. Since there are few drugs labeled for use in goats, it is not difficult to determine whether or not there is a legally licensed product available.
3. The third criterion requires that the individual animals to be treated are clearly identified, and that accurate records be maintained regarding the treatment of those specific individuals. If there is no permanent identification such as an ear tag, notch, or tattoo, the owner must make some effort to identify the treated animals with a visible temporary mark by using temporary tags or paint. If possible, these animals should be isolated. Records on animals and treatment must be kept for future reference to avoid any drug residues in the meat or milk.
4. The fourth criterion requires that a significantly extended time period be assigned for drug withdrawal prior to marketing meat or milk from treated animals. The owner must keep accurate records of the treatment, namely the person treating this animal, date, route of administration, product used and a proper withdrawal period. Proper withdrawal period can be obtained from your veterinarian. Veterinarians can access drug information at the Food Animal Residue Avoidance Databank, http://www.farad/org.
5. Many goat owners casually treat their animals and do not keep proper records of animals treated, drugs used, or proper withdrawal period for that product. If no information is available to establish a withdrawal time, then the treated animal or animal products such as milk and meat are permanently barred from the human food chain. This is to prevent illegal drug residues in products for human consumption. Although there are no drug residue test kits marketed specifically for goat meat, owners should be aware that drug residue testing is conducted on milk and meat produced for human consumption.
6. The last criterion details the information that must be listed on the drug dispensed for extra-label use. The label should include the name and address of the veterinarian, the established name of the drug(s), and the specific directions for use including: dosage, routes of administration, frequency of treatment, duration of therapy, cautionary statements, and the withdrawal time for any food that might be derived from the treated animal.

Ten Drug Use Tips

The following drug use tips can help ensure the proper administration of drugs and adherence to proper withdrawal times. All producers should restrict access to drugs to prevent indiscriminate or improper use. Remember that animal health products can be human health hazards.

1. Read the label carefully – labeling directions change frequently.
2. Use drugs only in animal species listed on the label or follow the "extra label" directions of a veterinarian.
3. Use the proper dose for the size of animal to be treated – overdosing can cause illegal residues.
4. Calculate pre-slaughter drug withdrawal times accurately – determine pre-slaughter withdrawal and milk discard times from the latest drug administration.
5. Use the correct route of administration – giving drugs incorrectly can lead to drug ineffectiveness, adverse reactions, illegal residues, and possible animal deaths.
6. Do not "double dose" – use of the same drug in the feed and by injection can cause illegal residues.
7. Select needle size and injection sites carefully, if injections are necessary – misuse can lead to tissue damage, reduced effectiveness, and/or illegal residues.

8. Allow proper withdrawal times for feed containing drugs – during the withdrawal time ensure that storage bins and feed are completely free of medicated feed and feed only drug-free feed or illegal residues may result.
9. Keep accurate records of drugs used and animals dosed – poor records can be costly if drug residue violations occur.
10. Seek the advice of your veterinarian – your records will allow him/her to provide safer and more effective treatment and save you money by preventing illegal residues.

For a complete explanation of all the precautions you need to take in using any particular drug or feed medication, first consult the drug label or feed tag. If you have any questions about the proper use of any drugs, see your veterinarian.

Medications Commonly Used in Goats and Approximate Withdrawal Times

The following tables list medications commonly used in goats with their dosages and estimated withdrawal times (WDT). These tables are adapted with permission from the author Dr. Seyedmehdi Mobini of Fort Valley State University, Fort Valley, GA, from a paper that appeared in the proceedings of the Georgia Veterinary Medical Association Food Animal Conference in 2003. These recommendations were formulated by Dr. Mobini through a review of the literature in the United States and foreign countries, recommendations of the Food Animal Residue Avoidance Databank (FARAD), and personal experience. For many of the drugs mentioned, FARAD has calculated a Withdrawal Interval (WDI) to distinguish from the regulatory and approved WDT. The WDI is based on foreign drug approvals or extrapolations based on available tissue residue and/or related pharmacokinetic data on these drugs. In some cases, there is insufficient or no pharmacokinetic data from which FARAD can derive a WDI for goats. In those instances, FARAD has relied on sheep or cattle data and then added a scientifically-based time period to extend beyond the approved WDT to ensure safety as well as compliance with the Animal Medicinal Drug Use and Clarification Act of 1994 (AMDUCA).

Finally, the reader should be aware that there are several drugs which may be approved for specific species at a specific dose and route of administration, but are PROHIBITED FROM EXTRA-LABEL USE in any major or minor food animal species. These include Fluoroquinolones/Enrofloxacin (Baytril) and Phenylbutazone (Dairy). Other drugs are PROHIBITED FOR USE UNDER ANY CONDITION IN ANY ANIMAL THAT WILL BE USED FOR HUMAN FOOD. These drugs are: Dipyrone, Clenbuterol, Nitrofurazones, Nitrofurans (Furacin), Nitroimidazole (Metronidazole, Dimetridazole, Ipronidazole), Diethylstilbesterol, Glycopeptides (Vancomycin) and Chloramphenicol.

Medications Commonly Used in Goats and Approximate Withdrawal Times

Dr. Seyedmehdi Mobini, Georgia Small Ruminant Research & Extension Center, Fort Valley State University, Fort Valley, GA

The drugs listed in this table are commonly used in goats. There are only a few drugs approved by the FDA to be used in goats. ***Use of drugs listed as "extra-label" is legal only if prescribed by your veterinarian in the context of a valid client-patient relationship.*** The withdrawal times for various drugs were compiled from different sources. The listed dosages and withdrawal times, as well as drug status and legality of use, is subject to change. Your veterinarian will prescribe the latest, most up-to-date drugs, dosages, and provide the correct withdrawal period. ***Consult your veterinarian before beginning any treatment!***

I. Antibiotics:	**Brand Name**	**Approval**	**Dosage**	**Route**	**Frequency**	**Withdrawal Time**	
						Meat	Milk
Ceftiofur	Naxcel®	APPROVED	0.5-1 mg/lb	IM	Once a day	0 days	0 days
Neomycin	Biosol® and other products	APPROVED	5 mg/lb	PO	Twice a day	3 days	NA
Amoxicillin	Amoxi-inject®	extra-label	5 mg/lb	SQ	Once a day	26 days	120 hours
Ampicillin	Polyflex®	extra-label	5 mg/lb	SQ	Once a day	10 days	72 hours
Benzathine Pen G	Pen BP-48®	extra-label	20,000 IU/lb	SQ	Every 48 hours	30 days	NA
Erythromycin	Erythro-200®	extra-label	1 mg/lb	SQ	Once a day	5 days	96 hours
Florfenicol	Nuflor®	extra-label	9 mg/lb	IM	Every 48 hours	28 days	120 hours
Oxytetracycline	LA-200®	extra-label	9 mg/lb	SQ	Every 48 hours	29 days	144 hours
Procaine Pen. G	Crysticillin®	extra-label	10,000-20,000 IU/lb	SQ	Once a day	16-21 days	120 hours
Sulfadimethoxine	Albon®	extra-label	25 mg/lb Day 1, 12.5 mg/lb Days 2 - 5	PO	Once a day	12 days	5 days
		EXTRA-LABEL USE IS PROHIBITED IN LACTATING DAIRY COWS. DO NOT USE IN LACTATING DAIRY DOES.					
Tylosin	Tylan®-200	extra-label	10 mg/lb	IM	Once a day	30 days	96 hours
Chloramphenicol	Chloramphenicol	EXTRA-LABEL USE IS PROHIBITED					
Enrofloxacin	Baytril® 100	EXTRA-LABEL USE IS PROHIBITED					
Furacin, nitrofurantoin	Furox®	EXTRA-LABEL USE IS PROHIBITED					
Gentamicin	Gentocin®	DO NOT USE					
Tilmicosin	Micotil®	DO NOT USE – TOXIC TO GOATS					

II. Anti-inflammatory Drugs:	Brand Name	Approval	Dosage	Route	Frequency	Withdrawal Time	
						Meat	Milk
Aspirin	Aspirin	extra-label	100 mg/kg	PO	Once a day	1 day	24 hours
Flunixin meglumine	Banamine®	extra-label	1.1-2.2mg/kg	IV or IM	Once a day	10 days	72 hours
Phenylbutazone	Bute	extra-label	10-20 mg/kg	PO	Once a day	60 days	DNU
		DO NOT USE IN LACTATING ANIMALS					
Dipyrone	Dipyrone	EXTRA-LABEL USE IS PROHIBITED					

III. Prevention of Coccidiosis:	Brand Name	Approval	Dosage	Withdrawal Time	
				Meat	Milk
Decoquinate	Deccox®	APPROVED	13-91 gm/ton of feed	0 days	24 hours suggested minimum, DNU
Monensin	Rumensin®	APPROVED	15-20 gms/ton of feed	0 days	96 hours suggested minimum, DNU
Amprolium	Corid®	extra-label	25-50 mg/kg BW in feed or water	2 days	48 hours
Lasalocid	Bovatec®	extra-label	20-30 gms/ton of feed	0 days	24 hours

IV. Anthelmintics:	Brand Name	Approval	Dosage	Route	Withdrawal Time	
					Meat	Milk
1. Avermectins:						
Doramectin	Dectomax®	extra-label	0.3 mg/kg	SQ	56 days	40 days
Eprinomectin	Eprinex®	extra-label	0.5 mg/kg	PO	NA	NA
Ivermectin	Ivomec® Drench	extra-label	0.3 mg/kg	PO	14 days	9 days
Ivermectin	Ivomec® 1%	extra-label	0.3 mg/kg	SQ	56 days	50 days
Moxidectin	Quest®, Cydectin®	extra-label	0.5 mg/kg	PO	23 days	56 days
	Cydectin® drench	extra-label	0.3 mg/kg	PO	14 days	NA
	Cydectin® Injectable	extra-label	0.2 mg/kg	SQ	30 days	DNU

2. Benzimidazoles:						
Albendazole	Valbazen®	extra-label	10 mg/kg	PO	7 days	120 hours
Fenbendazole	Panacur®/ Safeguard®	APPROVED at 5 mg/ Kg, extra-label as recommended	10 mg/kg	PO	14 days	120 hours
Oxfendazole	Synanthic®	extra-label	10 mg/kg	PO	14 days	120 hours
3. Cholinergic Agonists:						
Morantel Tartrate	Rumatel®	APPROVED	10 mg/kg	PO	30 days	0 days
Levamisole	Levasole®	extra-label	8 mg/kg	PO	10 days	4 days

V. Anesthetics and Tranquilizers	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Ketamine	Ketaset®	extra-label	5-10 mg/kg	IV or IM	3 days	48 hours
Lidocaine	Lidocaine	extra-label	Variable for local anesthesia use, 1% in goats			
Thiamylal Na	Biotal	extra-label	10-20 mg/kg	IV	1 day	24 hours
Xylazine	Rompun®	extra-label	0.05-0.1 mg/kg	IV or IM	5 days	72 hours
Yohimbine	Yobin	extra-label	0.25 mg/kg	IV	7 days	72 hours

VI. Hormones:	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Cloprostenol	Estrumate®	extra-label	125 microgram	IM	0 days	0 days
Dexamethasone	Azium®	extra-label	20-25 mg	IM	14 days	4 days
Dinoprost	Lutalyse®	extra-label	5-10 mg	IM	1 day	24 hours
Oxytocin	Oxytocin	extra-label	10-20 IU	IM	0 days	0 days

VII. Electrolytes	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Calcium	Calcium borogluconate	extra-label	60 to 100 ml of 20 to 25% Solution	IV	0 days	0 days
Calcium	Calcuim gluconate	extra-label	50 to 100 ml 10 to 23% calcium ion solution	IV	0 days	0 days

NOTE: In the table above PO = oral administration; SQ = subcutaneous injection; IM = intramuscular injection; IV = intravenous injection. DNU = insufficient data available to make WDI estimation, this drug is not approved for lactating goats.

Goat Guideline for Anthelmintic Dosages (internal parasite dewormers) July 2006

Important --- Please read notes on the following page before using this chart

		Oral dosing. Note: 1 ml = 1 cc						Subcutaneous injection
		Valbazen Albendazole[1]	SafeGuard Fenbendazole[2]	Ivomec Ivermectin[3]	Levasole Levamisole[4]	Cydectin Pour-on Moxidectin[5]	Cydectin Drench Moxidectin[6]	Cydectin *Injectable* Moxidectin[7]
Animal Weight		20 mg/kg	10 mg/kg	0.4 mg/kg	12 mg/kg	0.5 mg/kg	0.3 mg/kg	0.2 mg/kg
lbs	kg	2 ml/ 25 lb	1.1 ml/ 25 lb	6 ml/ 25 lb	3 ml/ 25 lb	1.1 ml/25 lb	3.4 ml/25 lb	1 ml/ 110 lb
20	9.1	1.6	0.9	4.8	2.4	0.9	2.7	0.2
25	11.4	2.0	1.1	6.0	3.0	1.1	3.4	0.2
30	13.6	2.4	1.4	7.2	3.6	1.4	4.1	0.3
35	15.9	2.8	1.6	8.4	4.2	1.6	4.8	0.3
40	18.2	3.2	1.8	9.6	4.8	1.8	5.4	0.4
45	20.5	3.6	2.1	10.8	5.4	2.1	6.1	0.4
50	22.7	4.0	2.3	12.0	6.0	2.3	6.8	0.5
55	25.0	4.4	2.5	13.2	6.6	2.5	7.5	0.5
60	27.3	4.8	2.7	14.4	7.2	2.7	8.2	0.5
65	29.5	5.2	3.0	15.6	7.8	3.0	8.8	0.6
70	31.8	5.6	3.2	16.8	8.4	3.2	9.5	0.6
75	34.1	6.0	3.4	18.0	9.0	3.4	10.2	0.7
80	36.4	6.4	3.6	19.2	9.6	3.6	10.9	0.7
85	38.6	6.8	3.9	20.4	10.2	3.9	11.6	0.8
90	40.9	7.2	4.1	21.6	10.8	4.1	12.2	0.8
95	43.2	7.6	4.3	22.8	11.4	4.3	12.9	0.9
100	45.5	8.0	4.6	24.0	12.0	4.6	13.6	0.9
105	47.7	8.4	4.8	25.2	12.6	4.8	14.3	1.0
110	50.0	8.8	5.0	26.4	13.2	5.0	15.0	1.0
115	52.3	9.2	5.2	27.6	13.8	5.2	15.6	1.0
120	54.5	9.6	5.5	28.8	14.4	5.5	16.3	1.1
125	56.8	10.0	5.7	30.0	15.0	5.7	17.0	1.1
130	59.1	10.4	5.9	31.2	15.6	5.9	17.7	1.2
140	63.6	11.2	6.4	33.6	16.8	6.4	19.0	1.3
150	68.2	12.0	6.8	36.0	18.0	6.8	20.4	1.4

Footnotes:

1. **Valbazen** Suspension (11.36 % or 113.6 mg/ml): ***Do NOT use in pregnant does in the first trimester of pregnancy.*** Meat withdrawal time is 9 days and 7 days for milk (FARAD).
2. **Safe-Guard/ Panacur** Suspension (10% or 100 mg/ml): Approved in goats at 5 mg/kg with meat withdrawal time of 6 days and no withdrawal period for milk. Although the label dose in goats is 5 mg/kg, it is generally recognized that 10 mg/kg dosage is required for good efficacy. At 10 mg/kg dosage, meat withdrawal is 16 days and 4 days for milk (FARAD).
3. **Ivomec Sheep Drench** (0.08% or 0.8 mg/ml): Protect from light. Coughing may occur during and following drenching. Meat withdrawal time is 14 days (FARAD).
4. **Levasole Soluble Drench Powder (Sheep)**: Oral solution ONLY. To prepare use 1 packet (13 gm/11.7 gm active ingredient) dissolved in 262 ml [8.9 oz.] water (44.7 mg/ml) {or 52 gram packet dissolved in 1048 ml water [35.4 oz.].} NOTE: This is different dilution from the label directions for administration. Meat withdrawal time is 4 days (FARAD).
5. **Cydectin Pour-on for cattle** (0.5% or 5 mg/ml): Meat withdrawal time is 23 days. ***Not for use in lactating dairy goats.***
6. **Cydectin Drench for sheep** (.1% or 1 mg/ml): Meat withdrawal time is 14 days. ***Not for use in lactating dairy goats***.
7. **Cydectin Injectable for cattle** (1% or 10 mg/ml): GIVE SQ. Meat withdrawal time is 30 days. ***Not for use in lactating dairy goats.***

NOTE for Guideline for Anthelmintic Dosages in Goats

The attached chart was developed by Ray M. Kaplan, D.V.M., Ph.D. (University of Georgia) and modified by Patty Scharko D.V.M., M.P.H. (University of Kentucky) and Lionel Dawson D.V.M., M.S. (Oklahoma State University). It is provided as a possible guideline for anthelmintic (deworming) dosages for goats. Producers should consult their veterinarian for advice on their specific management situation for determining dosages for their herd. ***With the exception of fenbendazole administered at the 5 mg/kg dose, these drugs are not approved by the Food and Drug Administration (FDA) for use in goats, and when used in goats are considered extra-label use (fenbendazole at the recommended dose rate of 10 mg/kg is considered extra-label usage). The FDA regards extra-label use of drugs as an exclusive privilege of the veterinary profession and is only permitted when a bona fide veterinarian-client-patient relationship exists and an appropriate medical diagnosis has been made. The chart is intended to serve as guideline for improving accuracy when dosing goats with an anthelmintic, but these drugs should be used in goats only when appropriate veterinary advice has been received.***

Drug resistance in parasites of goats is extremely common. The effectiveness of an anthelmintic should always be tested before being used by performing a FECRT (Fecal Egg Count Reduction test) or larval development (DrenchRite) assay if available.

*** The current recommendation is to use the Cydectin cattle **injectable** formulation and **NOT** the **pour-on** formulation (orally) or the sheep oral drench. When administered by subcutaneous injection, moxidectin provides improved drug levels as compared to oral administration.*

CAE and Mastitis

excerpted from

Meat Goat Production Handbook & Dairy Goat Production Handbook

Caprine arthritis encephalitis (CAE)

Caprine arthritis encephalitis (CAE) is caused by a retrovirus and can affect all breeds of goats but is most common in the dairy goat industry. Up to 80% of all dairy goat herds tested have infected animals compared with only up to 10% of meat goat herds. The CAE virus is transmitted from an infected adult goat to kids through consumption of colostrum and milk. There is also evidence to suggest that CAE can be transmitted directly from goat to goat possibly through saliva, nasal secretions, urine, feces, venereal transmission from infected bucks, and through mechanical transmission (needles, tattooing equipment, etc.). While generally not a deadly disease, CAE can result in lost production, particularly in older goats. There is no evidence that CAE affects humans and milk and meat from CAE-infected animals is safe for human consumption.

Clinical signs

There are four forms of the disease, a central nervous system or "CNS" form that affects kids, an arthritic form that affects adults, a pneumonia form, and a mastitic form. The arthritic form in older goats is most commonly seen.

In the CNS form, young kids (2 to 4 months of age) develop a weakness in the rear legs, stumble, and finally cannot rise. The unused leg muscles lose strength and terminally affected kids are unable to sit up and can only lie on their sides. Throughout the course of the disease, kids remain bright and alert and will continue eating and drinking with assistance.

In the arthritic form, goats will have one or more swollen joints. The knee joints are most frequently affected followed by the hocks and stifles. Initially, joint swelling may wax and wane and lameness is minimal. As the disease progresses, affected goats gradually lose weight and condition, have poor hair coats, swollen knees (golf ball to grapefruit size), and have signs of joint pain and lameness, particularly during cold weather. Affected goats may eventually walk on their knees. The pneumonia form is usually seen during advanced pregnancy when the animal is stressed. The mastitic form occurs in adult does and is also known as "hard bag." At the time of parturition the udder is swollen and very firm but contains very little milk.

Treatment, prevention, and control

There is no treatment. Infected animals can be assisted by good nutrition, nursing care, and pain relief with anti-inflammatory drugs.

Prevention and control consist of purchasing CAE-free animals, culling infected animals, raising CAE-free kids, and preventing potential goat-to-goat transmission. Blood tests can detect CAE and animals should be tested prior to purchase. Periodic blood testing is required to monitor herd CAE status as animals will seroconvert (meaning they will blood test positive for the disease) at different times. An animal may test negative and 3 months later test positive. Once an animal tests positive, it will not revert to negative status (once infected, always infected). Repeated annual or biannual testing and strict culling is necessary to keep a herd CAE-free.

To raise CAE-free kids, remove them from affected dams at birth and feed pasteurized colostrum and milk, feed bovine colostrum and milk, or feed commercially available artificial colostrum replacer. Colostrum can be heat-treated by raising the temperature to 133°F (56°C) for 60 minutes or 165°F (74°C) for 15

seconds. Milk is pasteurized by treating at 145°F (63°C) for 30 minutes or 161°F (72°C) for 15 seconds. The temperature is critical for colostrum because a higher temperature will denature colostral proteins that provide disease immunity and a lower temperature will not kill the virus. Pasteurization can be accomplished using a water bath heated by an electric frying pan or by equipment purchased for the task. It is probably not safe to feed kids unpasteurized milk from test negative does.

Finally, because there is evidence that any body fluid from an infected goat is a possible source of the disease, separating infected from uninfected animals is important. Disinfect anything that could transmit body fluids (milk, saliva, feces, blood, or nasal discharges) between goats and after each use. This includes milking machines, tattoo needles, etc.

Mastitis

Inflammation of the mammary gland or mastitis is seen in dairy and meat goats. With the exception of CAE virus infection of the mammary gland, all mastitis is caused by bacteria. The disease is many times more prevalent in dairy goats because of their intensive management. High stocking density in their housing, bedding types, milking technique, and the use of milking machines all facilitate the transfer of environmental and contagious bacteria to the teat end of the dairy goat. These factors play an important role in the incidence of mastitis.

Diagnosis is mainly done by looking at changes in animal behavior, body temperature, and milk consistency, palpation of the udder, and culturing the milk. Other tests may be necessary to diagnose subclinical mastitis, the condition where animals are normal by all measures and they are producing milk that appears normal. These tests rely on the detection of elevated counts of somatic cells in the milk. A somatic cell count (SCC) can be done by the direct microscopic method or by automated electronic counters that are calibrated using the direct microscopic counts. The California Mastitis Test (CMT) is an indirect test that uses an anionic detergent that reacts with the DNA in the somatic cells in the milk sample to form a gel. High viscosity of the gel is indicative of high SCC and, thus, also indicative of subclinical mastitis.

Classifications of mastitis

In general, mastitis is a bacterial infection of the mammary gland. Mastitis due to CAE virus will not be addressed here because its presentation, diagnosis, and control are different than those of bacterial mastitis. Cases of mastitis are designated "clinical" if they cause the doe to be sick (depressed, off-feed, fever, and abnormal milk) or "subclinical" if the doe and milk remain normal. Subclinical animals are usually identified by a high CMT score or SCC count. It is useful to identify the causative organism by bacterial culture of milk from the affected doe, so that it can be tested for susceptibility to various antibiotics. Some bacteria are considered "untreatable" because they do not respond to antibiotics (e.g. Staphylococcus aureus and Myco-

Table 1. Common microorganisms responsible for subclinical or clinical mastitis.

Mastitis type	Organism	Treatment potential
Environmental	› Coagulase negative *Staphylococcus* spp. › *E. coli*, *Klebsiella*, etc. › *Pseudomonas* spp. › *Streptococcus* spp. › *Bacillus* spp.	Treatable
	› Various fungi	*Untreatable*
Contagious (goat to goat)	› *Strep. agalactiae*	Treatable
	› *Staph. aureus* › *Mycoplasma*	*Untreatable*

plasma spp.) The identification of the specific bacteria also indicates the likely source of that bacterium, i.e., from the environment or from other infected does. This information allows treatment with the appropriate antibiotic and correction of conditions that facilitated the infection to occur.

In general, any bacteria that enter the mammary gland can cause mastitis. Table 1 is a useful classification of commonly cultured organisms from goat milk that are responsible for environmental and contagious mastitis. Other less common organisms are Trueperella pyogenes, Corynebacterium pseudotuberculosis, Pasteurella multocida, and Mannheimia haemolytica.

Clinical mastitis

Clinical mastitis may be recognized by the presence of heat, redness, pain, and swelling of the udder. Lameness or stiffness to the hind leg on the affected side of the mammary gland may be seen. Palpation of the udder may reveal swelling of the affected side, firmness of the gland, and enlargement of the supramammary lymph nodes of the affected side. Milk stripped from the gland may have an abnormal color, flakes or clots, or be watery or thicker than normal. Unfortunately, the consistency of the milk provides little information on the identity of the organism.

Clinical mastitis can be a life-threatening disease and should be treated immediately, even before the organism is identified by culture. However, it is important to get a sample before treatment is initiated so that the organism can be positively identified later if the initial treatment is not effective. The following steps allow immediate treatment with a backup plan in case of treatment failure:

1. Take a milk sample in a sterile vial that you can get from your veterinarian. Your veterinarian can show you how to take the sample without contaminating it with other bacteria.
2. Freeze the sample.
3. Immediately begin treating the animal with the antibiotic that has worked the best in the past.
4. Submit the frozen sample for culture and sensitivity to your veterinarian or state diagnostic lab if treatment is not successful, otherwise discard the frozen sample.
5. Maintain records of culture results and treatment successes and failures so that you can maximize your initial treatment successes.

It is important to establish a relationship with your veterinarian. Almost no antibiotics are approved for use in goats. All labeled dosages for cows must be adjusted for goats. Practically every product is considered "extra-label" for goats and requires a prescription and specific labelling by your veterinarian to be legal. Antibiotic withdrawal times are more predictable in cattle and, therefore, antibiotic testing of milk is necessary in goats before the milk is safe for human consumption.

Subclinical mastitis

Subclinical mastitis can be caused by any of the same organisms that cause clinical mastitis. By definition, subclinical mastitis has no outward signs in either the animal or the milk. These mastitis cases result from mild infections with low numbers of organisms and the higher SCC level, induced by the infection, is an effective immune response that prevents bacterial proliferation to the point of developing into a clinical case.

Subclinical mastitis is usually detected by the California Mastitis Test. It is a "doe-side" test that uses viscosity as indirect measure of SCC (Table 2). Because the goat is not clinically ill, some producers delay treatment until the doe's lactation is complete. Treatment of cows with subclinical mastitis during lactation has not shown to be economically advantageous. That is, the increase in milk produced by eliminating the infection does not pay for the treatment costs plus the value of milk lost during the treatment and withholding periods. However, routine screening of all milking does with the CMT can detect new cases early when they are most likely to result in a complete cure, if treated. Treatment of subclinical cases may become necessary when the bulk tank SCC approaches the state legal limits.

Estimates of somatic cell count (SCC)

Direct microscopic somatic cell count (DMSCC)

The DMSCC is the gold standard for all of the other estimates of SCC. The CMT, Wisconsin Mastitis Test, and all electronic counters are calibrated by the DMSCC method. Direct microscopic examination usually involves 0.01 ml of milk on a slide within an area of 1 cm^2. Pyronin Y-Methyl Green Stain, often referred to simply as the green stain, is currently used for determining SCC in goat milk. The method is tedious and has poor repeatability. Several counts are made on the same sample and the results are averaged. DMSCC is not commonly used except for validating calibration standards for electronic counters. By law the method must be used to verify illegal counts on individual bulk tank samples. Only trained personnel in state or commercial laboratories are qualified to perform this procedure. States that regulate Grade "A" milk following the Pasteurized Milk Ordinance conduct this staining procedure on goat milk.

California Mastitis Test (CMT)

The CMT is commonly used on dairy goat farms. It is a simple, semi-quantitative test for detecting the number of nucleated cells (neutrophils and epithelial cells) in the milk. Equal amounts of milk and a reagent are combined in a white paddle and swirled. The reagent contains 3% alkyl aryl sulfonate and bromocresol purple. The reaction detects DNA which is released when the detergent ruptures the somatic cells. Samples are scored based upon the degree of gel formation in the sample. Table 2 shows that the CMT is not useful on bulk tank samples; a CMT score of 1 has a range that overlaps a CMT score of 0 on the low end of SCC and almost reaches the legal limit of 1,500,000 at the upper range of SCC.

Table 2. California Mastitis Test scoring system in goats (Schalm, 1971).

CMT Score	Neutrophil cells/ml	
	Median	Range
0	60,000	0 – 480,000
Trace	270,000	0 – 640,000
1	660,000	240,000 –1,400,000
2	2,400,000	1,000,000 – 6,000,000
3	---	>10,000,000

It is a common misconception that the CMT is used to diagnose clinical mastitis. Clinical mastitis is diagnosed by many signs including the abnormal milk consistency. The CMT test is unnecessary for clinical mastitis but will consistently result in a score of 3.

The subclinical infection level in the herd is important because there are legal limits on the SCC in goat milk. The federal limit is 1,500,000 per ml of milk as listed in the 2013 Pasteurized Milk Ordinance but states can have tighter requirements.

The CMT is useful in identifying the goats that are likely to be milk culture positive for target treatment. Approximately 75% of the does that score 2 or 3 on the CMT will result in positive milk cultures whereas few CMT scores of Trace or 1 result in positive cultures. This is useful information if the goal is to reduce high SCC counts in bulk tank milk that is approaching legal SCC limits.

Treatment

Treatment plans are critical for clinical mastitis. Subclinical mastitis with CMT readings of 2 or 3 may be treated with lactating intramammary (IMM) products to reduce bulk tank SCC or treated with dry cow IMM products when the doe goes dry.

Some clinical cases of mastitis will need to be treated as emergencies if the doe is weak or down or has a body temperature above 104°F (40°C) or below 99°F (37°C). Frequent stripping of milk from the affected

half is always a good idea. Intravenous fluids and antibiotics are needed in these cases in addition to IMM antibiotics. These cases generally require treatment by the veterinarian to save the life of the animal. In some cases, euthanasia is necessary. Non-steroidal anti-inflammatory drugs (NSAIDs) are also necessary but should be given after rehydration to avoid kidney damage.

For non-life-threatening cases of clinical mastitis, IMM products will be the treatment method of choice. Many IMM cow products are available but must be approved and properly labeled by the veterinarian for use in goats. In general, the IMM products for cows are dosed at one tube per treatment. The proper dosage for the goat is one-half tube per infected one-half udder. If she is affected in both halves, dose one-half tube in each half udder.

In addition to IMM therapy, several antibiotic classes are approved in cattle for intramuscular (IM), subcutaneous (SQ), or intravenous (IV) use. These drugs are also available through your veterinarian or a dispensary with proper veterinary labeling for goats. Some injectable products do not pass into the milk when given IM or SQ and can be used without the worry of antibiotic residues.

Another important product for clinical mastitis therapy are NSAIDs. NSAIDs reduce fever and inflammation and make the animal feel better and thus return to feed sooner. Overdosing is a concern and repeated dosing should be limited because of kidney toxicity.

The producer should work with his or her veterinarian to have several IMM and injectable antibiotics as well as NSAIDs on the farm properly labeled for mastitis treatment. Get instructions from the veterinarian on proper insertion of the IMM cannula and where to give IM injections safely.

Selection of the initial antibiotic for a clinical case is always somewhat hit-or-miss because treatment should be initiated immediately but the results of culture and sensitivity are not available for days. Have your veterinarian suggest a broad spectrum antibiotic for initial use and whether to treat as IMM or IM therapy or both. Therapy can be changed if the regimen does not seem to be working. Staphylococcus aureus or Mycoplasma spp. do not respond to antibiotics so a cure should not be expected.

Antibiotic residues and withdrawal times

Antibiotics are removed from the body through the kidney or the liver. The rates of clearance vary with the type of antibiotic, dosage, route of administration, species as well as health and hydration of the animal. The IMM products have expected withdrawal times for cows on the label. These times vary from 36 to 96 hours after the last treatment, depending on antibiotic used. These times should be used as minimum wait times before running tests for antibiotic residue in treated does.

On-farm kits are available for the producer to detect antibiotic residues in the milk of treated animals. IDEXX Laboratories and several other companies make milk residue tests that can detect any class of antibiotics that is approved for use in dairy animals. The tests are cheap and run time is 10 minutes. The test should be negative before that goat's milk is added to the bulk tank again. Costly penalties are enforced when antibiotic residues are detected at the milk processing facility.

Prevention

Animals entering and leaving the herd

The dairy should strive to become a closed herd, meaning that all replacement doelings are produced on the farm. If animals are purchased for expansion of the herd, the safest animals, from a mastitis point of view, are springing doelings. If adult animals are to be purchased and introduced into the herd, a pre-purchase bulk tank milk sample should be taken for culture from the herd of origin to detect any contagious pathogens that might be present in the herd. If the herd of origin passes the bulk tank test, milk from the individual lactating goats selected for purchase should be tested by CMT and cultured. CMT scores should be 1 or less

and no contagious pathogens should be present. Dry animal purchases should be delayed until freshening so that CMT and culture tests can be done to the same criteria. Be sure to ask for both a bacterial culture and a mycoplasma culture as mycoplasma requires special growth media.

Dry therapy

Dry cow IMM products are available for extra-label use through your veterinarian. These products have long acting carriers so that the antibiotic lasts about 1 month within the mammary gland. This extended period of antibiotic exposure improves treatment success of existing subclinical infections and prevents new infections during the dry period. Some producers treat both halves of all goats going dry. Selective treatment of only high CMT score halves is another option.

Orbeseal® is a non-antibiotic IMM paste that can be placed in the udder following the dry antibiotic treatment. The teat ends will remained sealed for at least 100 days or until the material is milked out of the udder at freshening. This treatment is recommended if coliform infections are occurring during dry period.

Vaccinations

Mastitis vaccines have been developed for very few of the bacteria that cause mastitis. The purpose of vaccination is to increase the immune response to the presence of a bacteria or other organism. Vaccination of subclinically infected animals may result in a rise in the SCC because the majority of the somatic cells are part of the immune system.

There are several Staphylococcus aureus vaccines on the market. These vaccines are best used on springing doelings to protect them from a condition known as "blue bag." A first-time infection with Staph. aureus can cause a gangrenous udder (blue bag) in a small percentage of cases. These cases result in death or euthanasia. The number of cases are reduced or eliminated by vaccination of doelings. The vaccination protection seems to be long-term so that only a single dose is recommended. Whole herd vaccination is not recommended unless bulk tank culture shows the herd to be Staph. aureus free. The vaccination of does, subclinically infected with Staph. aureus, may result in rise in bulk tank SCC.

Several vaccines are marketed against coliform bacteria (E. coli, Klebsiella, Enterobacter, Salmonella, etc.) These bacteria are part of the bacterial flora of the large intestine and, thus, may be found wherever fecal material is found. The vaccine is directed against endotoxins that are produced by the bacteria. The vaccine does not result in a measurable rise in SCC. Coliform mastitis infections are another cause of occasional deaths in the milking herd. They can also cause abortions due to the endotoxin of the coliform bacteria causing release of enough prostaglandin to lyse the corpus luteum of pregnancy. The vaccine, if elected to be used, is repeated at yearly intervals when the does are dry.

Autogenous mycoplasma vaccines have been used but have not shown to be effective against mycoplasma mastitis.

Control

Bulk tank cultures

The bulk tank contains valuable management information for mastitis control. A sample should be taken periodically (monthly or quarterly) for bacterial culture and identification. The sample should be taken after 15 minutes of agitation to assure that the milk in the tank is uniformly mixed. Request a general bacterial culture as well as a mycoplasma culture. The goal is to identify the presence of contagious bacteria early before they are spread throughout the herd. If Strep. agalactiae, Staph. aureus, or Mycoplasma spp. are identified on bulk tank culture, the individual infected goats must then be identified. CMT of all individuals and culture of those with CMT scores of 2 or 3 is indicated. Infections due to Strep. agalactiae are treatable

but infections due to the other two bacteria are not. Immediate culling of animals with untreatable disease should be considered. Otherwise, a separate herd of infected animals should be established and they should be milked after the "clean" herd. The separate herd is a permanent change to management and must be maintained until the last animal with contagious, untreatable mastitis is culled.

Monthly somatic cell count of the herd

In addition to bacterial culture, somatic cell counts (SCC) are a valuable tool in monitoring a herd for subclinical mastitis. Somatic cells are primarily leucocytes (white blood cells) produced to fight infection. An increase in the number of somatic cells in the milk has been used as an indicator of mastitis in cows. In the dairy cow industry, cell counts are usually done on each animal on a monthly basis to monitor the herd and be able to diagnose new subclinical mastitis cases. If monthly SCC is not feasible, a monthly CMT of individual goats should be performed. CMT readings of 2 or 3 are indicative of subclinical infection. Treatment may be indicated depending on whether you elect to treat subclinical infections during lactation or only during the dry period.

Records

Individual records should be kept on each goat so that the mastitis history is considered when making culling decisions. It is also important to record clinical signs, response to specific therapy, and identification of the bacteria involved. A separate log of treatments, dates, and results of residue tests should be kept to prevent accidental shipment of milk from does that are not yet residue free.

Housing

The adequacy of housing can be assessed by whether or not the goats come into the parlor clean and dry even under the worst environmental conditions. Animals that come into the parlor wet or dirty are wearing thousands of bacteria on their skin and hair. If water is required to clean the udder, it provides mobility of the bacteria to the teat end, increasing the probability of new infections. Bedding should be changed often so that it does not provide moisture for bacterial growth. Sand bedding is preferred in the dairy cow industry because it does not support bacterial growth and the contact surface remains dry.

Milking technique

Milking techniques vary with machine station design and manager preference. A clean, dry doe that is presented for milking should experience the following general protocol:

1. Remove any debris from the udder and pre-dip with an antiseptic, usually an iodine teat dip.
2. Allow 30 to 45 seconds of kill time before wiping off with a clean, dry towel.
3. Apply milking machine.
4. Break vacuum and remove machine.
5. Apply teat dip again after machine removal.

Liner squawks are caused by vacuum fluctuations that can drive bacteria into the teat canal. The milking unit should be immediately adjusted to stop the squawking. The final teat dip is extremely important. Dipping is preferred to spraying because coverage of the teat orifice is assured. Fresh feed should be available after milking to encourage animals to stand to allow time for complete closure of the streak canal before lying down. The vacuum level and pulsator function should be assessed at each milking and milking machine function should be evaluated semi-annually at a minimum.

CL and Urinary Calculi

excerpted from

Meat Goat Production Handbook

Caseous lymphadenitis

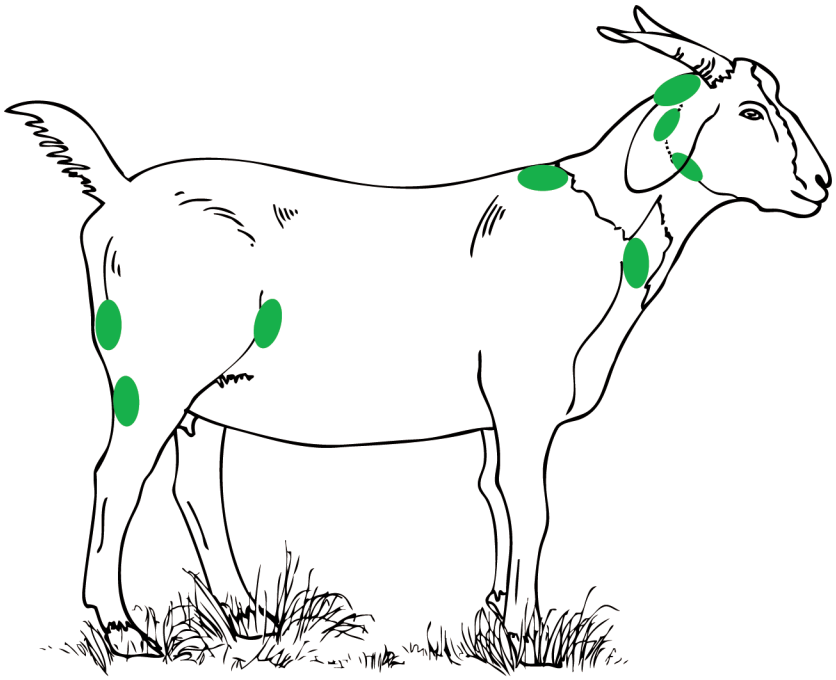
Caseous lymphadenitis (CL) is an extremely common disease that is usually ranked as the most important disease goat owners have in their herds. CL is characterized by one or more abscesses involving lymph nodes, typically associated with nodes in the head and neck. Occasionally, the organism will involve internal lymph nodes and result in a wasting syndrome. Both the external and internal forms of CL may coexist in the same animal. CL is transmitted orally, through direct contact with skin, and occasionally by inhalation. Some goats within a herd appear to be very resistant to CL while others are very susceptible. The causative agent, Corynebacterium pseudotuberculosis, can live for long periods of time in soil and on the surface of farm equipment, feeders, and water troughs; thus, it is extremely difficult to eradicate. Once a goat is infected, it remains infected for life.

Clinical signs

The most commonly seen sign is an enlargement of one or more of the lymph nodes of the head and neck. The enlarged lymph nodes, ranging in size from 1½ to 6 inches (3 to 15 cm), are thick-walled and filled with thick, pasty, greenish pus.

Treatment, prevention, and control

Affected animals should be isolated and abscesses opened and drained away from the herd and grazing areas. All pus and discharge should be caught and burned or buried. This disease can affect humans so gloves should be worn. For proper procedure, see the lancing abscesses section of the "Meat Goat Herd Health Procedures and Prevention" chapter. The affected goat should be isolated from the herd until the opened abscess is completely healed over. Goats with multiple abscesses should be culled. Antibiotic use is not successful at clearing the infection. However, in genetically superior or valuable animals, the use of tulathromycin (Draxxin®) injected either within the enlarged lymph node or under the skin (at a dose of 2.5 mg/kg once) may temporarily reduce the size or resolve the abscess, preventing drainage and potential contamination of the environment. However, this drug will not cure a goat of CL.



Location of lymph glands.
Illustration by K. Williams.

The best prevention is to maintain a closed herd or to carefully screen

new additions to the herd by performing a blood test, submitting non-draining lymph node abscess content for bacterial culture (consult your veterinarian), and by examining for the presence of abscesses or scars from old abscesses. All affected animals should be isolated from the herd or culled. Once this disease has entered a farm, it is difficult to eradicate. There is a vaccine available for sheep (Case-Bac™ or Caseous D-T) which may decrease the incidence and severity of the disease. It is a killed vaccine which requires two doses initially and an annual booster. The vaccine has no efficacy in animals which are already infected. As of May 2012, Texas Vet Lab, Inc. launched the first conditionally licensed CL vaccine available for goats (Corynebacterium pseudotuberculosis Bacterin).

Obstructive urolithiasis, urinary calculi, or stones

Obstructive urolithiasis, urinary calculi, or stones is a disease where crystals are first formed in the bladder then lodge in the long and narrow urethra (urinary canal) of male goats, preventing them from urinating. Most common sites of obstruction along the urethra are the distal sigmoid flexure and the vermiform or urethral process (a whip-like structure at the end of the penis). Female goats are largely unaffected mainly because their urethra is significantly shorter and wider than that of male goats.

There are several factors that can contribute or predispose an animal to suffering from urinary calculi. These include early castration, urine pH, diet, and body water balance. Early castration of ruminants, e.g., in goat kids less than 3 months of age, results in decreased diameter of the urethra, increasing the chance of blockage. The normal alkalinity (high urine pH) found in ruminant urine favors the formation of urinary stones such as struvite, apatite, and calcium carbonate. Male goats consuming large amounts of concentrates, such as pet or show goats, are commonly affected. It is virtually nonexistent in animals that receive little to no grain with the exception of animals grazing western pastures with high silica content. Total body water balance plays an important role in urine output and concentration. When water intake decreases such as during the winter or because of illness, the urine output will be decreased, increasing chances of blockage.

Types of urinary calculi

Stones regularly associated with calculi formation in goats include complexes having calcium (Ca), phosphate (P), and(or) magnesium (Mg), silicate, calcium carbonate, calcium oxalate, and ammonium phosphate called struvite. While calculi can form in any geographical region, silicate stones are generally limited to goats grazing forages grown on western pastures that have excess soil silica content.

Calcium carbonate stones result from feeding rations very high in Ca, typically high legume diets (clovers and alfalfa) such as seen in the major alfalfa producing areas of the U.S. Legumes contain 1 to 2% Ca and have very high ratios of Ca to P (Ca:P of 6:1 to 10:1). Calcium oxalate stones form as a result of diets high in Ca and in oxalates. Certain plants are oxalate accumulators (rape/kale family, rhubarb, sugar beet tops, and pigweed).

Phosphate or struvite stones occur when feeding rations having a disproportionate ratio of Ca to P (< 2:1) or high levels of Mg and P. In general, grasses are low in Mg, Ca, and P but are balanced in terms of Ca:P ratios (1.5:1 to 2:1). Thus, grazing goats rarely experience urinary stone problems. Rather, affected goats typically are fed high levels of grain and/or pelleted feeds. Grains are high in P and low in Ca and have Ca:P ratios of 1:4 to 1:6.

Clinical signs

The main sign is a male goat persistently straining to urinate but passing little to no urine. Urine may be blood-tinged. Drops of urine and blood or urine crystals may be seen on the hair of the sheath. Affected animals will be restless, switch their tails, and kick at their bellies. As the blockage progresses, some goats will vocalize in pain. Severe and complete blockage can lead to the rupture of the urethra or bladder. Initially,

this will alleviate the discomfort felt by the animal. Swelling around the sheath does suggest that the urethra has ruptured and urine is leaking into the soft tissue. Progressive distention of the abdomen due to accumulation of urine may be noted if the bladder has ruptured. An animal with a ruptured bladder will quickly go off feed, become weak, depressed, and eventually die.

Treatment, prevention, and control

There are varying levels of treatment that can be attempted. Overall, factors to consider include stage of the disease (partial or complete urethral obstruction, ruptured urethra or ruptured bladder), class of animals (commercial, breeding stock, pet), and type of stones present. Any male goat that is completely obstructed is considered to be a medical emergency. In a partially blocked goat, acidifying the urine with ammonium chloride, increasing salt content of the diet, and giving vitamin C may help dissolve the small sand-like calculi. If the stones are larger and lodged in the urethral process, the process should be removed either with a scalpel blade or sharp scissors. If the stones are lodged in the urethra, tranquilizers may help relax the muscles of the urethra and facilitate natural expulsion of the stone by the pressure of attempted urination. A catheter can be passed into the urethra to permit infusion of sterile saline in an attempt to enlarge the urethra and dislodge the offending stone. However, due to the presence of the urethral diverticulum (pouch like structure) in male goats, it is often difficult to advance the catheter all the way to the bladder. In severe cases and especially in valuable animals, relief of urinary obstruction will likely require more invasive treatment such as surgery. Consult your veterinarian as soon as possible. For some animals, salvage slaughter may be chosen but must be done prior to bladder rupture.

Dietary management is the key to controlling and preventing urinary stones. Ensure that animals have access to fresh, clean water at all times. Goats are finicky drinkers and will not drink dirty, tepid, algae-infested water, etc. Access to loose salt may help to increase water consumption and subsequent urination that keeps the bladder flushed. Maintain a Ca:P ratio of 2:1 to 2.5:1 in the diet. Increase amount of hay and ideally do not feed excess concentrates to goats. To acidify the urine, goats receiving high grain diets can be fed ammonium chloride up to 2% of the total ration (200 to 300 mg/kg diet/day) or ammonium sulfate at 0.6 to 0.7% of the ration. Ammonium chloride is unpalatable and higher levels will reduce intake. Alternately, feed ¼ lb/head/day of Bio-Chlor®, a highly palatable protein supplement with high levels of chlorine and sulfate that is used in the dairy cow industry. Urine should be acidic (pH of 5.5 to 6.5) within 1 week. Delay castration until puberty (3 to 4 months of age) if planning on keeping the animal as an adult or do not keep early castrated males older than 1 year. If delayed castration is selected, ensure that buck kids are separated from does of breeding age to prevent unwanted and premature natural breeding.

The Art of Great Goat Cheese

Mrs. Gianaclis Caldwell
Pholia Farm Creamery
Rogue River, OR

The Art of Great Goat Cheese

Gianaclis Caldwell

What is Cheesemaking?

- The removal of water from milk
  - The concentration of the nutrients
  - A way to preserve milk
  - A way to make delicious, valuable products
- Art and science combined
- A hobby or a business

Three Ways to Make Cheese

- Heat + acid = coagulation
  - Quick, simple cheeses like ricotta and paneer
  - Short shelf life
- Bacteria + time = Acid = coagulation
  - 12 – 24 hours
  - Fromage blanc, chevre, yogurt
  - Longer shelf life
- Rennet = coagulation
  - 4-6 hours plus pressing
  - Cheddar, gouda, most cheeses made
  - Longest shelf life

Art and Science – The Challenge

- Anyone can make cheese
  - It takes practice, skill, and intuition to make great cheese
- "Milk is always waiting to prove how unique it is"
  - Species
  - Seasonality
  - Breed
  - Feed
- "Milk was never meant to see the light of day"
  - Milk quality for cheesemaking
  - Grade AA milk for raw milk cheeses

Uniqueness of Goat Milk

- Fat differences
  - Higher content of the fatty acids (capric, caproic, and caprylic)in goat milk than in cows milk.
  - Easily damaged from pumping, bacteria, time
- Protein differences
  - Casein (protein) to whey-protein ratio is lower in goat's than in cows milk (70:30 vs 80:20)
  - Type of casein
- Seasonal differences
  - Components
  - Enzymes

Tools for the Goat Cheese Maker

- Choosing recipes that match the milk
  - DNA typing for casein
  - Breed averages for casein
  - Experience
- Adapting to the seasons
  - Components, SCC, Enzymes
  - Calcium chloride
- Mastering acid control
  - pH monitoring and goals
  - Washing curd

The Beautiful Goat - Cheese

- Understanding presentation
  - Color and contrast
  - Texture
  - Flavor
- The Story
  - Why goats
  - Not a replacement for cows
  - Breaking the paradigm

More

- *gianacliscaldwell.com*
- *pholiafarm.com*
- *On Facebook*

Parasite Management in Small Ruminants

Dr. Barry Whitworth, DVM
Area Food/Animal Quality and Health Specialist for Eastern Oklahoma
Oklahoma State University

Introduction

Gastrointestinal parasites are the most common cause of disease in small ruminants. With resistance to chemical dewormers so prevalent, controlling internal parasites is very difficult. Deworming in a sustainable way is even more of a challenge. Producers must use management and not rely solely on dewormers to stay on top of this problem.

The major nematodes (roundworms) encountered with small ruminants are:

Haemonchus contortus (Barber Pole worm) Abomasum
Teladorsagia (Ostertagia) circumcincta (Brown Stomach worm) Abomasum
Trichostrongylus columbriformis (Bankrupt Worm) Small Intestine

The acronym "HOT" representing *Haemonchus*, *Teladorsagia (Ostertagia)*, and *Trichostrongylus* are the most prevalent with *Haemonchus* being the most devastating.

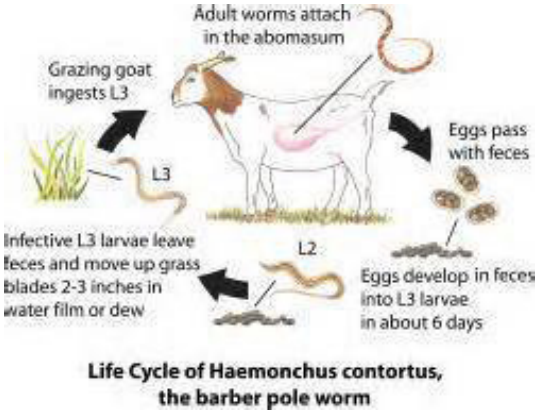
The following list is of nematodes that on occasion cause problems in small ruminants:

Trichostrongylus axei
Cooperia
Nematodirus
Oesphogostomum
Bunostomum
Trichuris ovis
Strongyloides papilosus

Parasite Live Cycle

Understanding the parasite life cycle will help producers better control them.

The lifecycle of the roundworms has three stages which are the development stage, prepatent or pre-adult stage, and the patent or adult stage. Development stage requires heat and humidity. Ideal temperature ranges from 70 to 80 degrees Fahrenheit (F), but any temperature above 45 degrees F will allow for development. Temperatures above 85 degrees F or below 45 degrees F will begin to hamper development. Humidity needs to be 80% or higher. The eggs are excreted in the fecal pellets. The egg hatches into the first stage larvae (L1). L1 molts (sheds cuticle or skin) to L2. L1 and L2 survive by eating bacteria in the feces and soil. L1 and L2 are susceptible to dying in cold, hot, and dry conditions. L2 molts to L3 which has a protective sheath and is less susceptible to the elements. L3 is the infective form of the parasite. L3 must have moisture to free itself from the fecal pellet. Once free, it rides a wave of water on to a blade of grass up to a height of 2 to 3 inches. Once ingested, this begins the prepatent or pre-adult stage. Two molts take place during this stage (L3 to L4 and L4 to L5). If conditions are not favorable for survivability of offspring, L4 will go into an arrested development stage (hypobiosis) for a period of time. The patent or adult stage is the mature breeding adult.



Life Cycle of Haemonchus contortus, the barber pole worm

Courtesy of www.acsrpc

By understanding the parasite lifecycle, a producer is aware of the environmental conditions that favor the production of parasites. The producer now can make management decisions to try to combat the parasites.

DISEASE

The roundworms attach and live in certain locations in the digestive tract. *Haemonchus* and *Teladorsagia* live in the abomasum. *Trichostrongylus* survive in the proximal part of the small intestine. Clinical signs of disease are associate with damage done at the site in the digestive tract. The damage done to the intestinal tract results in an inability to break down nutrients and failure to absorb nutrients. This results in diarrhea and poor performance. Haemonchus is a blood sucker which causes in anemia. Anemia will manifest as weakness and poor performance and death if severe enough.

DEWORMERS

Producers have three approved chemical dewormers to use in goats. Fenbendazole (Safeguard, Panacur), Morantel (Rumantel, Positive Pellet), and Albendazole (Valbazen). It should be noted that Albendazole is only approved for the control of adult liver flukes in goats. Using Albendazole for control of other internal parasites or using other chemical dewormers not approved for goats would be considered an extra label use. This would require a prescription from a veterinarian. A prescription may only be issued with a proper veterinary-client-patient-relationship (VCPR).

RESISTANCE

Unfortunately, the misuse of chemical dewormers has led to parasite resistance in most goat flocks. This is a worldwide problem and is the biggest threat to the goat industry.

MONITORING

Producers need to have some way of monitoring the parasite burdens in their flocks. A fecal egg count (FEC) is a good way of accessing parasite burdens. Another monitoring device is checking eye scores (FAMACHA). FAMACHA checks for anemia by observing the eye for paleness. The producer has to remember that it only checks for Haemonchus and no other roundworms. The five-point-check uses FAMACHA and 4 other observations to access parasite burdens. The four other observations are body condition score (BCS), dag score (fecal soiling of tail), hair coat (appearance), and jaw (bottle jaw). By adding the other four observation to the FAMACHA score, the producer has a better chance of not missing other roundworms that cause problems in goats.

ALTERNATIVE TO CHEMICAL DEWORMERS

Much research has been performed on other forms of dewormers. Tannin-rich forage have been used to control *Haemonchus*. Nematode trapping fungus has been used in Europe but a good delivery system has not been established. Copper oxide wire particles (COWP) are being used and do good job on Haemonchus. Vaccinations against roundworms is being researched in Australia. All of these alternatives are available or may be in the future.

MANAGEMENT

In the future, parasite control will need to rely more on management and the careful use of chemical dewormers. Some of the following management strategies will aid in the control of parasites:

- Keep good records to find those problem goats
- Stocking rates of 2 head per acre
- Good nutrition strengthens the immune system
- Monitor worm burdens (FEC, FAMACHA, Five-point-check)
- Rotational grazing provide 6 weeks rest between grazing
- Proper use of chemical dewormers
- Provide browse
- Haymaking and tillage
- Tannin-rich forage
- Graze with cattle or horses
- Do not graze to close to the grown

CONCLUSION

Gastrointestinal parasites will continue to be a major problem for goat producers in the future. Producers will need to rely more on management and less on chemical dewormers to control parasites in the future.

Basic Goat Husbandry

Mr. Jerry Hayes

Langston University

Introduction

Every goat producer is confronted with simple management tasks such as:

- telling the age of a goat.
- animal identification.
- hoof trimming.
- castration.
- body condition score.

Ageing Goats

Number and arrangement of teeth

Estimating the age of goats is done by looking at the teeth. The arrangement of teeth on the jaw, from front to back, is incisors, canines, premolars, and molars. Ruminants only have incisors on the bottom jaw. The top jaw has a thick layer of tissue called the "dental pad." Ruminants do not have canine teeth and this open space along the jaw is useful when needing to insert one's fingers to pry open a goat's mouth for drenching, tubing, or other purposes.

Mature goats will have a total of 8 incisors (4 pair), 6 premolars (3 pair), and 6 molars (3 pair). It is customary when ageing goats by looking at their teeth to discuss teeth in terms of "pairs" rather than in total.

Telling the age of goats

Young goats have deciduous or "baby" teeth that are replaced by permanent teeth at a later age. Kids are generally born with the central pair of deciduous incisors (incisors erupt from the center outward) with the second pair erupting at 1 to 2 weeks, third pair at 2 to 3 weeks and the fourth pair erupting at 3 to 4 weeks of age. Kids also will develop 3 pairs of deciduous premolars but no molars.

As kids age, the deciduous incisors are replaced by permanent incisors, again from the center pair outward. The middle pair of deciduous incisors will be replaced sometime around 12 months. The second, third, and fourth pairs are replaced at roughly yearly intervals at 1.5 to 2 years, 2.5 to 3 years, and 3.5 to 4 years of age. Thus, a goat with 1 pair of permanent incisors is roughly 1 year of age, 2 pair of permanent incisors is 2 years of age, and so on. At four years of age when all permanent teeth are in place, the animal may be referred to as having a "full mouth."

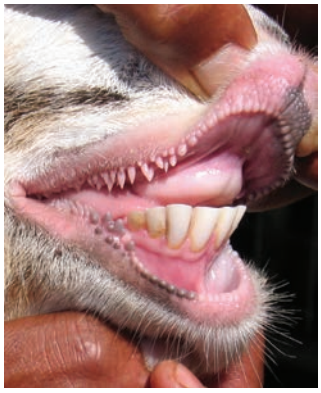
Ageing goats over 4 years of age is more difficult. Over time, the gums recede and teeth appear elongated. Teeth may also become broken or worn down from grazing and foraging. Animals that have broken or lost teeth are often referred to as "broken mouthed." "Undershot" is a condition in which the lower jaw is longer than the upper jaw whereas "overshot" is the opposite. Malformed teeth can affect the ability to graze and consume nutrients.

Animal Identification

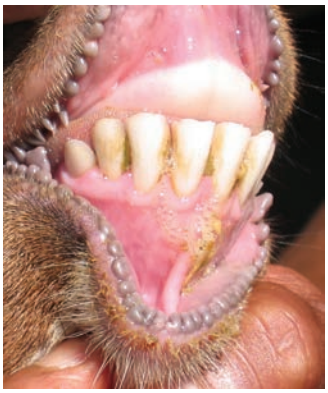
The proper identification of animals is essential. Proper identification enables the producer to keep comprehensive records for milk production, reproduction, health problems, and management practices. The efficient maintenance of this information requires a permanent identification system. Several systems of identification

Kid (< 1 year old).

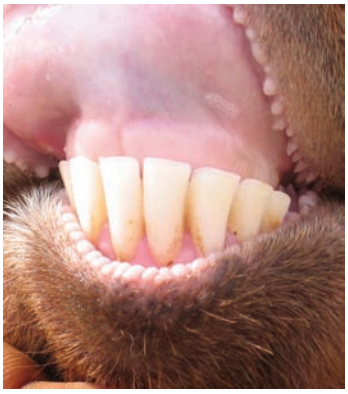
1 year old.



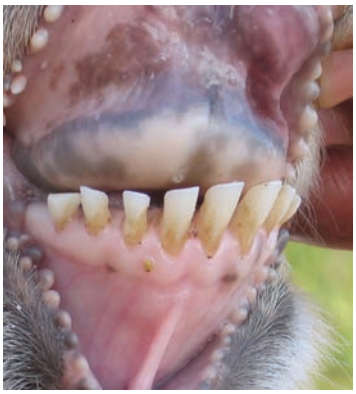
2 year old.



3 year old.



4 year old.



8½ year old.

Broken mouth.

may be used. The system selected will depend upon the size of the herd, the environmental conditions, the primary purpose for identifying individual animals, and regulations of federal government and breed-governing bodies. There are two basic types of identification: permanent and non-permanent. Permanent identification includes tattooing, ear notches or microchips. Non-permanent identification includes paint, chalk and tags.

Tattooing is permanent identification.

Tattooing

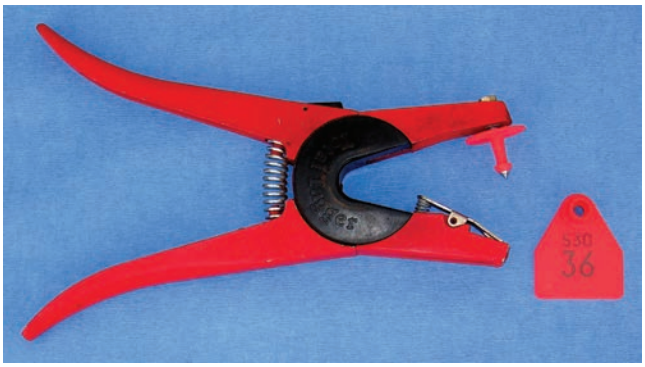
Tattooing is one method of identification that is permanent if properly done. However, it is not easily viewed and may require another complementary method of identification, such as an ear tag, that is visible from short distances. Tattooing involves making needlelike projections in the goat's skin. The tattoo ink is forced into the punctures and remains visible after the puncture wounds heal. It is a good idea to sterilize the equipment and clean the goat's ears to help prevent the spread of some blood-borne diseases. On older animals some tattoos may be difficult to read; holding a bright light source such as a flashlight behind the ear when reading may make the tattoo more legible.

To tattoo an animal, begin by inserting the proper digits into the tattoo pliers. Check for correctness by pressing the pliers onto a piece of paper or cardboard. Secure the goat with a halter or head gate and clean the ear to be tattooed with alcohol. Don't use water for cleaning as it could enter the ear canal and result in infection. Clip or trim any excessive hair present. A generous amount of ink should be applied to the center of the ear between the ribs of cartilage (green ink should be used for dark ears). Position the tattooing pliers between the ribs of cartilage and squeeze firmly forcing the needle-like numbers into the ear tissue. Care should be taken in removing the tattoo pliers from the ear to not scratch the tattooed area. Ink should be reapplied and rubbed into the tattoo. Using an old toothbrush will assist in pushing the ink into the punctures. Afterwards, the equipment and individual tattoo pieces should be cleaned and sprayed with alcohol.

Tattoo pliers and ink.

Ear tags

Ear tags are an easy way to identify each goat in the herd. Unlike tattoos, they can be read without actually having to catch the goat. Unfortunately, unlike tattoos, they can break or be ripped out of the goat's ear. Some producers use two ear tags because of this problem. Goats that are shipped are required to have a scrapie ear tag and these can be used for animal identification. Before putting in the ear tag, it is important to record what ear tag number is assigned to the goat. Ensure the ear tags are inserted between the cartilage ribs on the ears. The producer whose goats have been ear tagged will have an easy-to-read identification number which can be used for herd records.



Ear tag pliers and plastic ear tag.

Microchip

The insertion of a microchip in the base of the ear or tail web of the animal is another form of permanent identification. After insertion, the microchip should be scanned to ensure that it is reading correctly. Care should be taken in recording the microchip number against the tag number of the animal to ensure the integrity of the microchip identification. Exhibitors are required to provide their own reader at many livestock shows.

Ear notching

Ear notching is commonly practiced in identifying goats. It has the advantage of being visible from a distance allowing identification without the necessity of catching the animal and can accommodate numbers up to 9999. Ear notching pliers are used to put "V"-shaped notches in the edges of the ear and a hole punch is used to punch holes in the middle of the ear, if necessary. The animal is restrained and notches and holes may be treated with iodine. As this process results in bleeding, the notching pliers should be disinfected between animals to prevent transmission of any blood-borne diseases. The notching system used is that begun in the Angora industry and adapted for meat goats. However, some producers may use alternate numbering system.

Ear notching pliers.

Example of ear notching.

Generally, notches on the goat's left ear mean: 10 (top), 1 (bottom), 100 (end); and 1,000 (center hole). On the goat's right ear, notch values are: 30 (top), 3 (bottom), 300 (end); and 3,000 (center hole). Thus, a goat with the number 135 would look as follows: 1 notch on end of left ear (100); 1 notch on top of right ear (30), 2 notches on bottom of left ear (2); 1 notch on bottom of right ear (3) with a total value equaling 135.

Hoof Trimming

Hoof trimming goats is a simple task that can be easily learned. The goal of hoof trimming is to allow your goat to walk normally. The lack of trimming, or improper trimming, can lead to foot and leg problems. The amount of time between trimmings depends on many factors, such as type of terrain, the goat's age, level of activity, nutritional level, and genetics. In environmental areas where natural wearing does not occur, producers need to trim hooves on a regular basis. Goats raised in relative confinement and on small acreages may require more frequent trimmings than goats raised in vast pastures. Generally, foot trimming should be done as needed.

Overgrown hoof.

Proper hoof trimming technique.

Each hoof of the goat has two toes. The wall of each toe tends to overgrow and must be trimmed. The heels of the hoof and the dewclaws (especially on an older goat) may also develop extra tissue that needs to be trimmed. Most producers use foot shears or hoof trimmers. Other tools used may include a hoof knife with sharp edges, a pocketknife or a rasp. Pocketknives or a hoof knife can be dangerous to use for both operator and animal as goats may jump. Some people like to use hoof nippers to cut off the tip of the hoof or file it down with rasps.

Initially, use the point of the hoof trimmers to remove any dirt from the outside and the bottom of the hoof. The front of badly overgrown hooves can then be removed. The sides of the hoof should be cut back even with the sole of the foot. Continue to trim the sides around one toe and repeat the process on the other toe. Trim the frog and heel flat until the sole is parallel to the hairline of the pastern. Trim off thin slices. A good rule to follow is to stop when you see pink. If blood appears stop trimming and apply blood stop powder and finish the trimming at a later time.

Castration

All young bucklings that are not to be evaluated as replacement bucks should be castrated. For some producers, this means castrating between the ages of 2 and 4 weeks. Castration of young animals produces less stress in the animals and there is less chance of complications occurring due to the procedure. Young bucks are capable of breeding females as early as 4 to 5 months of age. If a decision is made to not castrate young males, management practices should be in place to prevent unwanted matings.

Three common ways to castrate bucks is through the use of an elastrator that places a rubber ring around the scrotum, a Burdizzo® clamp that crushes the spermatic cord, and the use of a knife to cut the scrotum and remove the testicles.

Elastrator with rubber bands.

Elastrator

Using an elastrator is an inexpensive, quick, and bloodless method of castration. It involves putting a heavy rubber ring around the scrotum near the body. The ring stops blood circulation to the scrotum and testicles and these will dry, shrivel, and slough off in 10 to 14 days. It must be done while the scrotum is still very small, i.e., from three days to three weeks of age depending on breed size, before the scrotal muscles and associated tissues develop.

The rubber ring is first put on the prongs of the elastrator (a pliers-like device that when squeezed will open the ring allowing the scrotum and testes to pass through). The male

kid is restrained and the scrotum is passed through the open ring with the prongs of the elastrator facing the kid's body. The producer must feel the scrotum to ensure that both testicles are in the scrotum below the ring. The rubber ring is positioned close to the body and then slipped off the elastrator prongs. Care must be taken to not apply too close to the body where one runs the risk of trapping the urethra

Body Condition Score

Every goat producer has animals that are either too thin (under-conditioned) or too fat (over-conditioned). Failure to recognize these animals and take corrective actions will cost dearly in terms of decreased fertility, increased disease or internal parasite incidence, decreased milk production, and increased operating costs. Thus, goats need to be maintained with a moderate amount of body condition. When overall body condition starts to decrease in the herd, it is a sign that managerial intervention is needed such as supplemental feeding, deworming, pasture rotation, etc. Conversely, when overall body condition starts to increase in the herd, it is a sign that the producer should reduce supplemental feeding. Ignoring an animal's body condition and waiting to intervene until goats become either too thin or too fat may result in production and(or) animal losses or decreased profits from overfeeding. Therefore, producers need to develop skills in assessing body condition of their goats so that a desired moderate body condition can be maintained.

Body condition score (BCS) has been shown to be an important practical tool in assessing the body condition of cattle, sheep, and goats because BCS is the best simple indicator of available fat reserves which can be used by the animal in periods of high energy demand, stress, or suboptimal nutrition.

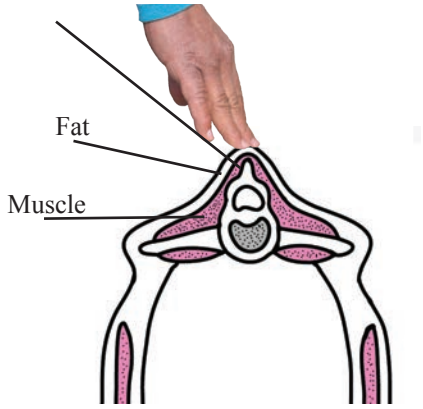
Scoring is performed in goats using a BCS ranging from 1.0 to 5.0, with 0.5 increments. Examples of BCS of 1.0, 2.0, 3.0, 4.0, and 5.0 are given using photographs and written descriptions. Assigning the 0.5 score increment is done when the animal being evaluated is intermediate to the BCS described. A BCS of 1.0 is an extremely thin goat with no fat reserves and a BCS of 5.0 is a very over-conditioned (obese) goat. In most cases, healthy goats should have a BCS of 2.5 to 4.0. BCS of 1.0 , 1.5, or 2.0 indicate a management or health problem. A BCS of 4.5 or 5 is almost never observed in goats under normal management conditions; however, these BCS can sometimes be observed in show goats.

It is important to note that BCS cannot be assigned by simply looking at an animal. Instead, the animal must be touched and felt. The first body area to feel in determining BCS is the lumbar area, which is the area of the back behind the ribs containing the loin. Scoring in this area is based on determining the amount of muscle and fat over and around the vertebrae. Lumbar vertebrae have a vertical protrusion (spinous process) and two horizontal protrusions (transverse process). Both processes are used in determining BCS. You should run your hand over this area and try to grasp these processes with your fingertips and hand. The second body area to feel is the fat covering on the sternum (breastbone). Scoring in this area is based upon the amount of fat that can be pinched. A third area is the rib cage and fat cover on the ribs and intercostal (between ribs) spaces.

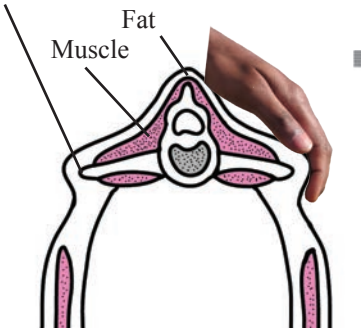
With practice, evaluating the BCS of an animal will only take about 10-15 seconds. By adding BCS as a regular part of your management program, you can more effectively monitor your feeding and herd health program for a healthy and productive herd.

Lumbar Region

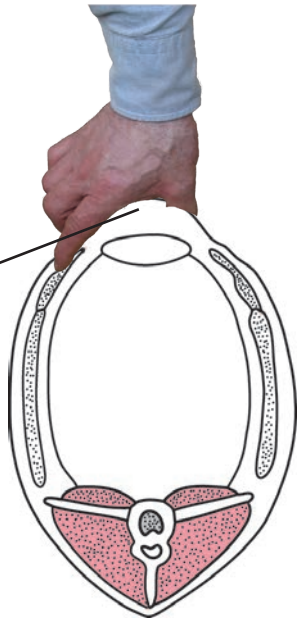
Spinous process



Transverse process



Sternum



BCS 1.0

Visual aspect of the goat: Emaciated and weak animal, the backbone is highly visible and forms a continuous ridge. The flank is hollow. Ribs are clearly visible. There is no fat cover and fingers easily penetrate into intercostal spaces (between ribs).

The spinous process of the lumbar vertebrae can be grasped easily between the thumb and forefinger; the spinous process is rough, prominent, and distinct giving a saw-tooth appearance. Very little muscle and no fat can be felt between the skin and bone. There is a deep depression in the transition from the spinous to transverse process.

The hand can easily grasp the transverse processes of the lumbar vertebrae which are very prominent. Clearly half of the length of the transverse process is discernible.

Diagrams adapted from Edmonson, et. al, 1989. J. Dairy Science, 72:68-78. Used with permission from the American Dairy Science Association.

Sternal fat can be easily grasped between thumb and fingers and moved from side to side. The cartilage and joints joining ribs and sternum are easily felt.

BCS 2.0

Visual aspect of the goat: Slightly raw-boned, the backbone is still visible with a continuous ridge. Some ribs can be seen and there is a small amount of fat cover. Ribs are still felt. Intercostal spaces are smooth but can still be penetrated.

The spinous process of the lumbar vertebrae is evident and can still be grasped between the thumb and forefinger; however, a muscle mass can be felt between the skin and bone. There is an obvious depression in the transition from the spinous to transverse process.

The hand can grasp the transverse process but the outline of the transverse process is difficult to see. About one-third to one-half of the length of the transverse process is discernible.

Sternal fat is wider and thicker but can still be grasped and lifted by the thumb and forefinger. The fat layer can still be moved slightly from side to side. Joints are less evident.

BCS 3.0

Visual aspect of the goat: The backbone is not prominent. Ribs are barely discernible; an even layer of fat covers them. Intercostal spaces are felt using pressure.

The spinous process of the lumbar vertebrae cannot be easily grasped because the tissue layer covering the vertebrae is thick. When running a finger over the spinous process, a slight hollow is felt. There is a smooth slope in the transition from the spinous to transverse process.

The outline of the transverse process of the lumbar vertebrae is slightly discernible. Less than one-quarter of the length of the transverse process is discernible.

Sternal fat is wide and thick. It can still be grasped but has very little movement. Joints joining cartilage and ribs are barely felt.

BCS 4.0

Visual aspect of the goat: The backbone cannot be seen. Ribs are not seen. The side of the animal is sleek in appearance.

It is impossible to grasp the spinous process of the lumbar vertebrae, which is wrapped in a thick layer of muscle and fat. The spinous process forms a continuous line. There is a rounded transition from the spinous to transverse process.

The outline of the transverse process of the lumbar vertebrae is no longer discernible. The transverse process forms a smooth, rounded edge, with no individual vertebrae discernible.

Sternal fat is difficult to grasp because of its width and depth. It cannot be moved from side to side.

BCS 5.0

Visual aspect of the goat: The backbone is buried in fat. Ribs are not visible. The rib cage is covered with excessive fat.

The thickness of the muscle and fat is so great that reference marks on the spinous process are lost. The spinous process forms a depression along the backbone and there is a bulging transition from the spinous to transverse process.

The thickness of the muscle and fat is so great that reference marks on the transverse process are also lost. It is impossible to grasp the transverse process.

The sternal fat now extends and covers the sternum, joining fat covering cartilage and ribs. It cannot be grasped.

Meat Goat Nutrition

Dr. Steve Hart

Langston University

Introduction

Proper nutrition is essential for the health and productivity of all animals and is the basis of successful production systems. A well planned and executed preventive health program cannot overcome problems that are created by poor nutrition. Nor can advanced reproductive technologies overcome nutritional limitations of reproduction. Therefore, nutrition of the goat is of paramount importance for successful goat production. Nutrition is the science of providing nutrients to animals in adequate amounts and in forms that the animals will consume. For sustainable and profitable production, these nutrients must also be provided in a cost-effective manner.

The ruminant stomach

Goats are ruminants, animals with a four-compartment stomach, as are cattle, sheep, and deer. The compartments are the reticulum, rumen, omasum, and abomasum (true stomach). Monogastric or simple-stomached animals such as humans, dogs, and cats consume food that undergoes acidic breakdown in the stomach and enzymatic digestion in the small intestine where most nutrients are absorbed. In ruminants, feed first undergoes microbial digestion in the reticulum and rumen (together often called the reticulo-rumen) prior to acidic digestion in the abomasum and enzymatic digestion and nutrient absorption in the small intestine. It is the microbial digestion in the reticulo-rumen that enables ruminants to consume and utilize grass, hay, leaves, browse, etc.

The reticulum and rumen form a large fermentation vat that contains microorganisms, mainly bacteria, that breakdown and digest feedstuffs, including the fibrous component of grass, forbs, and browse that cannot be digested by monogastric animals. Some of the breakdown products produced through digestion of feed by bacteria are absorbed by the animal through the rumen wall and can supply a large part of the energy needs. The rest of the byproducts of digestion, undigested feed, and ruminal microorganisms flow out of the reticulo-rumen into the omasum where large feed particles are trapped for further digestion and water is reabsorbed. Material then flows into the abomasum where acidic digestion takes place and then to the small intestine for further enzymatic digestion and nutrient absorption.

The rumen provides several advantages to the goat in addition to digestion of dietary fiber. The bacteria in the rumen are capable of synthesizing all B vitamins needed. Bacteria can also synthesize protein from nitrogen recycled in the body, which may be advantageous on low protein diets. For proper ruminal function, goats require a certain level of fiber (measured as crude fiber, acid detergent fiber, or neutral detergent fiber) in the diet. Goats have bacteria in the rumen that can detoxify antinutritional factors, such as tannins. This enables goats to better utilize feedstuffs containing high tannin levels such as those found in browse. There are very few situations in which a goat will not consume adequate fiber, but one is when a very high grain diet is being fed. Inadequate fiber consumption can then lead to several disease conditions. The most important disease condition is acidosis or an extremely low pH in the rumen, causing decreased feed consumption.

When ruminants are born, the first three compartments of the stomach are underdeveloped and the stomach functions similar to that of a monogastric animal. This enables absorption of antibodies in colostrum and efficient utilization of nutrients in milk. As the young ruminant consumes solid feed, especially high in

fiber, and the microbial population is established, the rumen is stimulated to develop. The rumen must have an acceptable degree of development for successful weaning.

The greatest asset of goats is the ability and tendency to utilize woody plants and weeds, not typically consumed by other species of animals (e.g., cattle and sheep), converting them into a saleable product. Therefore, these plant species can be inexpensive sources of nutrients and make for a very profitable goat enterprise. Goats typically consume a number of different plant species in any one day and can utilize some poisonous plants because they do not consume enough to be toxic. Similarly, goats are believed to have a relatively high ability to detoxify absorbed anti-nutritional factors. Goats are more resistant to bloating than other ruminants, and after a brief adaptation may graze alfalfa without bloating.

Nutrients

Nutrients are defined as substances that aid in the support of life. The six classes of nutrients include protein, carbohydrate, fat, vitamins, minerals, and water. Nutrients are often classified as organic (carbon-containing) or inorganic (minerals).

Energy is not considered a nutrient, but can be derived from the breakdown of several nutrients including fat, protein, and both simple and complex carbohydrates. Energy is required to propel the biochemical processes that are necessary to sustain life. A deficiency of energy will cause weight loss, low productivity, and ultimate death of an animal. An oversupply of energy will usually result in excessive fatness, which is also unhealthy. A simple unit of measurement of energy is pounds of total digestible nutrients (TDN). A lb of TDN, equivalent to a pound of digested carbohydrate, equals 2,000 Kilocalories (or Calories as used in human nutrition) of digestible energy. There are a number of other measures of energy used, but they are less easily understood.

Water

Water is an essential nutrient for all animals and is sometimes overlooked. While goats require less water than cattle, they do need water and require additional quantities when lactating or coping with hot weather. A 110 lb goat will require 1 to 3 gallons of water per day depending upon diet, intake, and weather, toward the lower range in winter and toward the upper range in the hottest days of summer. A lactating goat will require an additional 1 quart of water for every 1 pint of milk produced. If a goat is producing 5 pints of milk at peak lactation while raising twins, 2.5 gallons of water are required each day. If goats are eating green material, a substantial part of their water requirement can be met by water contained in the plant material. However, if dry feed such as hay is consumed, water must be supplied to meet the requirement.

Water should be kept clean to encourage intake. This usually involves regular cleaning of the waterer. It is important that the area around the waterer not be muddy, as this is a good environment to spread foot rot and internal parasites. Placing some rock or gravel around the waterer can help keep feet dry and reduce disease problems. Water cleanliness is especially important for bucks on high grain diets. Their water needs to be shaded in summer and warm in the winter to encourage intake and reduce the risk of urinary calculi.

Carbohydrates

Carbohydrates usually provide the majority of energy to goats. Carbohydrates can be classified as simple, such as sugars (easily identified by their sweet taste; maybe 1, 2, or 3 sugar molecules linked together), or complex, such as starch (found in grains) or cellulose (i.e., fiber). Grass, forb, and browse plant species generally contain high levels of cellulose, which must be digested by rumen bacteria to provide energy.

Cellulose is often referred to as fiber, although the term fiber also pertains to other substances such as hemicellulose and lignin. Fiber in young plants may be highly digestible and provide a high level of energy, but fiber in older, mature plants is often poorly digested and may only provide half the energy of other

carbohydrates. Fiber in the diet may be characterized chemically in several ways, such as crude fiber (CF), acid detergent fiber (ADF), and neutral detergent fiber (NDF). These abbreviations are used in hay analysis and may appear on feed tags. In general, the lower the fiber level, the higher the level of digestible energy. However, a certain minimum fiber level is required for healthy rumen function.

Goats do not adapt as easily to high concentrate diets as cattle and sheep and are more likely to get acidosis, founder, urinary calculi, and enterotoxemia. To avoid these problems, very gradually increase the concentrate level in the diet when placing goats on high concentrate diets and maintain a minimum of 12% crude fiber in the diet or about half of the diet as grass, browse, or hay. Goats are typically not feed efficient, except for some rapidly growing Boer goats, and may require 7 lbs or more of feed per pound of gain. Also, one must be very alert for health problems with goats on high grain diets.

Fats

Fats, also called lipids, are very high in energy, providing more than twice the energy of carbohydrate on a weight basis. The fat content of ruminant diets is generally low, as plants have a low fat content. Plant waxes are fats that goats consume as they graze and browse, but they are not digested. Fat may be added to diets to increase the energy content. However, high levels of added fat depress fiber digestion unless treated to be inactive in the rumen. These fat sources are termed "bypass" and may be used in dairy goat diets but are generally not used in meat goat diets.

Protein

Protein is composed of building blocks called amino acids that the body uses to produce all of the different proteins required for growth, production, and maintenance. Protein is required in the diet for accumulation of new body mass (growth) and for replacing protein lost by normal wear and tear.

Ruminant animals are usually fed supplemental protein to make up for dietary shortfalls. In the rumen, bacteria degrade much of the consumed protein and use the amino acids to form bacterial protein. Bacteria can also form protein from nonprotein sources such as urea and, if provided with sufficient energy, can form significant quantities of protein. To prevent breakdown and digestion by ruminal bacteria, some protein sources are protected from degradation by coating or other means. Some natural proteins are also resistant to ruminal degradation by bacteria. These types of proteins are referred to as "bypass protein" as they bypass digestion in the rumen. Other common terms for bypass protein are "ruminal escape" and "rumen undegraded." Bypass protein sources are very important in dairy cow nutrition, but have lesser significance in most meat goat production systems.

Urea is the main nonprotein nitrogen source fed to ruminants. However, goats are not commonly fed urea as frequently as cattle. This may be because goats are more subject to urea toxicity than cattle. Goats appear more efficient than other species at recycling nitrogen in the body to the rumen where it can be used to form microbial protein, given that sufficient energy is available. This recycling of urea to the rumen helps to reduce the amount of protein required in the diet. When animals are consuming a low quality forage, a grain supplement may also improve protein status by providing additional energy for protein synthesis by ruminal microbes.

Vitamins

Vitamins function as critical chemicals in the body's metabolic machinery and function as co-factors in many metabolic processes. A deficiency of a vitamin will slow or block the metabolic process in which that vitamin is involved, resulting in deficiency symptoms. Vitamins are divided into those that are fat soluble (i.e., A, D, E, and K) and those that are water soluble (i.e., B vitamins and C).

The bacteria in the rumen of the goat can synthesize adequate amounts of the water soluble vitamins. Thiamine, or vitamin B1, may become deficient under some conditions (e.g., feeding a high concentrate

diet, especially those with high sulfur which may come from a high level of molasses) and cause the disease polioencephalomalacia. Sometimes, however there are other unexplained causes of polioencephalomalacia. Another situation that could lead to thiamine deficiency is improper feeding of the coccidiostat Corid®. The coccidiostat ties up thiamine, making the coccidia unable to reproduce. Feeding Corid® longer or at higher levels than recommended could lead to polioencephalomalacia. Polioencephalomalacia is a nervous disorder where the animal becomes blind, depressed, presses with his head, and the pupil slit in the eyes becomes up and down rather than the normal side to side profile. Treatment requires immediate injection of large quantities of thiamine.

Fat soluble vitamins must be supplied to the goat because the body cannot directly make them. The recommended levels of vitamins in formulated feed is 5,000 IU (international units, a measure of the potency of vitamins) of vitamin A per lb, 2,000 IU/lb of vitamin D, and 80 IU/lb of Vitamin E. The liver can store significant amounts of the fat soluble vitamins.

Vitamin A can be synthesized from carotene, the pigment that gives grass and hay their green color. As long as sufficient green feed is consumed, vitamin A intake will be adequate. Vitamin A is necessary for normal epithelium (skin) development and vision. A deficiency of vitamin A causes many symptoms, including tearing of the eyes, diarrhea, susceptibility to respiratory infection, and reproduction problems. Vitamin A is often supplied to animals not consuming green forage such as in winter months. Many mineral and vitamin supplements contain vitamin A.

Vitamin D is called the sunshine vitamin because animals can synthesize the vitamin with the help of the sun. Ultraviolet light in sunshine converts pre-vitamin D found in the skin to a pro-vitamin D form that is used by the animals. Usually, even limited sunlight exposure is adequate to provide a day's supply of vitamin D. Sun-cured hay contains Vitamin D. Vitamin D is necessary for calcium absorption and metabolism by the body. A deficiency of vitamin D, called rickets, results in lameness, weak bones, and bowed and crooked legs. The liver is the main Vitamin D storage site in the body. Vitamin D is normally present in mineral supplements and often added to complete feeds.

Vitamin E functions as an antioxidant in conjunction with the mineral selenium. The requirements for one can be partially met by the other. Thus, vitamin E is very important in areas with marginal or deficient levels of selenium. A common vitamin E deficiency disease, particularly in newborn or young animals, is white muscle disease, where white spots are seen in the heart and skeletal muscle due to oxidation damage. A marginal deficiency of vitamin E can depress the immune system and cause reproductive failure. Green grass and green sun-cured hay have high levels of vitamin E. Most mineral supplements and complete feeds contain vitamin E, especially in areas that are deficient in selenium. Vitamin E is expensive and minimal supplemental levels are used in contrast to vitamins A and D that are less expensive and often included at generous levels.

Vitamin K is technically required by animals and functions in the clotting of blood. Vitamin K is produced by bacteria in the lower digestive tract and absorbed. Generally, goats do not need to be supplemented with vitamin K.

Minerals

The inorganic nutrients are called minerals. Minerals are further subdivided into macrominerals, those required at 0.1% or more in the diet (macro means large), and microminerals, those required at the part per million (ppm) level (micro means small). A ppm is the weight of a paperclip in a thousand pounds of feed. A hundred ppm is equal to 1.6 ounces in a thousand pounds of feed. Macrominerals include calcium, phosphorus, sodium, potassium, chloride, sulfur, and magnesium. Microminerals include iron, copper, cobalt, manganese, zinc, iodine, selenium, molybdenum, and others. Minerals function in many ways in the body. Some such as

calcium and phosphorus are major structural components of bones and teeth, as well as having other functions. Other minerals facilitate nerve functioning or fulfill a role as electrolytes. The mineral requirements for goats are not as well known as they are for other livestock species and have often been extrapolated from sheep or cattle requirements due to a lack of studies in goats. As such, mineral recommendations for goats often have a wide range because of lack of accurate goat-specific information.

Macrominerals

The macrominerals are listed below, followed by the abbreviation, normal dietary range, function, deficiency symptoms, and major dietary sources.

Calcium (Ca) 0.3 - 0.8%

The major biological function of calcium is for bones. Bones contain 99% of the calcium in body. Calcium is also necessary for muscle contraction, nerve conduction, and blood clotting. The main deficiency symptoms are seen in the skeletal system. Bones can become soft and weak and may be deformed resulting in lameness. This condition is called rickets or osteomalacia. Vitamin D deficiency causes similar symptoms due to the role of vitamin D in the absorption and metabolism of calcium. Calcium is relatively high in milk and lactating goats need adequate levels of calcium for milk production. Does can get hypocalcemia (milk fever) while lactating due to a metabolic disorder which results in a shortage of calcium in the blood due to calcium being used for milk production. Urinary calculi is a condition brought about in part by an imbalance in the calcium to phosphorus ratio in the diet. Generally, about twice as much calcium as phosphorus should be in the diet of ruminant animals. An excess of calcium can cause abnormal bone growth. Major common dietary sources of calcium include forages, limestone and dicalcium phosphate.

Phosphorus (P) 0.25 - 0.4%

Approximately 80% of the body's phosphorus is found in bones, with the remainder in the blood and other tissues. In addition to skeletal structural functions, phosphorus is essential in energy metabolism, acid-base balance, and is a constituent of enzymes and genetic material. The major symptoms of phosphorus deficiency include reduced growth, listlessness, unkempt appearance, depressed fertility, pica (depraved appetite-eating wood, rocks and bones), and decreased serum phosphorus. Phosphorus is the most commonly encountered mineral deficiency and also the most expensive macromineral. Sources of phosphorus include protein supplements, cereal byproducts, mineral supplements, and dicalcium phosphate.

Sodium (Na) 0.2%

Potassium (K) 0.8 - 2.0%

Chloride (Cl) 0.2%

All three of these minerals function as electrolytes in the body. Electrolytes are mineral ions, carrying a positive or negative charge that the body uses for osmotic balance, pH balance, and water movement. They are also essential in transmission of nerve impulses. These minerals are highly water soluble and are easily lost with diarrhea. Electrolyte solutions used to treat animals with diarrhea contain all three of these minerals. A deficiency of potassium could occur on high concentrate diets, with symptoms including poor appetite, urinary calculi, body stiffness progressing from front to rear, and pica (depraved appetite as described above). A deficiency of chloride depresses growth. A deficiency of sodium causes reduced growth and feed efficiency. Salt provides both sodium and chloride. Most forages have adequate levels of potassium.

Sulfur (S) 0.2 - 0.32%

The major biological function of sulfur is as a component of sulfur-containing amino acids. Therefore, sulfur is important in protein synthesis, milk and hair production, enzymes, hormones, hemoglobin, and connective tissue, and is a component of the vitamins biotin and thiamine. The major deficiency symptoms include poor

animal performance, hair loss, excessive salivation, tearing of eyes, and weakness. Major source of sulfur is protein which contains sulfur as a component of some of the amino acids. Therefore, sulfur is important in diets where nonprotein nitrogen (e.g., urea) is used to substitute for some protein. Sulfur-containing mineral blocks are often used for control of external parasites in goats. Excessive sulfur in high concentrate diets can contribute to polioencephalomalacia as discussed for the water soluble vitamin thiamine.

Magnesium (Mg) 0.18 - 0.4%

Magnesium is found in bones (60 to 70% of that in the body), liver, muscle, and blood. It is required for normal skeletal development, and nervous and muscular system functions, as well as for enzyme systems. It is also closely associated with metabolism of calcium and phosphorus. In ruminants, a major magnesium deficiency disease is grass tetany, often seen in animals grazing fast-growing, lush, cool season pastures. Affected animals have low blood magnesium levels, exhibit a loss of appetite, are excitable, stagger, have convulsions, and may die. High fertilization rates, cool temperatures, and high levels of plant potassium and(or) rumen ammonia may contribute to the disease. A major supplemental source of magnesium is magnesium oxide, which is often supplemented on winter wheat pasture and mixed with a protein source to encourage consumption.

Micro or trace elements

The first level after the mineral name is what is thought to be the minimum requirement in the diet, while the second is the value above which the element can become toxic. Most supplemental trace minerals are provided by trace mineralized salt or mineral mixes that are designed to provide 25 to 50% of requirements. This is adequate if the animal's diet is marginal in a mineral but inadequate if that mineral is severely deficient. Unless a documented deficiency exists, it is best not to provide 100% of a trace mineral, because an excess of one mineral may depress the absorption of another creating a deficiency. Excess supplementation of some minerals can cause toxicity problems, especially with copper and selenium.

Iron (Fe) 35 - 500 ppm

The major function of iron is as a component of hemoglobin, required for oxygen transport. It is also a component of certain enzymes. The major iron deficiency symptom is anemia. Anemia can also be caused by blood loss due to several factors, including injury, internal parasites (barberpole worm or liver fluke), and a bad case of external parasites such as lice. Iron is stored in the liver, spleen, and bone marrow. Milk is very low in iron; therefore, kids raised for a long time on milk alone will develop anemia. Soil contamination on forages can provide significant levels of dietary iron. Iron sulfate is a common means of adding iron to the diet. Forages in some areas have excessively high levels of iron that suppress utilization of other trace minerals.

Copper (Cu) 10 - 50 ppm

Copper is essential in formation of red blood cells, hair pigmentation, connective tissue, and enzymes. It is also important in normal immune system function and nerve conduction. Deficiency symptoms include anemia, "bleached" looking (lighter color) and rough hair coat, diarrhea, and weight loss. Young goats may experience progressive incoordination and paralysis, especially in the rear legs. High dietary molybdenum can depress absorption of copper and cause a deficiency. There should be at least four times as much copper as molybdenum in the diet.

Sheep (both hair and wool types) are sensitive to copper toxicity, whereas goats require copper levels similar to beef cattle. Angora goats may be more sensitive to copper toxicity than meat and dairy goats. There are differences in copper requirements for several sheep breeds, and this could be true for meat goats, but no data are available. Although most of the United States has adequate copper levels (Figure 7), many areas have high levels of molybdenum (Figure 6) due to soil geology and, therefore, require copper supplementation.

The liver stores copper, which can protect against toxicity in the short term. However, when liver capacity is exceeded, animals can die rapidly from a hemolytic crises caused by stress, such as being chased.

Cobalt (Co) 0.11 - 25 ppm

The only well accepted biological function of cobalt is as a component of vitamin B_{12}. Rumen microbes utilize cobalt for growth and produce vitamin B_{12}. Cobalt deficiency symptoms include loss of appetite, anemia, decreased production, and weakness. Most natural feedstuffs contain adequate levels of cobalt. There are cobalt-deficient areas in the United States (Figure 1).

Zinc (Zn) 40 - 500 ppm

Zinc is found in all animal tissue and is required by the immune system and for normal skin growth. Zinc is also essential for male reproduction. Deficiency symptoms include dermatitis (thick, dry patches of skin), hair loss, skin lesions, swollen feet, and poor hair growth. The bran and germ of cereals contain high levels of zinc.

Manganese (Mn) 40 - 1000 ppm

Manganese is important for bone formation, reproduction, and enzyme functioning. Deficiency symptoms include a reluctance to walk, deformity of forelegs, delayed onset of estrus, poor conception rate, and low birth weight. It is unusual to have a manganese deficiency.

Selenium (Se) 0.1 - 20 ppm

Selenium functions with vitamin E as an antioxidant, protecting cell membranes from oxidation. Selenium also affects reproduction, metabolism of copper, cadmium, mercury, sulfur, and vitamin E. Deficiency symptoms include poor growth rate, kids being unable to suckle, white muscle disease (cardiac and skeletal muscles have white spots), sudden death by heart attack, progressive paralysis, and retained afterbirth. Selenium is deficient in many areas because of low soil levels (geological factors; Figure 8); however, there are a few regions of high selenium soils leading to high to toxic levels in plants. Toxic levels of selenium cause shedding of hair, diarrhea, and lameness. Most plants that are not grown in selenium deficient soils will have adequate selenium levels. It is more effective to provide selenium supplementation through feed than by injection.

Molybdenum (Mo) 0.1 - 5 ppm

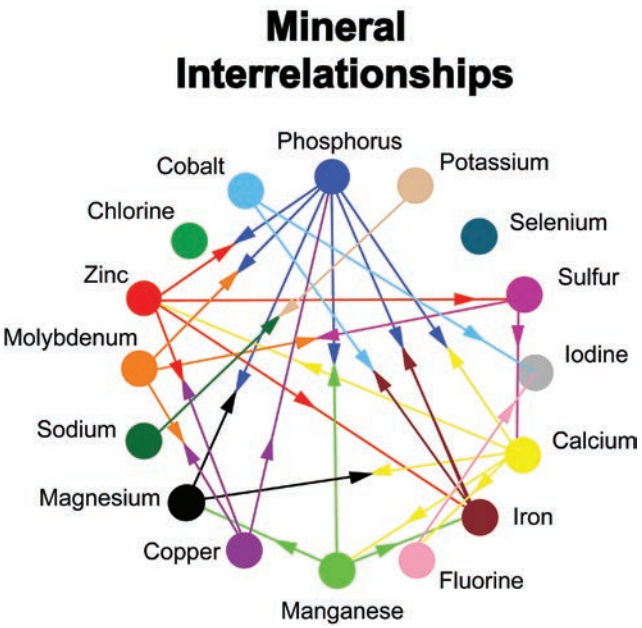
Molybdenum deficiencies are very rare. Toxicity occurs above 3 ppm due to reduced copper absorption, resulting in a copper deficiency. The copper level must be four times the molybdenum level to overcome this effect. High dietary levels of molybdenum are usually related to soil content. Molybdenum (as ammonium tetrathiomolybdate) is often used to treat copper toxicity in animals (Figure 6).

Iodine (I) 0.5 - 50 ppm

The only proven biological function of iodine is as a component of thyroid hormones that regulate energy metabolism and reproductive function. The major iodine deficiency symptom is goiter - a swelled or enlarged thyroid gland in the neck. This should not be confused with the thymus gland in the neck on young animals (the thymus gland is especially pronounced in Nubian kids, but shrinks after several months of age). Also, iodine deficiency causes reduced growth and milk yield, pregnancy toxemia, and reproductive problems such as late term abortion, hairless fetus, retained placenta, and weak kids. Most of the southern U.S. has adequate iodine in the soil and most minerals and trace mineralized salts contain iodine. A number of areas in the northern U.S. are deficient in iodine due to soil geology.

Mineral nutrition considerations

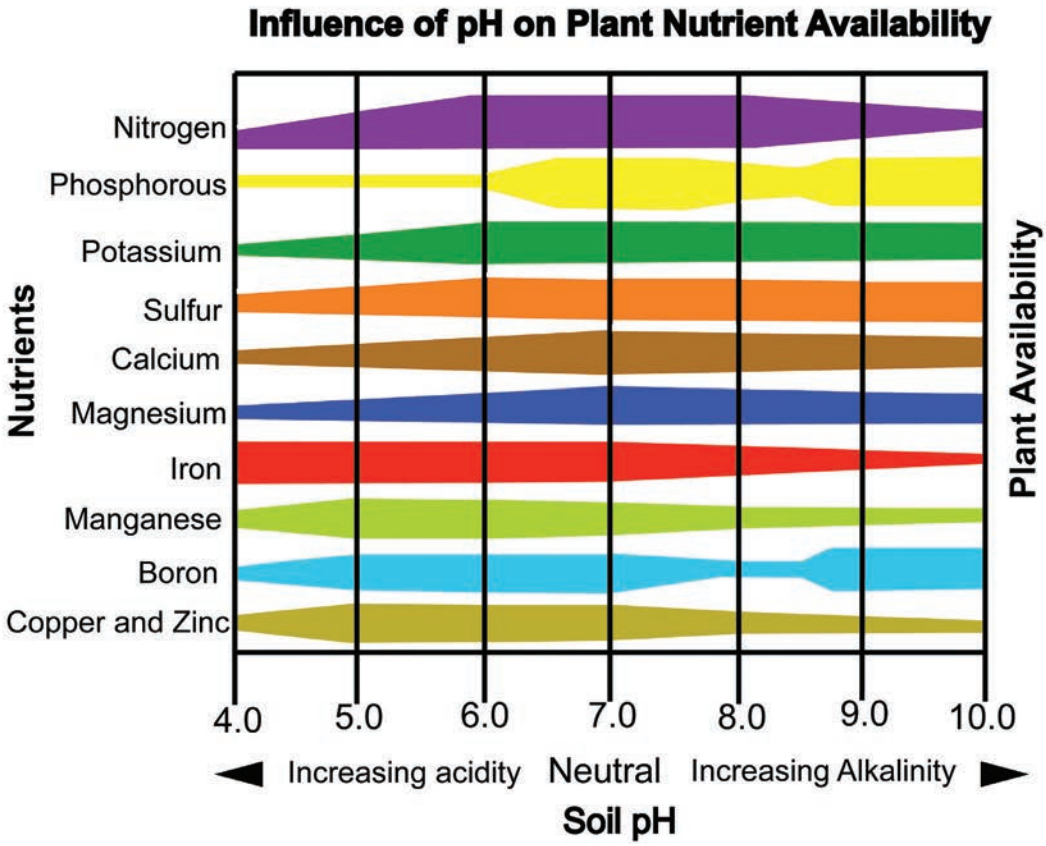
Plants are a major source of minerals for the goat, requiring all minerals that goats require except iodine. However, plant requirements for minerals, such as cobalt and selenium, may be much lower than the level



Drawing by K. Williams.

required for animals. Some soils are inherently deficient in some minerals such as iodine and selenium due to soil geology. Plants grown on soils deficient in a mineral are likely to be deficient in that mineral. However, some plants have an ability to concentrate the minerals available in the soil. Maps of mineral deficient areas of the U.S. are available. However, consulting local extension agents is a better method of determining soil mineral deficiencies or toxicities that could affect mineral levels in local forages. Soil maps showing deficient areas of selenium, copper, molybdenum, and cobalt are located at the end of this article.

Various factors other than soil mineral level can interact to influence the mineral content of forages. Soil pH is one factor that affects mineral uptake by plants. Under acidic soil conditions, many trace minerals are less available for plant uptake. Environmental temperature at certain times of the year may also affect mineral



Influence of pH on availability of plant nutrients.
Redrawn from S.S.S.A.P., 1946. 11:305 by K. Williams.

uptake. Interactions among minerals after soil fertilization can also affect their availability for incorporation into plant material. Season of the year affects plant mineral concentrations, mainly due to a dilution effect, with decreasing mineral levels as plants mature. Different plant species will also have varying contents. Browse and forb plant species may have higher mineral concentrations than do some grasses. As goats eat a variety of plants, they are less likely to have mineral deficiencies than other species of animals that eat predominantly one plant species.

To determine plant mineral content a producer can collect and send samples for analysis. Parts of plants that are being consumed throughout the day and growing season should be sampled. Analysis of a sample will cost a minimum of $25.00. To obtain enough data to formulate a custom mineral supplement would require sampling several times over a growing season and over more than 1 year if possible. This could be worthwhile for a large goat herd but too expensive for most producers. The alternative is to use a commercially prepared mineral block or loose supplement. Some mineral mixes are formulated for regions and are more appropriate to use than a mineral formulated for the whole United States. Many state extension specialists know what minerals are likely to be deficient in given areas of a state and know what levels of calcium and phosphorus are appropriate for beef cattle production. Those recommendations are a good place to start for goat mineral nutrition.

Mineral supplements should not be overfed. Mineral supplements are formulated for goats to consume a sufficient quantity. Many minerals interact with one another (interactions shown on opposite page) and excess consumption of one mineral may decrease absorption and(or) utilization of another. For example, it is well known that excess iron depresses absorption of zinc, copper, manganese, and selenium. There are several regions of the United States that have high enough levels of iron to depress absorption of these other minerals, requiring them to be supplemented. Feeding a regional mineral with no supplemental iron would be preferable to feeding an all-purpose mineral containing high levels of iron that would further depress absorption of these minerals.

The range between safe supplementation and toxic levels is narrow for many of the trace minerals. Do not overfeed trace minerals or mix additional minerals in a diet if another source of trace minerals, such as a trace mineral block, is present. Formulation of mineral supplements requires considerable expertise since the addition of high levels of one mineral may depress the utilization of another, causing a deficiency. Also, some trace minerals can be toxic in excess.

Calculation of supplemental levels for feed formulas requires a certain amount of technical expertise and specialized scales for weighing, along with sophisticated mixing equipment. Most common farm mixing methods are inadequate, resulting in “pockets” of dangerously high mineral levels in a batch of feed.

Choosing a mineral supplement

The most important consideration in choosing a mineral supplement is the level of calcium and phosphorus. Some mineral mixes are designated 12 - 8, which means they contain 12% calcium and 8% phosphorus. The levels of these two minerals should be the same that is being fed to cattle in your area (contact your county agent or livestock extension specialist). Phosphorus is expensive, so a 12 - 12 mineral will cost more than one that is 12 - 8. However, most forages are low in phosphorus, making it the most common mineral deficiency.

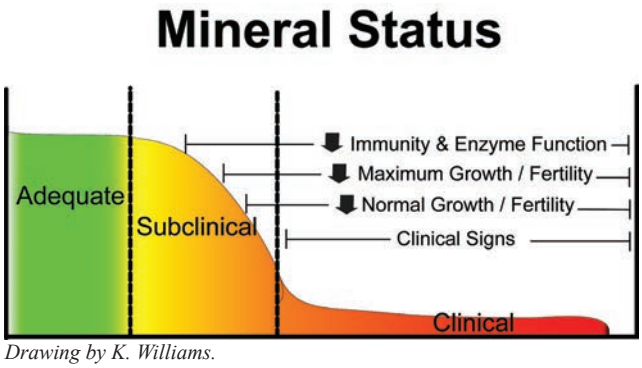
The mineral supplement should also contain trace minerals that are deficient in the area. Levels of trace minerals used in local cattle supplements can provide a guide for goats. Most mineral supplements are formulated to provide less than half the trace mineral requirements due to toxicity concerns. A mineral supplement should be provided in the loose form to maximize consumption. The salt level in the mineral drives intake;

therefore, no other sources of salt should be available. A mineral feeder should be used to protect from rain and keep the supplement clean. Replenish minerals frequently to keep them fresh.

Current approximate wholesale costs for supplying 100% of mineral needs of a 150 lb goat for various minerals in 1 year are as follows:

Calcium	$1.15
Phosphorus	$4.50
Salt	$0.40
Magnesium	$1.11
Potassium	$1.50
Trace minerals	$0.45
Other minerals	$0.65
Total	$9.70

Feedstuffs will normally provide at least half of all minerals and in some cases all required. It should be noted that phosphorus alone accounts for half the mineral cost.



Drawing by K. Williams.

Diagnosing mineral deficiencies or toxicities

The proper procedure for diagnosing a mineral deficiency or toxicity depends on which mineral is being considered. Secure the assistance of a local veterinarian and extension animal nutritionist in the state who are familiar with minerals in the region.

1. Deficiency or toxicity symptoms usually provide initial indications of mineral status (e.g., manganese and "knuckling over"). However, deficient animals do not always show classic symptoms and the major symptom may only be a 'poor doing' animal.
2. Blood tests are adequate for some minerals such as magnesium, calcium, and phosphorus, and for other blood factors that give an indication of mineral status. Examples of these factors include: glutathione peroxidase for selenium, hemoglobin for iron, zinc binding protein for zinc, and thyroid hormones for iodine.
3. Hair analysis has been used for zinc and selenium but in general is a poor diagnostic test.
4. The liver is a good tissue to test for iron and copper adequacy. Liver samples can be obtained via biopsy or from animals that are slaughtered or die.

Take home lessons on mineral nutrition

1. The diet should contain adequate levels of calcium and phosphorus and have close to a 2:1 calcium to phosphorus ratio.
2. Provide a free-choice loose mineral supplement with appropriate levels of calcium and phosphorus that contains trace minerals deficient in the region.
3. Monitor intake of the mineral to make sure the animals are eating an appropriate amount.
4. Avoid excessive feeding of any supplementation.

Body Condition Scoring

The adequacy of a nutritional program can be assessed by observing changes in body weight and condition of the animal. If animals lose weight, body condition will be reduced (animal is thinner), alerting an observant manager to a problem. Body condition is particularly responsive to energy and protein adequacy.

Body condition scoring is a system of assigning a numerical score based on physical characteristics indicative of fatness. These include the amount of muscle and fat covering the spine in the loin area and ribs and fat pad at the sternum. Body condition scores range from 1 (very thin) to 5 (obese) in one-half score increments. Langston University has information on the American Institute for Goat Research website describing Body Condition Scoring of Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcshowto.html) and Examples of Body Condition Scores in Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcs.html).

Animals should achieve a certain body condition during specific periods of the production cycle. For example, animals should have a body condition of at least 2.5 but no more than 4.0 at the beginning of the breeding season. Prior to entering the winter a minimum score of 3.0 is desirable. Also, if body condition score is 4.5 or greater, pregnancy toxemia prior to kidding is likely, as also is the case with a score of less than 2.0.

Using the Langston Interactive Nutrient Calculator

Practical goat nutrition involves providing sufficient nutrients for a desired level of productivity (milk, meat, or kids) at a reasonable cost. Nutrients are supplied via a combination of pastures, hay, supplements, and other feedstuffs; adequate amounts are required for animals to produce at an economically viable level. For commercial meat goat production, the economics of nutrition are of paramount importance due to their great impact on cost of production and subsequent profit. For show, purebred, and companion goats, the economics of nutrition may be of lesser importance.

Applied nutrition involves determining nutrient requirements and then working with available feedstuffs, including pasture, hay, or supplemental feeds, to provide the required nutrients in proper amounts. Nutrient requirements are affected by an animal age, weight, and production type and stage. For example, pregnancy, number of fetuses, etc. will affect the amount of nutrients needed by a doe.

Calculating nutrient requirements by hand can be difficult, but the Langston Interactive Nutrient Calculator (LINC) makes the task easy, only requiring answering several questions. In addition, it is linked to a nutrient balancer program that allows selection and use of pastures and feeds to meet the requirements. The calculator will determine not only protein and energy requirements, but also calcium and phosphorus needs.

Getting started

To teach you to use LINC, we will go through an example. Here is the assignment, calculate the nutrient requirements for a nonpregnant 3 year old mature ½ Boer cross doe that had twins 6 weeks ago. The doe has a 32 inch heartgirth and is under intensive grazing management. Her body condition score is 2.5.

First, go to the Langston web site http://www2.luresext.edu/goats/research/nutritionmodule1.htm.

Question 1 asks the biotype of goat. A drop down menu will give the choices of Boer, Boer cross, Spanish or indigenous (native) goat, dairy goat, or Angora goat. For Kiko goats, use the selection for Spanish and indigenous. Select “Boer cross.”

Question 2 asks the class of goat, and selections include suckling, growing goat less than a year and a half of age, mature goat including late gestation, and lactating goat including meat and dairy goats. If a lactating goat is selected, another drop down menu asks information needed to predict milk production. This information includes litter size (number of kids), week of lactation (weeks since she kidded), and age of

doe at kidding in years. Milk production, along with fat and protein percentages, are then predicted. These figures can be edited, which is useful for dairy goat producers who are more likely to know the amount of milk produced and its fat and protein contents.

For the example, select "lactating goat". Then in the subsequent menu, select the number of kids (twins) and input week of lactation (6) and age at kidding (2 - 3 years). The program predicts that the doe will produce 3.6 lbs of milk containing 3.6% fat and 3.3% protein.

Question 3 asks the gender of the goat, and the drop down menu has choices of doe, buck, and wether. Select "doe."

Question 4 asks the body weight of the goat. If the weight is known or a good estimate is available, it should be entered in the box. If the weight is unknown, the heartgirth (chest circumference) can be measured to predict body weight. Check the box to estimate weight via heartgirth and enter heartgirth in inches. A menu will appear with choices of genotype (breed) of goat (Alpine, Angora, Boer, ½ or less Boer, ¾ or ⅞ Boer, LaMancha, Nubian, Oberhasli, Saanen, Toggenberg, and Spanish). Some breeds require input of body condition score. Body weight is then estimated. Input "32" inches for a "½ or less Boer" and the estimated weight of the doe is 105 lbs. This can be used for estimating bodyweight for medicine dosage or weights for management purposes.

Question 5 asks the desired amount of weight gain or loss expected in a 1 month period, with selections ranging from losing 5 pounds (-5) to gain of 30 pounds. This gain is in addition to any pregnancy weight gain. Select 0 lbs per month.

Question 6 adjusts nutrient requirements for the energy expended during grazing if goats have access to pasture. The drop down menu includes choices of stable feeding, intensive management, semi-arid grazing (goats on extensive ranges), and arid (desert) grazing. For the sample calculation select "intensive management, temperate or tropical range." This selection will be used in all the examples that follow.

Question 7 asks the percentage TDN of the diet being fed and uses a default value of 60. If the TDN level in the feed is known, this value can be adjusted. For dairy goats, the default value is 65%. Use the default of 60%. If you know the value of the feed you plan to use put it in here. This value is important in prediction of intake.

Question 8 asks the percent protein in the diet and the default is 10%. For dairy goats, the default is 14%. Use the default of 10%. If you know the value of the feed you plan to use, put it in here. This value is used to help predict intake.

Click on the "Calculate Requirements" button to calculate the energy and protein requirements, estimated dry matter intake, and calcium and phosphorus requirements. In this example, the requirements should be 2.5 lbs of TDN for energy, 0.34 lbs of crude protein, 6.65 grams of calcium, and 4.65 grams of phosphorus, with a predicted intake of 3.65 lbs of dry matter.

Providing needed nutrients

After calculating the nutrient requirements for goats, those nutrients must be provided using feedstuffs such as pasture, hay, concentrate, and minerals. For most goats throughout much of the year, nutrient requirements can be met by available pasture, a mineral supplement, and water. During times of limited forage availability or quality such as winter, or feeding poor quality hay or stockpiled forage, a supplement will be needed to supply deficient nutrients. The level of supplemental feeding should be adjusted with changes in animal requirements, such as increased needs of late pregnancy. Sometimes it may be preferable to put an animal in a lot and feed a complete diet or one high in concentrate such as with dairy goats.

There may be periods when nutrient requirements cannot be met, resulting in loss of body weight. This is acceptable at certain times in the production cycle if body condition is sufficient for the animal to draw upon body reserves and maintain the desired production level. An example would be weight loss during early lactation because sufficient nutrients cannot be consumed. However if the doe is in poor body condition, is a growing yearling, or has severe weight loss during this time, milk production will be depressed. During a drought, it may be acceptable for open or early pregnant animals that are not lactating to lose weight. During late pregnancy, inadequate nutrition can have adverse effects on pregnancy outcome and subsequent lactation. We can estimate what the projected bodyweight losses would be by reducing the bodyweight gains in question five and then calculating nutrient requirements until the energy and protein requirements match intake of those nutrients. Severe undernutrition can cause abortion, reduced livability of the kid(s), reduced milk production and adversely affect maternal behavior.

Feeding Different Classes of Goats

The feeding suggestions that follow are oriented to commercial goat producers. Purebred, show, and companion animals are often fed more for larger frames and better body condition, but excessive body condition can be deleterious to the animal health.

Feeding bucks

Mature bucks can obtain most of their nutrients from pasture. However, yearling and 2 year old bucks have greater nutrient requirements since they are still growing. Bucks need to be in good body condition (BCS greater than 3) before the breeding season because feed intake may be relatively low during that time, with loss of body weight. Thus, body condition should be evaluated 3 months before the breeding season. Decisions can then be made on the supplemental nutrition needed for the buck to achieve the desired BCS.

Whenever bucks cannot meet nutritional needs from pasture, supplementation is necessary. Under most conditions, whole shelled corn or sweet feed at 0.25 to 0.5% of body weight will be adequate (0.5 to 1 lb of feed for a 200 lb buck). Feeding bucks high levels of grain (greater than 1.5% of body weight) for a long period of time makes them prone to urinary calculi. The levels of grain recommended above are safe for bucks. When pasture is scarce, bucks can be fed medium quality hay free-choice (all they can eat).

Using LINC, calculate the nutrient requirements for a 3 year old, 200 lb Boer cross buck, gaining no weight, and on pasture (intensive management). The calculated requirements are 2.39 lbs of TDN, 0.26 lbs of crude protein, 5.05 grams calcium, and 4.09 grams phosphorus, with predicted dry matter intake of 3.55 lbs. However, it is important to note that the estimated dry matter intake is influenced by the dietary TDN and CP concentration inputs. Therefore, if the default values are used and a forage, which makes up all or most of the total diet other than a mineral supplement, has different levels, then the predicted dry matter intake may not be close to the actual amount. In the example above, default values were assumed. To determine if these nutrient requirements can be met by native range with a mineral supplement, click on "Select Feed Ingredients" at the bottom of the page. A page listing different feeds will appear. In the "Forages" section below "Concentrates," click on "range, early summer," and under "Minerals" choose a 12-12 mineral supplement. Go to the bottom and click on "Input These Feed Ingredients into the Ration."

The ration window will appear that lists each ingredient chosen. Intake figures should be entered in the column labeled "Amount, lbs as fed." The estimated intake for this buck is 3.55 lbs dry matter (lbs of diet not including the water content of the feedstuffs), whereas in this window the consumption amount is entered as the "as fed" form. Because feedstuffs vary in water content (compare the water content of fresh, green pasture to the same forage dried and harvested as hay), nutrient requirements and intake estimations are calculated on a "dry matter basis." Dry matter basis means that all water has been removed. However, animals eat feed in an "as-fed" form. This calculator will determine the amount of dry matter intake for each ingredient from

the as-fed figures entered. This relieves the producer from having to estimate dry matter, allowing the amount fed to the animal to be entered, with the program performing the needed dry matter calculations.

The mineral supplement bag label predicts intake of 0.5 to 1 lb/month/hundred lbs of body weight. At that rate, the 200 lb buck will consume 2 lbs/month or 0.067 lbs/day (2 lbs ÷ 30 days), roughly 1 ounce. Some supplements estimate an intake such as 1 to 1.5 oz/day, but this can vary with the size of the goat. Enter 0.07 lbs for the mineral. Therefore, in this example it can be assumed that forage dry matter intake is 3.55 lbs. The value of 3.55 is entered into the "Amount, as-fed" column for range forage. Clicking in the "Amount, lbs DM" column will calculate the amount of DM and nutrients provided (Running total) compared with the Requirements. The amount of as-fed native range grass provided should be increased until the forage dry matter provided equals the 3.55 lbs previously calculated. This is done by trial and error method until a correct answer is found. In this case, the correct amount is 3.95 lbs of as-fed native range, which will provide 3.55 lbs of dry matter. Therefore, the estimated daily ration for this buck is 3.95 lbs of native range grass hay, or an equivalent amount of pasture, on a dry matter basis plus 0.07 lbs of mineral per day.

Comparing the Running total with the Requirements shows that this diet did not meet the requirement for TDN (2.12 lbs provided vs a requirement of 2.39; 89%). Crude protein, calcium, and phosphorus are supplied in excess of requirements. Because the equations used in these predictions include a small safety margin (i.e., requirements are most likely slightly greater than actual), if the deficiency is not marked the diet could be used as is with careful monitoring of performance measures, most notably BCS. In addition, one should consider that the diet actually consumed could be higher in quality than the 'book' composition values used. In this regard, when taking plant samples, plants are often cut at the ground level, such as for hay. Conversely, goats select certain plant parts (especially leaves) that have higher nutrient contents. Therefore, the composition analysis used in the calculations might not have matched what was actually eaten. For example, if a TDN concentration in consumed forage of 65% and a crude protein level of 12% are assumed, the predicted TDN intake is 95% of that necessary to satisfy the TDN requirement.

Accurate and abundant data on the nutrient content of plant parts consumed by goats are lacking. When hay is fed and animals are 'forced' to consume most of it, the hay analysis will closely match what is consumed. The same applies to supplemental feeds that are totally consumed. One way to more accurately determine the true composition of diets of grazing goats is to follow the animals for a couple of hours and hand pluck the portions of plants consumed and send the sample in for analysis. However, plant composition and plant parts selected vary over time, making it desirable to sample plants monthly or more frequently.

In the absence of feed nutrient analysis, it is important to try to match the description of feeds or pasture as closely as possible to that in the LINC feed tables. If actual analysis has been determined, it can be entered into LINC at the bottom of the feed library. Information required includes concentrations of TDN, crude protein, calcium, and phosphorus. Hopefully in the future, more applicable data will be available for herbage grazed by goats.

Feeding replacement bucks and does

Replacement bucks and does must gain sufficient weight from weaning to breeding to be of adequate size and sexually mature. A Spanish doe weaned at 12 weeks of age would be expected to weigh 40 lbs and gain 5 lbs per month to achieve a minimum breeding size of 60 lbs at 7 months of age. A Boer doe weaned at 12 weeks of age would be expected to weigh 50 lbs and would need to gain 7.5 lbs per month to be 80 lbs at breeding. These are minimum weights, and it is advantageous for animals to be slightly heavier. Some purebred breeders wait to breed their doelings at 19 months of age because a doe with a bigger frame size is desired. Most commercial goat producers cannot afford the cost of an extra year of maintaining an animal with no production.

Does will generally gain sufficient weight if an adequate amount of a moderate quality forage is available. If doelings are not gaining adequate weight (as measured by a scale or through the heartgirth conversion program), they could be supplemented with whole shelled corn at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb doeling). Feeding excessive grain to does causes an overly fat condition. Fat may be deposited in the udder, leading to reduced formation of milk secretory tissue. The doe is also more likely to have pregnancy toxemia and birthing problems. If sufficient good quality pasture is not available, growing doelings will need good quality hay and a supplement such as whole shelled corn, sweet feed, or range cubes or pellets at 0.5 to 1.0% of body weight.

Bucklings must gain more weight than doelings to reach puberty. While there are no available recommendations for weight of meat goat bucklings at first breeding, these animals need to reach an adequate size to achieve puberty. Like doelings, body condition should be monitored and supplemented at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb buckling). Most bucks do not let a lack of body weight interfere with breeding, but some body reserves are necessary to maintain fertility and mating activity throughout the breeding season.

Feeding does throughout their life cycle

The four production periods of does are dry nonpregnant, pregnant, late gestation, and lactating. Does that are open (nonpregnant) or in the early stage of pregnancy (< 95 days) have fairly low nutrient requirements. For open does, the goal is to gain a little weight to be in good condition for breeding. A medium quality pasture, such as in late summer, or a medium quality hay is sufficient to prepare for breeding and the early stage of pregnancy. However, adequate quantities of feed are necessary.

Use the LINC to calculate the nutrient requirements for a 130 lb nonpregnant, mature Boer doe without change in body weight and with intensive pasture grazing. The requirements are 1.50 lbs of TDN, 0.18 lbs of crude protein, 4.03 grams of calcium, and 2.82 grams of phosphorus, with an estimated dry matter intake of 2.31 lbs (based on the composition of fall bermudagrass; 50% TDN and 9% CP). Feeds used are fall bermudagrass and a mineral supplement. A 130 lb doe is expected to consume the mineral at 0.1% of body weight per month = 1.3 lbs/30 days = 0.04 lbs of mineral per day. The estimated 2.27 (2.31-0.04 = 2.27) lbs dry matter intake of fall bermudagrass (3.25 lbs as-fed) provides 1.14 lbs of TDN (76% of requirement) and 0.20 lbs of crude protein (111% of requirement). In this example, it appears questionable as to whether or not body weight of the doe could be maintained with this forage (i.e., 50% TDN). The goat's ability to select higher quality plant parts, as noted above, might enable them to maintain their body weight. In this regard, if they are able to select a diet with a TDN concentration of 60% rather than 50% then the amount of TDN supplied is (2.27 × 0.60 = 1.36 lbs) which is 91% of the required amount, somewhat close to her requirements. Again, it is important to monitor body condition.

Calculate the nutrient requirements for a Boer doeling weighing 70 lbs, gaining 5 lbs per month, and with intensive pasture grazing, using LINC. The requirements are: 1.3 lbs TDN, 0.25 lbs crude protein, 2.98 grams of calcium, and 2.08 grams of phosphorus with a dry matter intake estimate of 2.06 lbs. If we adjust estimated TDN and estimated protein for the forage (questions 7 and 8 in LINC) since the 50% TDN of fall Bermudagrass is different than the 60% assumed, and use 9% CP instead of the 12% assumed, predicted dry matter intake is 2.32 lbs. Using the same feeds, fall bermudagrass and mineral, with a mineral consumption of 0.02 lbs (1% of body weight /month, divided by 30) and using fall bermudagrass for the remainder of her intake (3.3 lbs as fed), both TDN (1.16 lbs intake, 89% of requirement) and crude protein (0.21 lbs intake, 84% of requirement) are inadequate. To achieve the desired growth rate, supplementation may be necessary. By trying sweet feed as a third feedstuff it is determined, through trial and error, that 0.75 lbs of sweet feed along with 2.0 lbs of fall pasture will provide most of the energy requirement but only 0.19 lbs of crude protein (76% of requirement), which is inadequate. By deleting the sweet feed and changing to a 16% dairy

ration to supply the needed crude protein, it is finally determined that 0.75 lbs of a 16% crude protein dairy ration, 2.0 lbs pasture, and 0.02 lbs of mineral will provide 1.3 lbs of TDN (100% of requirement) and 0.25 lbs of protein (100% of requirement). The weight gain to achieve adequate breeding size should continue to be monitored with possible feeding adjustments made. The lesson here is that this doeling, because of the need for growth, has higher requirements than a mature doe and needs extra nutrition.

Flushing meat goats

Some people advocate "flushing" of meat goats prior to breeding. Flushing refers to the practice of providing extra nutrition to does approximately 2 weeks prior to breeding and for a variable portion of the breeding period (e.g., 1-2 weeks) to increase the number of ovulations and have a greater proportion of twins and triplets. This is widely advocated with sheep producers and Angora goat producers. Producers have extrapolated the practice to meat goats. However, several controlled studies with Spanish goats in reasonable body condition (BCS 2.5 – 3.5) have shown no response in kidding or conception rate of meat goats to flushing with extra protein, energy, or both. The practice may have utility for meat goats in poor body condition, but there does not appear to be justification for flushing does in acceptable body condition.

Winter feeding of does

Early to mid-winter is a time when does should be in early pregnancy. The goal of a wintering program is to economically provide the necessary nutrients to maintain a reasonable body condition, lose no weight, and keep them warm. In general, most wintering programs consist of both forage and supplement components. The forage component can consist of hay, stockpiled forage, or a cheap byproduct roughage feed. The supplement usually contains energy, protein, and often vitamins and minerals, although these may be provided separately as a mineral mix. Commonly utilized supplements include whole shelled corn (inexpensive source of energy), range cubes (inexpensive source of energy and protein), sweet feed, protein blocks, molasses blocks or tubs, and liquid feed.

Stockpiled forage is forage that is grown during the summer or fall upon which animals are not allowed to graze, reserving it for the winter months. In drier areas, the forage is well preserved, but in a more humid climate quality declines rapidly, making the practice less satisfactory. Stockpiled forage is a very inexpensive forage source since it does not have to be mechanically harvested (baling forage doubles the cost of forage); animals harvest stockpiled forage by grazing. Animals make much more efficient use of stockpiled forage when strip grazed (using temporary electric fence to limit animal access to an area containing a 1 to 3 day supply of forage) to minimize trampling. Fescue is used in many temperate regions for stockpiling and retains its quality well into late winter even in humid areas. Most recommendations for stockpiling fescue include late summer fertilization, clipping, and deferred grazing. Warm season grasses such as native range and bermudagrass can be stockpiled. The amount of deterioration is dependent on grass species and rain. If local cattlemen are using stockpiled forage it will probably work for certain classes of meat goats. Consult your state forage extension specialist for further information.

Calculate the requirements for wintering a 95 lb mature Kiko doe (use Spanish biotype) in early pregnancy gaining no weight and with intensive pasture grazing, using LINC. The requirements are 1.19 lbs TDN, 0.14 lbs protein, 3.13 grams of calcium, and 2.19 grams of phosphorus, with 1.86 lbs of dry matter intake estimated (based on default dietary TDN and CP levels). Feedstuffs that can be used include stockpiled (winter) bermudagrass and a 16% molasses lick. The estimated intake from the molasses lick label is 4 ounces or 0.25 lbs. Assume the remainder of dry matter intake is from the stockpiled bermuda pasture.

The molasses lick is not in the feed library so must be entered manually as a new feedstuff. Click on "Add/ Delete Ingredient to Feed Library," to bring up a table to be filled out. First, the feedstuff class is selected. This molasses lick is in the "concentrate" class. Then the name "16% molasses lick" is entered, and remaining

values are entered. These values can be obtained from the feedstuff tag or label or by calling the manufacturer. If a value is unknown, leave it blank. For this example, enter dry matter of 85%, 16% crude protein, 75% TDN, 2.8% calcium, and 0.45 % phosphorus. Click on "Add Feed Ingredient to Library" and the Select Feed Ingredient page appears. If needed, click on refresh feed library and 16% molasses lick appears under "Your Feed Ingredient Library." If you have a dry hay or feed, 85% dry matter is a good assumption.

To continue formulating the ration, select the 16% molasses lick and winter bermudagrass, then click on "Input these Feed Ingredients to the Ration." Enter 0.25 lbs for the 16% molasses lick under the "Amount, as-fed" column and guess at 1.5 lbs of winter bermudagrass. Through trial and error a total of 2.0 lbs bermudagrass is selected to fulfill intake requirement. The table shows that this diet provides 0.91 lbs of TDN (76% of requirement), 0.12 lbs CP (86% of requirement), 4.74 grams of calcium, and 1.52 grams of phosphorus (deficient). The diet is quite deficient in energy. To provide additional energy, add whole shelled corn. The diet is then reformulated to contain 0.6 lbs whole shelled corn, 1.4 lbs winter bermudagrass, and 0.25 lbs of lick molasses. This provides 1.15 lbs TDN (97% of the energy requirement) and meets the CP needs. Phosphorus is slightly deficient (13%), but if the bermudagrass is better than average the requirement can be satisfied. Mineral supplements vary in their phosphorus levels as phosphorus is an expensive ingredient. If a mineral supplement with a high phosphorus level is selected for feeding, the requirement would be met but likely at a high monetary cost.

Feeding does in late gestation

Energy requirements increase dramatically in late pregnancy (Figure 4). Using LINC, calculate the nutrient requirements for a 130 lb mature Boer doe, 140 days pregnant (10 days from kidding), gaining no weight, other than that due to pregnancy, and carrying twins. Under question 3, after clicking on the box for greater than 95 days pregnant, a form drops down for pregnancy number (twins), breed (predicts birth weight, can enter yours if known), and days of pregnancy (140). The requirements are 2.45 lbs TDN, 0.45 lbs crude protein, 3.97 lbs intake, 6.03 grams calcium, and 4.22 grams phosphorus.

A ration can be balanced using bermudagrass hay and 20% range cubes to meet the requirements by feeding 1.5 lbs of range cubes and 3.0 lbs of bermudagrass hay. This illustrates the high level of nutrition that is needed, especially in the last 3 weeks of pregnancy. High quality hay as well as supplementation is usually required. The range cubes contain a mineral supplement so no additional mineral mixture is needed.

Doelings require more supplementation than mature does, as the doelings are still growing. The nutrient requirements for a 95 lb growing Boer doeling with a predicted intake of 3.37 lbs, gaining 1 lb per month in addition to pregnancy weight gain and 140 days pregnant with a single kid are 1.77 lbs TDN, 0.36 lbs CP, 5.23 grams calcium, and 3.66 grams of phosphorus. If the same ingredients are used as those for the mature doe, how much of each will be required? The doeling could be fed 3.8 lbs of bermudagrass hay alone to meet the nutrient requirements for pregnancy with a single kid. However, if the doeling is carrying twins and is 140 days pregnant, her requirements are 2.27 lbs TDN and 0.47 lbs CP. This doeling will require 1.0 lbs of range cubes and consume 3.3 lbs of hay. If an abundance of high quality pasture is not available, the doeling will need some type of supplementation. If the forage (or hay) of adequate quality is available, only 1 to 1.5% of body weight of whole shelled corn may be needed as an energy supplement. This is important in that feed intake may be reduced in the last 4 to 6 weeks of gestation by the growing kids that reduce available abdominal space.

Feeding the lactating doe

The lactating doe has very high nutrient requirements. Calculate the requirements for a 4 year old 110 lb Boer cross doe nursing twins in week 4 of lactation. When lactating is selected under question #2 on LINC, a form drops down. Select litter size (twins), week of lactation (4), and age at kidding (4). The program then

predicts production of 4.5 lbs of milk per day with 3.6% fat and 3.3% crude protein. Nutrient requirements are 2.65 lbs of TDN, 0.41 lbs of protein, 7.61 g of calcium, and 5.33 grams of phosphorus, with 4.14 lbs of dry matter intake predicted (based on default dietary TDN and CP concentrations). During lactation, the doe can consume nearly enough nutrients if an abundant supply of high quality pasture is available, such as in spring or early summer. If "Range, early summer" is selected and fed at 4.7 lbs, the diet meets protein and calcium requirements, and 90% of energy requirement. However, phosphorus is deficient (3.76 vs. 5.33) and needs to be supplemented. However, does will likely lose some bodyweight due to the high demands of peak lactation (weeks 3 to 8 of lactation) and an inability to consume an adequate quantity of feed. Kidding should take place when there is an adequate supply of high quality pasture. If there is not adequate pasture, supplemental feed will be required. Inadequate nutrition will decrease body condition, reduce milk production, reduce kid weaning weight, and increase kid mortality.

If feeding bermudagrass hay and a 16% dairy ration, 2.6 lbs of hay and 2.0 lbs of the ration are required to fulfill requirements. However, the doe will still lose 2.0 lbs of bodyweight per month. When feeding high levels of grain such as the amount in this example, the animal should go through an adjustment period of two to three weeks during which time the grain portion of the diet is gradually increased to prevent digestion and other problems from occurring. Feeding a dairy ration and hay to a doe during late gestation and the lactating period will cost approximately $30 per animal. Utilizing available pasture as a feed source is a much cheaper alternative.

Kids are usually weaned at about 12 weeks of age. Milk production of the doe begins to decrease after the 6th week of lactation and is quite low by the 12th week. Nutrient requirements decline as stage of lactation advances, enabling the doe to maintain or even increase body condition on pasture alone. Kids may be creep fed while nursing to increase growth rate of the kids and reduce nutrient demands on the doe for milk production.

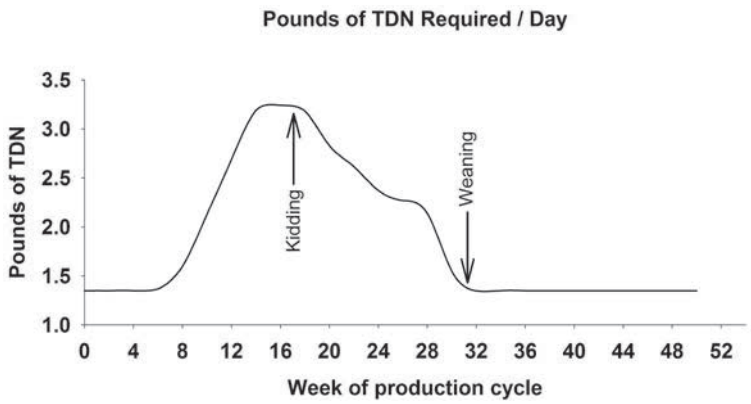
Creep feeding

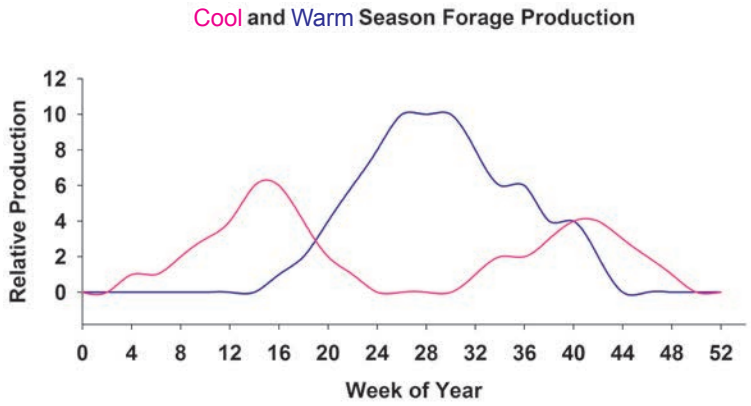
Creep feeding is a method of providing feed for the kids only. This is accomplished by fencing around a feeder and using a creep gate that has holes about 5 inch wide by 1 ft high. These holes are small enough so that kids can enter the feeder, but adults are excluded because they are too big to go through the hole. Creep feeding will provide extra growth for the kids and train them to eat feed, facilitating weaning. A commercial creep feed with at least 16% crude protein that is medicated with a coccidiostat should be used. It requires about 6 lbs of feed to produce 1 lb of animal gain. The more rapid growth from creep feeding may be beneficial for producing show prospects.

An alternative to grain-based creep feeds that is used in the beef cattle industry is to creep graze calves, using a creep gate that allows calves access to ungrazed high quality pasture. This may have application for goats using high quality pastures (crabgrass or sudangrass that is planted for the kids). In rotational grazing of cattle, the calves are often allowed to creep graze the next pasture before cows so that they have relatively high nutrient intake. Those pastures often have less parasites and disease organisms because of the time since last grazing.

Effect of Kidding Season on Nutrient Requirements

Nutrient requirements of does change dramatically with stage of production. Requirements increase dramatically the last 6 weeks of gestation due to increasing fetal growth and remain high in early lactation (kidding occurred on week 18 in chart). During the month prior to kidding and for the following 3 months (assuming weaning at 12 weeks of age), the doe will consume nearly as much nutrients as in the remaining 8 months of the production cycle. Thus, during that time it makes sense to supply nutrients from an inexpensive source, typically pasture. The cost of providing the same nutrients as hay is more than twice that of pasture,





and supplying through purchased feeds may be four to five times greater than for pasture.

Kidding should be planned for a time when pasture is rapidly growing. This period corresponds to late spring for pastures comprised of warm season forages such as bermudagrass or native range, browse, and forbs, but could be either fall or early spring for cool season grasses such as ryegrass, wheat, orchardgrass, and fescue. Cool season grasses usually produce less forage per acre than warm season forages, but generally are higher in energy and protein. The accompanying figure shows the relative production of cool and warm season forages for central Oklahoma. Consult a local pasture extension specialist or livestock extension specialist for local forage growth patterns. Rapidly growing pasture is high in protein and energy. A major consideration in determining the date to kid is level of forage production at that time. However, there are other considerations in selecting kidding date, such as parasites and market opportunities. Some markets provide a substantial price premium from kidding at a specific time of the year, such as producing prospect show wethers or registered animals. However, it may take a considerable market premium to cover the cost of purchased feed, so general reliance on pastures and forages is best.

Artificial Raising of Kids

Sometimes it is necessary to bottle feed young kids due to death of the mother or the mother refusing to take them. Milk feeding of commercial meat goats is usually not economical. It may be avoided by cross-fostering kids onto another doe as described under the goat management section. If a bottle raised kid is with other kids and does, they may learn to 'steal' sufficient milk to raise themselves. Kids can be raised on cow milk replacer, goat milk replacer (expensive) or, if none is available, cow milk from the store may be used.

It is very important that kids receive colostrum within 12 hours of birth. After 12 hours, antibodies absorption decreases. Colostrum may be milked from another doe that recently kidded. Colostrum contains antibodies that strengthen the immune system for the first months of life. A kid should be fed one ounce of colostrum per lb of weight (average birthweight 7 lbs, therefore, 7 ounces of colostrum) at each of three feedings in the first 24 hours. If the kid is too weak to nurse, it is appropriate to provide the colostrum via stomach tube. This does take some practice, but obtaining colostrum is critically important to kid survival.

Initially kids can be fed using a baby bottle or a nipple such as the Pritchard teat which fits on a plastic soda bottle. Kids can be bottle fed twice a day, although three times a day the first 4 to 6 weeks of life may increase growth rate. Kids are very susceptible to bloating and other gastrointestinal problems from milk replacers that contain a high level of lactose due to use of dried whey in their formulation. Reduced lactose milk replacers will reduce bloating problems.

A calf starter feed (with a coccidiostat such as Rumensin or Deccox, sometimes called medicated) and high quality hay should be made available the second week of life. Deccox can be used in the milk from week 2-6 to prevent coccidiosis. After 4 weeks of life, kids can be limit fed milk at one pint in the morning and also in the afternoon. This will stimulate consumption of starter feed and facilitate weaning.

Kids can be weaned after 8 weeks of age if they are consuming 2 ounces of starter per day and weigh two and a half times their birth weight (about 18 lbs). Weaning shock can be reduced by going to once a day milk feeding for several days to encourage consumption of the starter.

Considerations in Ration Formulation

Rations should be balanced not only for protein and energy, but calcium and phosphorus contents should be calculated, macrominerals supplemented, and a trace mineralized salt used to provide microminerals. A vitamin premix should be used to provide at least vitamin A and E.

If the diet is being fed at high levels to bucks or wethers, there is risk of urinary calculi. To prevent urinary calculi, the ration should be formulated with a minimum of phosphorus, over twice as much calcium as phosphorus, and a urine acidifier such as ammonium chloride at 0.5-1.0 % of the diet. Salt can also be included in the diet, such as at 1%, to reduce incidence of urinary calculi.

If the ration is being fed at high levels, sufficient fiber should be included in the diet to prevent acidosis. Dried brewers yeast and probiotics are often used in rations fed to animals at high levels to help prevent them from going off feed.

Feeds may have a coccidiostat included in the formulation to prevent coccidiosis. There are a number of coccidiostats, but Food and Drug Administration approved drugs commonly used include Deccox and Rumensin. Since goats are very susceptible to coccidiosis when stressed, such as at weaning or shipping, many starters and show feeds contain coccidiostats and have the term 'medicated' on the feed tag. Management considerations to reduce coccidiosis incidence include sanitation, cleanliness, and dry housing.

Feeding Systems

There are many methods of feeding goats. Feeds should be offered in such a way to minimize mold growth or fecal contamination that reduces intake. Mineral mixes must remain dry and should be replenished at 2 week intervals to avoid caking. Feed troughs should be designed to facilitate removal of feces and leftover feed. Troughs generally require a bar running above the length of the trough to keep goats from defecating in them.

Self feeders can be used for feeds containing sufficient roughage for use as a complete feed or for feed that has a built-in intake limiter. For large range operations, feeds such as whole shelled corn or range pellets or cubes are often fed on the ground. The feeding area is moved each day to have clean ground upon which to feed.

Round hay bales should be fed in a rack off the ground. Feeding round hay bales on the ground results in hay wastage and leaves a mess that is difficult to clean. Hay can be fed in a manger or hay feeder with keyhole slots, but horns may cause problems preventing access to feed. For large operations, unrolling round bales on the ground works well.

Nutritional Disorders

There are several diseases associated with nutritional management. These include acidosis, founder, enterotoxemia, pregnancy toxemia/ketosis, polioencephalomalacia, and urinary calculi.

Acidosis, founder, and enterotoxemia are all related to either feeding high levels of grain or a rapid increase in the level of grain in the diet. Acidosis is associated with the production of high levels of lactic

acid in the rumen from a large supply of starch that the animal consumed. Endotoxins may also be produced by ruminal bacteria that exacerbate the problem.

Founder refers to problems that occur with the feet of the animal as a consequence of acidosis. The blood vessels in the hoof constrict and in the long-term cause the hoof to grow rapidly, necessitating weekly hoof trimming.

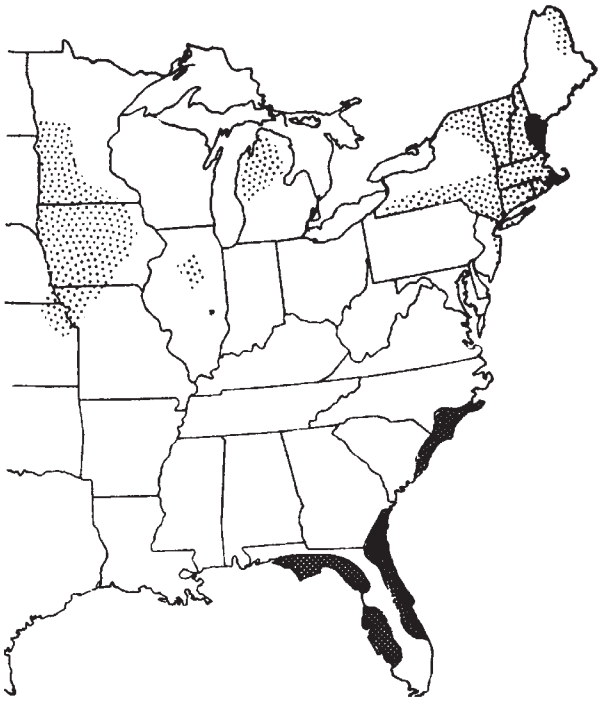
Enterotoxemia is caused by bacteria in the intestine that grow rapidly and produce an endotoxin in response to high levels of starch (grain) in the diet. Animals are in extreme pain from the effect of the endotoxin and often die quickly. Vaccination will help prevent this disease.

High levels of grain in the diet and stress are associated with polioencephalomalacia, which is a thiamine deficiency. High dietary levels of sulfur (such as from molasses in the diet) can increase incidence of the condition. The animals appear drunk, may not be able to stand, become blind, and slowly die. There is often a dramatic response to a large dose of thiamine (5 mg/lb), which may need to be repeated. These diseases can be best prevented by increasing the grain level in the diet slowly and maintaining 50% forage in the diet. Thiamine can be added to high concentrate diets at 0.25 lb/ton to aid in the prevention of polioencephalomalacia.

Pregnancy toxemia is a metabolic disease usually caused by animals being too fat (body condition score greater than 4) prior to kidding; although very thin animals (body condition score less than 2) are subject to the disease also. It is caused by a high demand for nutrients by the growing fetus in late pregnancy that is not being met (excess fat in the body and the growing fetus limit room in the stomach for food, reducing intake of the diet). This unmet nutrient demand causes a rapid breakdown of fat reserves, forming ketone bodies at high levels which are toxic. Treatments include administration of propylene glycol, large doses of B vitamins, glucose given intravenously and possibly Caesarian-section (to remove the fetuses and immediately reduce energy demand; see the Goat Health section). Prevention of the disease is far easier and more effective than treatment. Simply monitor animal body condition and adjust nutrition, especially energy, to manipulate body condition. Do NOT sharply reduce feed in late gestation as this may cause pregnancy toxemia. Also, pregnant goats in the last third of pregnancy will need a more nutrient dense diet (higher quality) due to fetal growth and reduced intake because of reduced stomach capacity. Exercise will help. Does can be encouraged to exercise by separating hay, feed and water at a substantial distance, forcing them to walk more.

Soil-Related Nutritional Problem Areas for Grazing Animals

Figure 1. Geographical distribution of Co-deficient areas in the eastern United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota and Allaway, 1972, by permission Soil Science Society of America.



All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

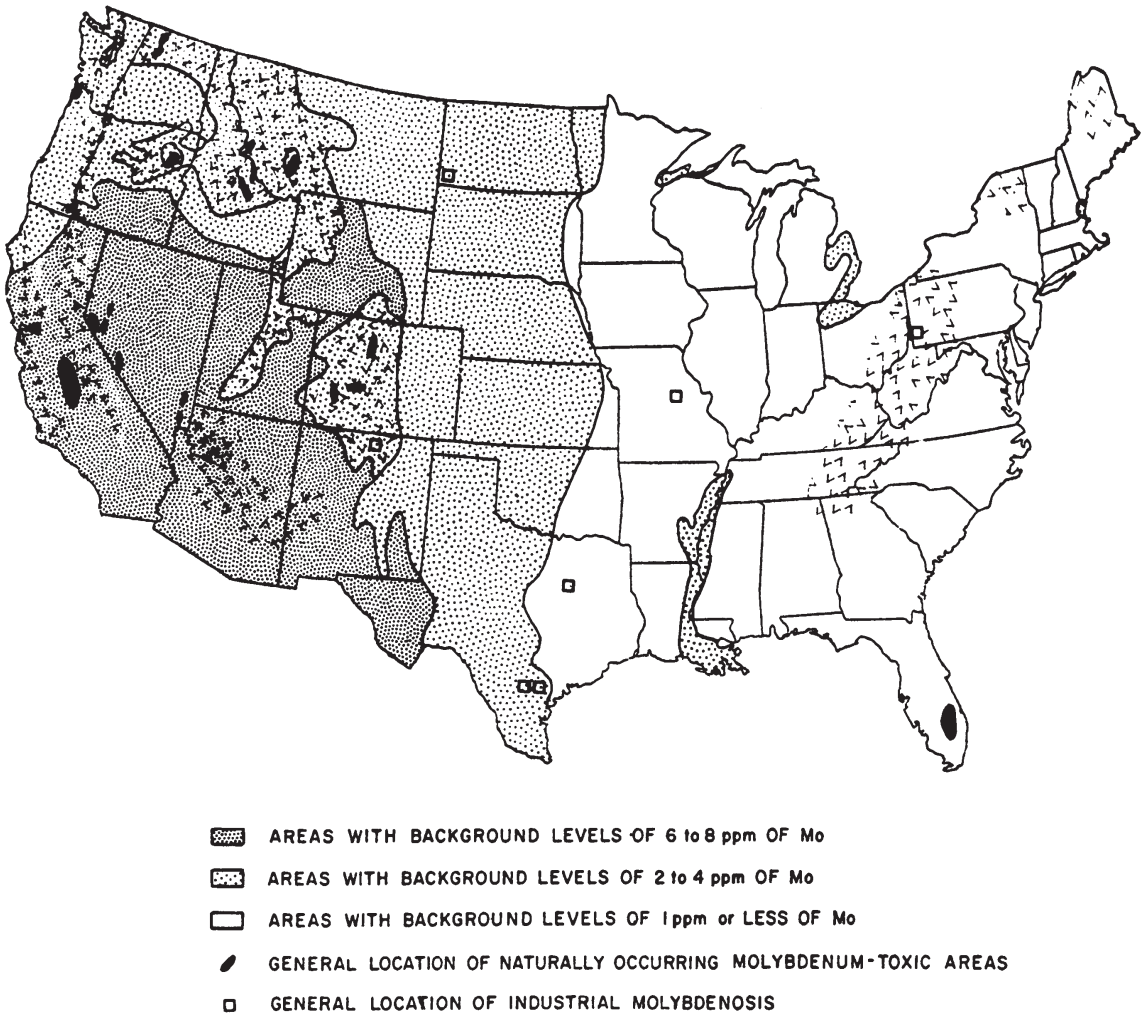


Figure 6. Generalized regional pattern of molybdenum concentration in legumes of the United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota, 1977, by courtesy Marcel Dekker, Inc.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

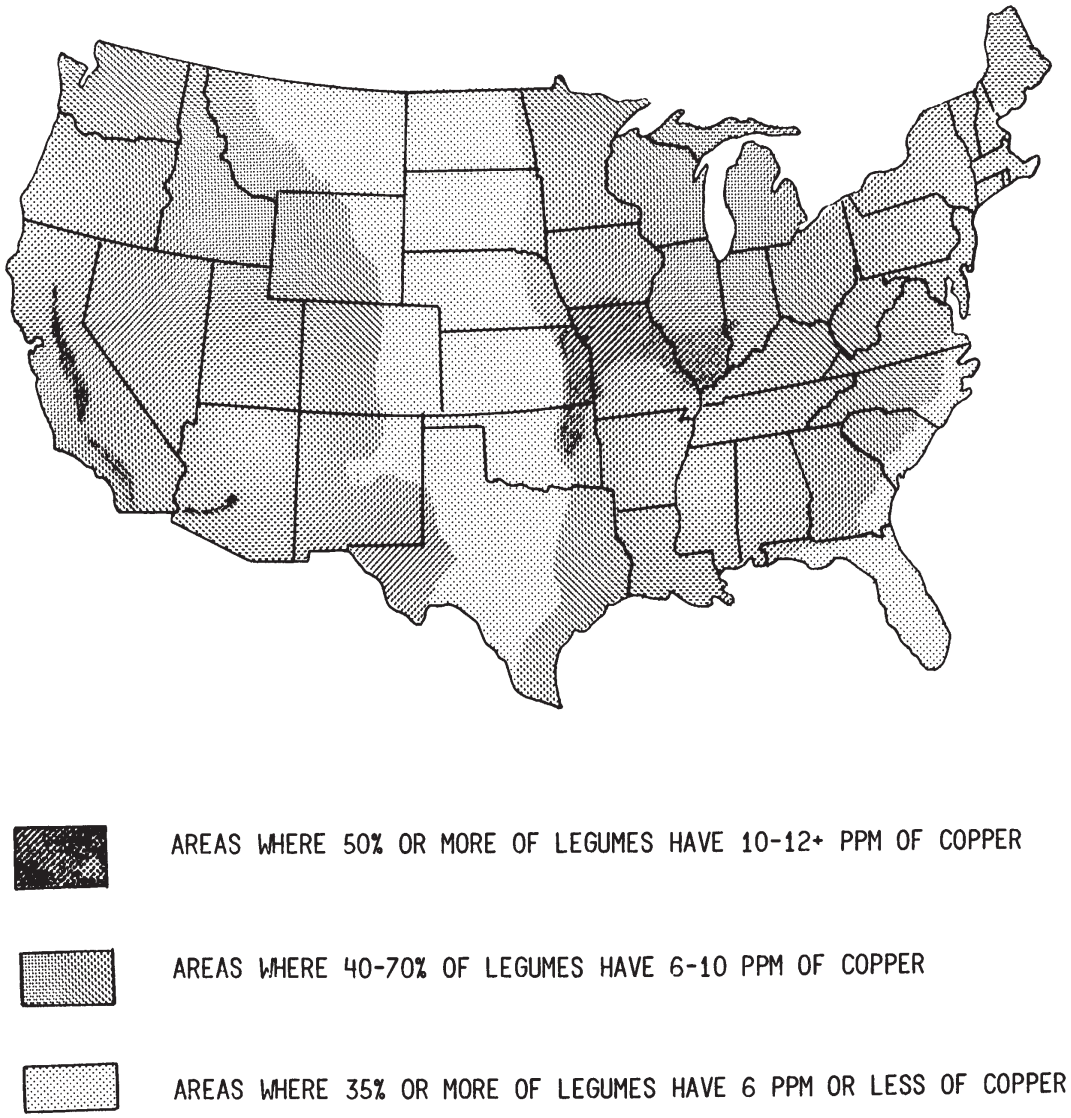


Figure 7. Generalized distribution of copper concentration in legumes of the United States (ppm = 1 μg/ g^{-1}). From Kubota, 1983a, by permission Amer. Society of Agronomy.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

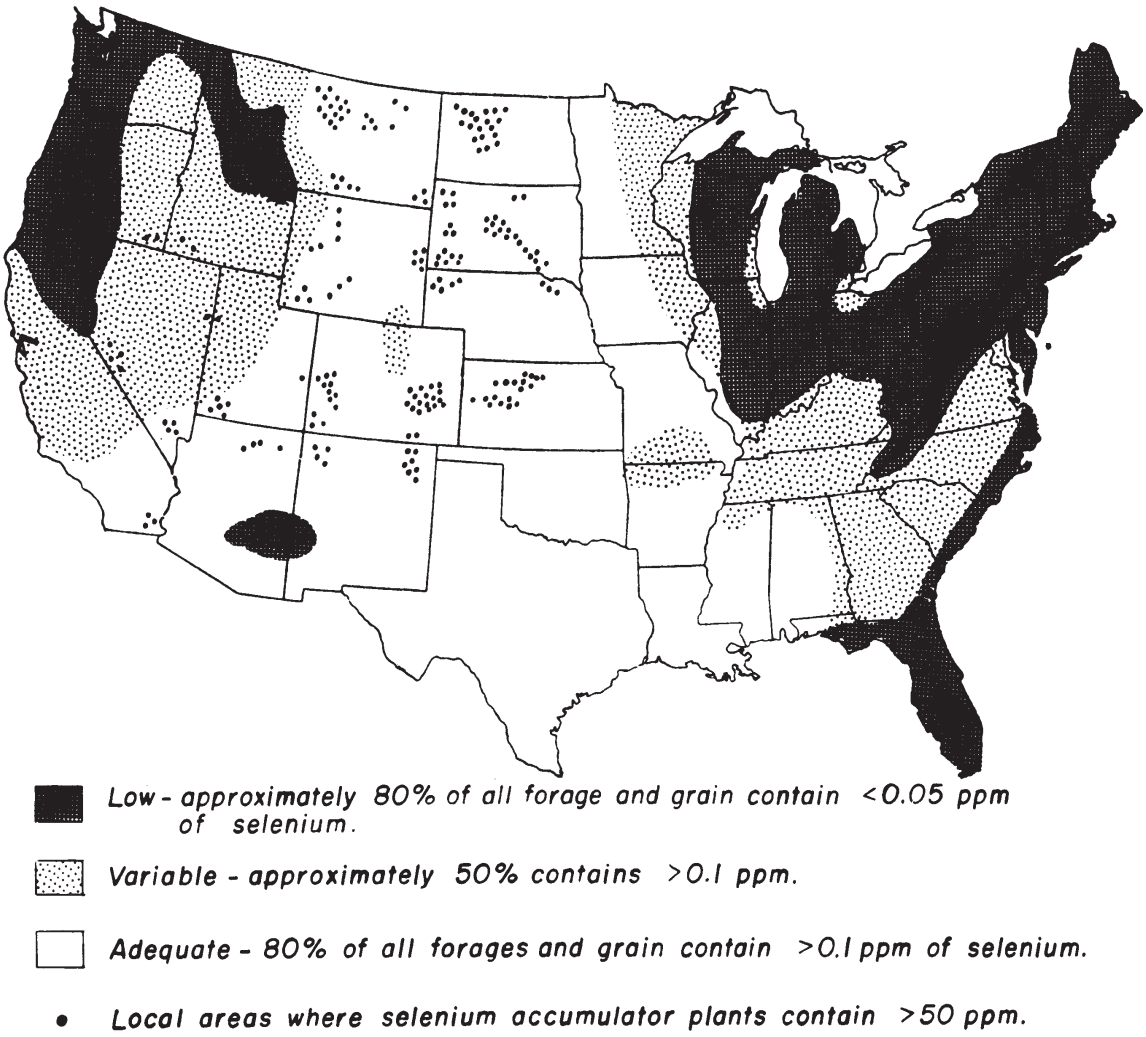


Figure 8. Geographical distribution of low-, variable-, and adequate-Se areas in the United States (ppm = 1 μg/g). From Kubota and Allaway, 1972, by permission Soil Science Society of America.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

Definitions useful for this section

Acidosis - A disease usually caused by feeding too much grain or increasing the level of grain in the diet too rapidly. It results in the rumen having very acid conditions, and endotoxins may be produced that adversely affect various parts of the body.

Body condition score - Abbreviated BCS. Applying a numerical score to describe the amount of muscle and fat cover on an animal. Usually performed by feeling along the backbone in the loin area, over the ribs, and at the breastbone (sternum). Scores range from 1 (extremely thin) to 5 (extremely obese).

Browse - Vegetative parts of woody plants, primarily leaves and twigs, that typically contain high levels of tannins.

Carbohydrates - The major energy source found in most feedstuffs. Carbohydrates contain twice as many hydrogen atoms as carbon and as many oxygen atoms as carbon, commonly designated as CH_2O. They include substances such as sugar, starch, fiber, cellulose, and hemicellulose.

Cellulose - A major structural carbohydrate in plants. A component of fiber that is poorly digested by nonruminant animals. Cellulose is composed of glucose molecules chemically linked by a "beta" linkage that is only digested by bacteria such as those in the rumen and(or) cecum.

Coccidiosis - An infectious intestinal disease caused by protozoan organisms (coccidia). The disease causes diarrhea and damages the lining of the intestine. Moisture, stress, and unsanitary conditions are conducive to coccidiosis.

Concentrates - A feed with less than 20% crude fiber and usually more than 60% TDN on an as fed basis. Often a mixture of feedstuffs with added minerals and vitamins.

Crude fiber - The more fibrous, less digestible portion of a plant primarily consisting of cellulose, hemicellulose, and lignin. A method of estimating the fiber content of a feedstuff through sequential extraction with acid and alkaline solutions.

Enterotoxemia - A disease caused by an overgrowth of bacteria (*Clostridia perfringens*) in the intestine usually due to fermentation of a large quantity of starch, with production of endotoxin. Usually causes rapid death of animals.

Fiber - A component of the feed that consists of cellulose, hemicellulose, and lignin. It is necessary for normal rumen health.

Forage - The edible part of the plant, other than separated grain, that can provide feed for grazing animals.

Founder - Refers to a consequence of acidosis, resulting in rapid growth of the hoof.

Mineral - The inorganic group of nutrients including elements such as calcium, phosphorus, copper, etc.

Nutrient - One of six classes of chemical compounds having specific functions in the nutritive support of animal life.

Nutrient requirements - The level of specific nutrients required to keep an animal healthy and productive.

Nutrition - The study of nutrients, determining what nutrients are required, what levels of nutrients are necessary for various levels of productivity, and how to provide those nutrients.

Polioencephalomalacia, PEM, or 'polio' - A neurological disease of goats caused by thiamine deficiency. The rumen normally produces adequate levels of thiamine, but under some conditions such as a high grain diet, high sulfur in the diet, stress, or being 'off feed,' the thiamine is degraded, thus causing the disease.

Stockpiled forage - Forage that is allowed to accumulate for grazing at a later time.

Supplement - A feed designed to provide nutrients deficient in the animal's main diet.

TDN - Total Digestible Nutrients, a measure of digested energy. A lb of TDN equals 2,000 Calories (kilocalories).

Vitamins - Specific organic substances required for various metabolic functions.

Financial Record Keeping

Mr. Brent Ladd

Oklahoma State University

Introduction

How can an agricultural producer define personal success? Some may measure success through profitability and positive cash flow. The quality of livestock, pasture, and farm appearance may also be signs of a successful operation. Others may measure success by the quality of life they enjoy through involvement in production agriculture.

Just as importantly, how does a producer measure their success? Questions a producer may use to measure success include whether the farm or ranch provides enough income to show a profit. Is there sufficient income to cover loan payments and pay family living expenses?

Producers need information to make management decisions in their operation. Questions might include what risks exist and what risk management strategies are required. What can be done to make the operation more profitable? Does the producer make more on crops or livestock? Should the producer buy or grow forage? Should the producer buy or raise more meat goats? Are the costs of production too high? What is the break-even price? Can the producer afford to try something new?

Effective record keeping can help a producer answer these questions and measure the success of their operation. Providing answers to these questions demonstrate the importance of financial records for an operation. These answers help evaluate alternatives and allow producers to make informed decisions relative to their needs.

Uses of Financial Records

Uses for records may include business analysis, communication, taxes, and providing documentation for government programs. Records can help producers calculate costs of production and identify profit or loss centers in the operation by accurately tracking income and expenses.

Historical business analysis provides a perspective into strengths, weaknesses, and areas for improvement. A current assessment allows a producer to identify and correct a problem before it grows larger. Forward planning can be used to implement past lessons learned and set new goals.

Business analysis allows measurement of financial performance and financial position of the operation. Records provide the necessary information to create cash flow statements, income statements, and balance sheets which are important in measuring financial performance and position. This information along with other records is useful for communicating with lenders, landlords, and business partners.

Records help in providing information at tax time. Cash records may include farm income and expenses, employee payroll, 1099s, plus asset sales and purchases. Most of these records should be kept for 3-7 years. Records can be used as documentation to qualify and maintain eligibility for government programs. These programs often require information such as crop yields, forage yields, stocking rates, acreage reports, and livestock sales.

Important Features in a Record Keeping System

An effective record keeping system should include features that facilitate business analysis using financial statements (both historical and projected), break-even analysis, enterprise analysis, investment analysis,

and risk assessment. The system may also include the ability to track costs and returns for projects that span multiple years, the ability to build budgets from records, enterprise level accounting (for example, meat goats or crops), and track custom work.

Record Keeping Options

How a producer keep records is important. It is necessary to balance time and effort required with potential benefits when choosing the method of record keeping. Producers may use notepads or notebooks, hand written record books, Excel spreadsheets specifically designed for record keeping, Quicken, Quickbooks, or specialized software for agriculture. Each method has varying degrees of ease of use and functionality.

Producers have many options, but financial record keeping begins with the check book register. The producer may record the transaction date, check number, payee, amount, and by using the memo, they can record what was purchased, how much, and for which enterprise. It is an excellent way to begin keeping records and to track the operation's income and expenses.

Quicken Features and Shortcomings

Quicken works well for cash accounting and is easy for beginners to use. It includes cash flow reporting features and investing features. Quickbooks allows double entry, accrual accounting, invoicing, accounts payable, and accounts receivable. It is a more expensive option. Quicken allows multiple accounts and may be used for budgeting, loan tracking, and tax planning. Information from Quicken may be used to generate reports and graphs. It also includes bill pay features and financial calculators. The categories feature allow users to separate transactions by type of income, expense, asset, or liability. OSU has developed a list of farm specific categories for use with Quicken.

Tags are another useful feature. These allow transactions to be sorted independent of category. They tell who, where, and what time period the transaction occurred. They may be used with categories to clearly identify each transaction. Tags can be used on transactions to provide information for project analysis. Producers can use tags to track expenses and income from a certain year's production or from a livestock show season. Quicken has the ability to generate reports and graphs on cash flow, transactions, and account balances. It can provide tax schedules and comparison reports.

Quicken has a few shortcomings when used by producers. It is not designed to keep production records. There is not a separate field to maintain physical information. It cannot maintain a depreciation schedule and does not include an invoicing feature.

Production Records

An electronic option to keep production records is the Goat Kidding Record Keeping software. Producers may use this spreadsheet to track goat kid births, birth weights, weaning weights, and parentage. This program also records identification information such as color, sex, and tag number. This program helps producers maintain information for use in making decisions on breading does and helps to measure productivity. It may be found at: http://agecon.okstate.edu/meatgoat/record.asp

Hand record books are available through the Oklahoma Cooperative Extension Service and from many lenders. One option is the Oklahoma Farm and Ranch Account book which has sections to record production information along with financial records. Producers can record breeding, birthing, and weaning records along with expenses and receipts. This record keeping system has multiple sections for records and may be customized for each producer's needs. The OSU Agricultural Economics website agecon.okstate.edu/farmbook offers links to individual pages to be printed as needed.

Benefits of Good Records

The benefits of keeping complete records include knowing the unbiased truth, gaining insights into strengths/ weaknesses of operation, and gaining a better understanding of the decision making environment. Good records also show profit and loss centers in the operation. Records can provide direction for maximizing the returns to resources owned. They provide documentation to be used in maintaining or obtaining credit. Records also give the ability to compare operation across years and benchmark against industry or state averages. Producers may use records to obtain information about the feasibility of new ventures. Records can show where there is production or financial risk and appropriate risk management measures to mitigate these risks.

Conclusion

Business management requires that producers focus on financial performance as well as production performance. A simple to use and consistent record keeping system is part of the process. Successful managers discover that life is a whole lot easier saving or making money through record keeping. The producer can then manage what has been measured. Goat producers interested in being profitable should expect to do no less.

References

Doye, D. (2013). Evaluating Financial Performance and Position. OSU Extension Facts AGEC-790, Cooperative Extension Service, Oklahoma State University. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1814/AGEC-790web2013.pdf

Doye, D. (2013). Farm and Ranch Financial Trends Worksheet. OSU Extension Facts AGEC-238, Cooperative Extension Service, Oklahoma State University. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1656/AGEC-238-2013.pdf

Doye, D. (2013). Farm and Ranch Stress Test. OSU Extension Facts AGEC-237, Cooperative Extension Service, Oklahoma State University. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1821/AGEC-237-2013.pdf

Doye, D. (2013). Goal Setting for Farm and Ranch Families. OSU Extension Facts AGEC-244, Cooperative Extension Service, Oklahoma State University. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1674/AGEC-244web2013.pdf

Doye, D. (2015). Ranch Business Planning and Management. In D. Doye & Lalman, D. (Eds.), Beef Cattle Manual (pp. 15-20). Stillwater, OK: Oklahoma Department of Career and Technology Education.

Doye, D. (2002). Record Keeping (and other Fun Farm Management Jobs) [PowerPoint Slides].

Doye, D. (2011). Record Keeping: Chore or Change Motivator? [PowerPoint Slides].

Doye, D. (2015). Quicken for Farm Financial Records [PowerPoint Slides].

Doye, D. & Ladd, B. (2015). Developing a Balance Sheet. OSU Extension Facts AGEC-752, Cooperative Extension Service, Oklahoma State University. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1805/AGEC-752web2015.pdf

Doye, D. & Ladd, B. (2015). Developing a Cash Flow Plan. OSU Extension Facts AGEC-751, Cooperative Extension Service, Oklahoma State University. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1782/AGEC-751web2015.pdf

Doye, D., Shippman, L., & Ladd, B. (2015). Developing an Income Statement. OSU Extension Facts AGEC-753, Cooperative Extension Service, Oklahoma State University. http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1789/AGEC-753web2015.pdf

OCES. (2015). Goat Kidding Records Software. Accessed at: http://agecon.okstate.edu/meatgoat/record.asp

DHI Training

Ms. Eva Vasquez
Langston University

STANDARD OPERATING PROCEDURES FOR DAIRY GOAT PRODUCTION TESTING

Effective January 1, 2004

CONTENTS

STANDARD OPERATING PROCEDURES

1.0 SCOPE & APPLICATION

1.1 This Standard Operating Procedure (SOP) is applicable to the systematic collection of data documenting milk yield including the measuring milk fat and protein for participants in DHI. The application of these procedures is to provide the framework for a uniform, accurate record system to be used for (1) making farm management decisions; (2) educational programs and research, including the genetic evaluation of does and sires; (3) breed association(s); and (4) the promotion and sale of animals.

2.0 SUMMARY OF PROGRAM

2.1 Sampling should be done in accordance with the National DHIA Uniform Operating Procedures (UOP). All UOP procedures, unless specific to dairy cows only, are to be followed. For purposes of compliance, the use of the terms “cows and heifers” is synonymous with “goats and kids”.

2.2 Procedures outlined in this document are specific to dairy goat production testing only. These basic and minimum standards are to be uniformly followed. They serve to ensure that records will provide the accuracy, uniformity, and integrity essential to dairy goat production records.

3.0 AUTHORITY

3.1 A Memorandum of Understanding exists between the ADGA and the Agricultural Research Service of the United States Department of Agriculture (USDA) to ensure the flow of DHIA records for industry purposes including genetic evaluation programs.

4.0 RESPONSIBILITY

4.1 DHIA dairy goat test supervisors and herd owners as well as persons in their employ are individually and collectively responsible for adherence to these Procedures.

4.2 To participate in this dairy record keeping program, herdowners must agree to conform to these procedures, registry requirements, the NDHIA Uniform Operating Procedures and the associated Code of Ethics.

5.0 DEFINITIONS

5.1 **Dairy Goat -** any goat from which milk production is intended for use or sale, or which is kept for raising replacement dairy kids and is an integral part of the dairy herd.

5.2 **Test Supervisor (TS) –** Any person authorized to collect milk weights and samples for inclusion in the Goat Genetic Evaluation Program (interchangeable with ‘tester’, ‘field sampler/technician’ or ‘supervisor’).

5.3 **Group Testing** – Must meet registry requirements. Each member of the test group is trained to perform supervisor responsibilities when weighing and sampling milk in the herds of other group members. All group testing is conducted under the jurisdiction and supervision of the DHIA.

6.0 PERSONNEL QUALIFICATIONS

6.1 All Test Supervisors are required to be approved by the DHIA of record prior to engaging in any field collection activities.

6.2 Training should be done in accordance with the Council on Dairy Cattle Breeding (CDCB) QCS Field Service requirements with the following being specific to dairy goat testing.

7.0 MINIMUM PERSONNEL TRAINING REQUIREMENTS

7.1 The minimum requirements for new test supervisors (TS) to test non-commercial herds (as determined by the herd's DHIA) without immediate supervision include demonstrated knowledge of (1) barn and parlor techniques, (2) data entry, (3) the *Code of Ethics* and *Uniform Data Collection Procedures, and (4) the Standard Operating Procedures for Dairy Goat Testing*. Commercial herds must have testers meeting the criteria of the CDCB auditing guidelines.

7.2 Documentation of the initial training must include (1) the name and date of training of the new TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.3 Continuing Education (CE) or refresher sessions should be provided in accordance with the CDCB Auditing guidelines. In addition, newsletters, videos, attendance at an ADGA annual meeting training session can serve as meeting CE requirements. Documentation must include (1) the name of each TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.4 TS other than those approved to test cowherds or commercial herds (as determined by the herd's DHIA) must obtain CE or attend an initial or a refresher session every 3 years. This is an exception to the CDCB auditing guidelines as it applies to those testers supervising herds using 'pail and scale' techniques. This exception is allowed as this type of test plan is subject to little change over time. Documentation of CE/Refresher must include (1) the name of each TS, (2) the name and credentials of the evaluator, (3) a list of the topics covered during the evaluation, and (4) a performance assessment based upon the CE/Refresher information provided.

8.0 EQUIPMENT AND SUPPLIES

8.1 Equipment needed for collection of dairy goat milk samples includes:

- sample vials or whirl paks*
- approved meter*, or
- sampling device (dipper) and scale*
- sample preservative
- field data sheets

*The appropriate sampling and measuring devices must be of proper composition. See Section 10 for SOP Meters and Scales

9.0 SAMPLE COLLECTION – PREPARATION

9.1 Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.

9.2 Obtain necessary sampling and/or weighing equipment.

9.3 Coordinate with herdowner and partner agencies, if appropriate.

10.0 SAMPLE COLLECTION - METHOD OPTIONS

10.1 Meters **-** All portable weighing and sampling devices being used for the generation of certified data must be of a National DHIA approved type. Meters for goat milk sampling must be calibrated in conformance to manufacturer specifications.

GOAT METERS

Manufacturer	Device	ICAR Approved	DHIA Approved
Tru-Test Limited - New Zealand	Goat Meter model 50000		Yes
Waikato - New Zealand	Goat Meter		Yes

10.2 Scales being used for the generation of milk weights to be included in the *Goat Genetic Evaluation Program* must meet the following weight tolerance ranges at each specified weight:

Pounds	Minimum	Maximum
1	0.9	1.1
2	1.9	2.1
5	4.8	5.2
10	9.7	10.3
20	19.4	20.6

10.3 All scales must be checked for calibration by a certified meter technician or an individual approved by the DHIA prior to being placed in active service. The field technician or the herdowner may own Scales. Approved individuals must calibrate scales using certified weights.
10.4 Scales should be identified with a unique identification number.
10.5 All scales must be submitted for an approved routine calibration check by a certified meter technician or an individual approved by the local DHIA on an annual basis.
10.6 All scales receiving repairs that may have affected accuracy must be checked for calibration by a certified meter technician or an individual approved by the local DHIA before returning to active service.
10.7 Each scale must be identified with a tag, sticker, engraving, or other marking indicating the last calibration year and meter center used.
10.8 Documentation of scales must include (1) the make and unique identification number of the scale, (2) the meter technician's or approved individual's name, (3) the meter center used, (4) the date of calibration check, and (5) the final calibration check readings.
10.9 Dip Sampling must be done in a manner that assures a representative sample from the entire milk volume collected.

11.0 SAMPLE HANDLING AND PRESERVATION

11.1 Use pre-preserved sample vials.
11.2 Samples should be kept at room temperature and out of direct sunlight.
11.3 Keep samples in control of the tester – ***EXCEPTION*** – for group tests, samples may also be in control of the group leader, or person designated to ship the samples/data to the laboratory.
11.4 Record all pertinent data on a field data sheet.
11.5 Samples should be shipped so that they arrive at the lab no later than 6 days after the test is performed.

12.0 DATA COLLECTION AND RECORDS MANAGEMENT

12.1 When a breeding date is available, and a doe freshens less than 10 days prior to the expected kidding date, it will be considered a normal kidding and the record initiated will be used for buck and doe evaluations. Does freshening 10 days or more prior to the expected kidding date, whether in milk or dry, will be coded as abnormal and the record initiated will not be used for buck and doe evaluations.
12.2 If a doe aborts while in milk and has carried a kid less than 80 days, her current record will continue without interruption. If a breeding date is not available, and the doe aborts while in milk for less than 240 days, her current record shall continue without interruption. Except for specific situations stated above, the current record shall end and a new lactation will begin.
12.3 Verification tests may be a required condition of test type plan or registry recognition level. It is the herdowner's and/or test supervisor's responsibility to arrange for such tests dependent on registry or regional requirements. Verification testing should be done in accordance with registry policies.
12.4 All data and information must be documented on field data sheets
12.5 Minimum Suggested Record Retention

- Field Sheets – 2 years
- Record Center sheets – 2 years
- Verification Sheets – 2 years

13.0 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)

All field QC requirements of the ADGA QA Project must be followed.

14.0 REFERENCES

Dairy Goat Registry Guidelines, 2003
Uniform Operating Procedures, June 2002
California DHIA, Dairy Goat QC Program
Council on Dairy Cattle Breeding, Auditing Guidelines, June 2002

Herd Data For Next Test

Date of Test			Technician	Net Per CWT		%	Fat Differential		%	Pro Differential	
Month	Day	Year	Number	$	Cents	Fat	Cents	10ths	Pro	Cents	10ths

Bulk Tank Weights	# Milkings	Total Lbs	SCC	MUN	
Pickup 1					Entire Herd Milked 3X
Pickup 2					_____
Pickup 3					

Milking	Start Time	End Time	Sampled	Weighed	Previous Test		
					Samp.	Wgh	Start Time
1st Milking (Prior for AM/PM)	: AM PM	: AM PM	Y N	Y N			
2nd Milking (Weigh for AM/PM)	: AM PM	: AM PM	Y N	Y N			
3rd Milking (3X Herd)	: AM PM	: AM PM	Y N	Y N			

HERD CODE ____-____-_____

TRANSFER DOES

DOE				CODE	COMPLETE THIS SECTION IF COW TRANFERS FROM ANOTHER HERD ON TEST			
					OLD HERD CODE			
INDEX NO.	REGISTRATION OR EARTAG NO.	BR	BARN NAME		STATE	COUNTY	HERD NO.	INDEX NO.
				T				
				T				
				T				
				T				

BREED CODES FOR NEW AND TRANSFER DOES

A - ALPINE	E - EXPERIMENTAL	S - SAANEN
B - OBERHASLI	L - LA MANCHA	T - TOGGENBURG
C - SABLE	N - NUBIAN	M - MIXED
D - NIGERIAN DWARF	P - PYGMY	

A-RECORD AN "A" IF ADDING 1ST LACTATION DOE WITH DRPC COMPUTER REF. NUMB.
C-RECORD A "C" IF CORRECTING EXISTING DOE.

NEW DOES ENTERING THE HERD OR IDENTITY CORRECTION

DOE				DATE OF BIRTH			SIRE		DAM			KID'S SIRE IDENTITY		CODE	DRPC COMPUTER REFERENCE NUMBER
INDEX NO.	REGISTRATION OR EARTAG NO.	BR	BARN NAME	MONTH	DAY	YEAR	UNIFORM AI CODE NUMBER REGISTRATION OR EARTAG	BR	REGISTRATION OR EARTAG NO.	BR	BARN NAME	SIRE CODE EARTAG OR OTHER NUMBER	BR		

SUPERVISOR'S BARN SHEET

DHI-201

Supervisor's Signature

Herd Code _____ - _____ - _____

Test Date		
Mo	Day	Yr

Type Test		Sched. Day		Assoc.		Supv.		Cows In Herd		Cow Months		Total Fees	

String	Old Status: Code / Brd	Old Status: Date / Reg/Tag Number	Old Status: Last Milk	Cow Index	Milk Weights: Milking 1st	Milking 2nd	Milking 3rd	Feed Prg or Conc. Fed 2	CAR	Conc. Fed 1	Sample No.	Batch	Barn Name	New Status: Code	New Status: Date Changed Mo	Date Changed Day	New Repro Status: No. Br.	Repro Code	Bred or Heat Date Mo	Bred or Heat Date Day	Calf Identity or Service Sire: Calf: Tattoo, Tag, or Other / Sire: Reg No. or Bull Code	Sex	Disp	Calf Number	Body Wt.	Birth Diff.	Old Repro Status: No. Br.	Repro Code	Due Date / Bred or Heat Date	Error Code

Status Codes
2. Calved
3. Dry
5. Left Herd
6. First Lact
7. Entered Herd
8. Aborted
9. Induced Lact

Condition Affecting Record (CAR)
1. Sold Feet/Legs
2. Sold Dairy
3. Sold Low Prod.
4. Sold Repro.
5. Sold Injury/Other
6. Died
7. Sold Mastitis
8. Sold Disease
9. Sold Udder
X. Sold Reason Not Rprtd.
A. Abnormal
H. In Heat on Test Day
E. Milk Weight Missed
I. Injected on Test Day
F. Sample Missed

Repro. Codes
1-9 No. Breedings
C. DNB (Do Not Breed)
H. In Heat
K. Checked OK to Breed
N. Open
P. Diagnosed Pregnant

Birth Difficulty
1. No Problem
2. Slight Problem
3. Needed Assistance
4. Considerable Force
5. Extreme Difficulty

Disposition Codes
B. Died, Birth
E. Died, 1st 24 Hrs
1. Died, Scours
2. Died, Respiratory
3. Died, Disease
4. Died, Other
5. Sold, Dairy
7. Sold, Other
T. Embryo Transplant

Condition Codes From Previous Test
1. Bred Date Removed
2. Calving Date Missing
3. Dry Date Missing - Estimated
4. Milk Weights Missing - Estimated
5. Milk Weights Abnormal
6. Cow ID Missing
7. Reported Sire of Cow Invalid
8. Calving Dates Less Than 200 Days Apart
9. New Cow ID Invalid

Calf Sex
F. Female
M. Male
7. Unknown

Date_____ 2015 Langston DHI Supervisor Test

(Must return by Mar. 1, 2015 if you want a certificate)

Were you previously certified by Langston to be a supervisor?

Yes No

Name:_____

Address:_____

City:_____ **State:**_____ **Zip:**_____

Telephone:_____

Who do you test for:_____ **E-mail** _____

1. A transfer doe is….
   A: A doe from another herd on test, that is entering your herd.
   B: A doe in your herd that has just freshened.
   C: A doe coming into your herd who has not been on test before.
   O: None of the above.

2. A verification test consist of how many milkings?
   A: 1
   8: 2
   C: 3
   O: 1 AM& 1PM

3. If I have a milk weight entered for a doe, and she has a O in the second column on the barn sheet (OMS 201) there is no problem.

   True _____False

4. Before sending the paperwork, I always ensure that I have put down fresh dates for does that have freshened and dry dates for does that have since the last test.

   True False

5. If I have not put down a milk weight for a doe who has an I in the second column on the barn sheet (OMS 20I) there is no problem.

   True False

Langston DHIA
Invoice

Herd Code # _____

Herd Owner _____

Verification Test YES NO

Service Affiliate Fee
DMS 201 _____x $.08 _____

Herd Processing Fee 01 – 20 does = $6.00 _____
21 – 40 does = $7.00
41 – 60 does = $8.00
61 – 80 does = $9.00
81 – 100 does = $10.00

Milk Analysis Fee
Total Samples _____ x $1.15 _____

Accounting Fee ……..$2.00

No Cash. Check or Money Order Only Please

Total _____

HERD OWNERS:
YOU MUST RETURN THIS SHEET BEFORE YOUR HERD WILL BE PROCESSED!
THIS SHEET MUST BE FILLED OUT BY THE HERDOWNER!

Number of Does dried this month _____

Number of Does freshened this month _____

Does Dried:

INDEX # DRY DATE

Does Freshened:

INDEX # FRESH DATE

(COPY THIS SHEET IF MORE SPACE IS NEEDED)

Langston University Goat DHIA
Agriculture Research & Cooperative Extension

E.L. Holloway Agriculture Research, Extension, and Education Center
Langston University
PO Box 1730
Langston, OK 73050
405-466-6207
dhi@langston.edu

Acknowledgement of Membership Agreement
in the Langston University Goat DHIA

As the owner of dairy goats and being interested in making my herd more efficient and more profitable through the use of herd management records as provided to members of this association, I hereby apply for membership of the above organization and desire DHIA-like testing services.

Should my membership be accepted, I agree:

1. To comply with all rules, regulations, administrative procedures and policies now in effect or established by the association during my continued membership, and I acknowledge receipt of a copy of existing rules, regulations, and policy manual which I have read and understand;
2. To comply with the National Dairy herd Improvement Program Uniform Operating Procedures as approved by the Council on Dairy Cattle Breeding and requests from Dairy Records Management Systems, and to be responsible equally with the supervisor in seeing that all rules and regulations are complied with in obtaining production records for my herd;
3. To cooperate with the supervisor if a supervisor is used in the testing plan which I am enrolled in and to provide him/her access to whatever information I control or have so as to enable him/her to keep complete records for my herd, specifically including but not limited to freshening and dry dates, purchase and sales dates, identification of all animals and plant delivery weights on milk sold.

_____ _____
Date Signature of Applicant

Applicant name:

Name: _____

Address: _____

City State Zip: _____

Phone: _____ Email: _____

Agreement accepted this _____day of _____ 20__ as a member, the applicant is entitled to all rights, benefits and privileges of this organization.

_____
Langston University Goat DHIA Representative

USDA Farm Bill

Mr. Phil Estes
USDA FSA

USDA

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

2014 Farm Bill

FACT SHEET

March 2014

What's In the 2014 Farm Bill for Farm Service Agency Customers?

The Agricultural Act of 2014 (the Act), also known as the 2014 Farm Bill, was signed by President Obama on Feb. 7, 2014. The Act repeals certain programs, continues some programs with modifications, and authorizes several new programs administered by the Farm Service Agency (FSA). Most of these programs are authorized and funded through 2018.

OVERVIEW

The Direct and Counter-Cyclical Program and the Average Crop Revenue Election programs are repealed and replaced by two new programs, Price Loss Coverage (PLC) and Agricultural Risk Coverage (ARC). Upland cotton is the only covered commodity that is no longer eligible to participate in these programs, but rather, becomes eligible for the new Stacked Income Protection Plan (STAX) offered by the Risk Management Agency (RMA). Until STAX becomes available, upland cotton is eligible for transition payments made by FSA for 2014 and 2015 crops.

The Marketing Assistance Loan program and sugar loans continue mostly unchanged. The Milk Income Loss Contract Program continues through Sept. 1, 2014, unless it is replaced by the Dairy Margin Protection Program prior to that date.

The Conservation Reserve Program (CRP), USDA's largest conservation program, continues through 2018 with an annually decreasing enrolled acreage cap. The contract portion of the Grassland Reserve Program enrollment has been merged with CRP. The Biomass Crop Assistance Program is extended and funded at $25 million per year.

The Noninsured Crop Disaster Assistance Program has been expanded to include protection at higher coverage levels, similar to buy-up provisions offered under the federal crop insurance program. The Livestock Forage Disaster Program, the Livestock Indemnity Program, the Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish, and the Tree Assistance Program are continued, with modifications starting in October 2011, and succeeding years. The Supplemental Revenue Assistance Program (SURE), which covered losses through Sept. 30, 2011, is not reauthorized.

The credit title of the Act continues and improves the direct and guaranteed loan programs that provide thousands of America's farmers and ranchers the opportunity to obtain the credit they need to begin and continue their operations. The changes in the act provide FSA greater flexibility in determining eligibility including expanded definitions of eligible entities, years of experience for farm ownership loans, and allowing youth loan applicants from urban areas to access loans. FSA's popular microloan and down payment loan programs, important to furthering the Administration's objective of assisting beginning farmers, have been improved by raising loan limits and emphasizing beginning and socially disadvantaged producers. The act also provides greater enhancements for lenders to participate in the guaranteed conservation loan program and eliminates term limits for the guaranteed operating program, allowing farmers and ranchers the opportunity for continued credit in cases where financial setbacks may have prevented them from obtaining commercial credit.

ADJUSTED GROSS INCOME

Adjusted gross income (AGI) provisions have been simplified and modified. Producers whose average AGI exceeds $900,000 during a crop, fiscal, or program year are not eligible to participate in most programs administered by FSA and the Natural Resources Conservation Service (NRCS). Previous AGI provisions distinguished between on-farm and nonfarm AGI.

PAYMENT LIMITATIONS

The total amount of payments received, directly and indirectly, by a person or legal entity (except joint ventures or general partnerships) for Price

FACT SHEET

What's In the 2014 Farm Bill for FSA Customers March 2014

Loss Coverage, Agricultural Risk Coverage, marketing loan gains, and loan deficiency payments (other than for peanuts), may not exceed $125,000 per crop year. A person or legal entity that receives payments for peanuts has a separate $125,000 payment limitation.

Cotton transition payments are limited to $40,000 per year. For the livestock disaster programs, a total $125,000 annual limitation applies for payments under the Livestock Indemnity Program, the Livestock Forage Program, and the Emergency Assistance for Livestock, Honey Bees and Farm-Raised Fish program. A separate $125,000 annual limitation applies to payments under the Tree Assistance Program.

ACTIVELY ENGAGED IN FARMING

Producers who participate in the Price Loss Coverage or Agricultural Risk Coverage programs are required to provide significant contributions to the farming operation to be considered as "actively engaged in farming." The act requires the Secretary to promulgate regulations to define "significant contribution of active personal management" as part of this determination.

COMPLIANCE

The Act continues to require an acreage report for all cropland on the farm. The acreage report is required to be eligible for Price Loss Coverage; Agriculture Risk Coverage; transition assistance for producers of upland cotton; marketing assistance loans; and loan deficiency payments.

Compliance with Highly Erodible Land Conservation (HELC) and Wetland Conservation (WC) provisions continues to be required for participation in most FSA and NRCS programs. These provisions place restrictions on the planting of an agricultural commodity on highly erodible land or wetlands. Further, they prohibit the conversion of a wetland to make possible the production of an agricultural commodity.

The Act adds premium assistance for crop insurance as a benefit subject to compliance with HELC and WC provisions. New provisions are created for determinations, administration, and penalties relating to HELC and WC provisions that are unique to crop insurance. FSA will make HELC/WC eligibility determinations for crop insurance participants based on NRCS technical determinations of HELC/WC compliance.

PRICE LOSS COVERAGE (PLC) AND AGRICULTURAL RISK COVERAGE (ARC)

Base Reallocation and Yield Updates: Owners of farms that participate in PLC or ARC programs for the 2014-2018 crops have a one-time opportunity to: (1) maintain the farm's 2013 bases through 2018; or (2) reallocate base acres (excluding cotton bases). Covered commodities include wheat, oats, barley, corn, grain sorghum, rice, soybeans, sunflower seed, rapeseed, canola, safflower, flaxseed, mustard seed, crambe and sesame seed, dry peas, lentils, small chickpeas, and large chickpeas. Upland cotton is no longer considered a covered commodity, but the upland cotton base acres on the farm are renamed "generic" base acres. Producers may receive payments on generic base acres if those acres are planted to a covered commodity.

A producer also has the opportunity to update the program payment yield for each covered commodity based on 90 percent of the farm's 2008-2012 average yield per planted acre, excluding any year when no acreage was planted to the covered commodity. Program payment yields are used to determine payment amounts for the Price Loss Coverage program.

Price Loss Coverage: Payments are issued when the effective price of a covered commodity is less than the respective reference price for that commodity established in the statute. The payment is equal to 85 percent of the base acres of the covered commodity times the difference between the reference price and the effective price times the program payment yield for the covered commodity.

County ARC: Payments are issued when the actual county crop revenue of a covered commodity is less than the ARC county guarantee for the cov-

FACT SHEET

What's In the 2014 Farm Bill for FSA Customers March 2014

ered commodity and are based on county data, not farm data. The ARC county guarantee equals 86 percent of the previous five-year average national farm price, excluding the years with the highest and lowest price (the ARC guarantee price), times the five-year average county yield, excluding the years with the highest and lowest yield (the ARC county guarantee yield). Both the guarantee and actual revenue are computed using base acres, not planted acres. The payment is equal to 85 percent of the base acres of the covered commodity times the difference between the county guarantee and the actual county crop revenue for the covered commodity. Payments may not exceed 10 percent of the benchmark county revenue (the ARC guarantee price times the ARC county guarantee yield).

Individual ARC: Payments are issued when the actual individual crop revenues, summed across all covered commodities on the farm, are less than ARC individual guarantees summed across those covered commodities on the farm. The farm for individual ARC purposes is the sum of the producer's interest in all ARC farms in the state. The farm's ARC individual guarantee equals 86 percent of the farm's individual benchmark guarantee, which is defined as the ARC guarantee price times the five-year average individual yield, excluding the years with the highest and lowest yields, and summing across all crops on the farm. The actual revenue is computed in a similar fashion, with both the guarantee and actual revenue computed using planted acreage on the farm. The individual ARC payment equals: 65 percent of the sum of the base acres of all covered commodities on the farm, times the difference between the individual guarantee revenue and the actual individual crop revenue across all covered commodities planted on the farm. Payments may not exceed 10 percent of the individual benchmark revenue.

Election Required: All of the producers on a farm must make a one-time, unanimous election of: (1) PLC/County ARC on a covered-commodity-by-covered-commodity basis; or (2) Individual ARC for all covered commodities on the farm. If the producers on the farm elect PLC/County ARC, the producers must also make a one-time election to select which base acres on the farm are enrolled in PLC and which base acres are enrolled in County ARC. Alternatively, if individual ARC is selected, then every covered commodity on the farm must participate in individual ARC. The election between ARC and PLC is made in 2014 and is in effect for the 2014 – 2018 crop years. If an election is not made in 2014, the farm may not participate in either PLC or ARC for the 2014 crop year and the producers on the farm are deemed to have elected PLC for subsequent crop years, but must still enroll their farm to receive coverage. If the sum of the base acres on a farm is 10 acres or less, the producer on that farm may not receive PLC or ARC payments, unless the producer is a socially disadvantaged farmer or rancher or is a limited resource farmer or rancher. Payments for PLC and ARC are issued after the end of the respective crop year, but not before Oct. 1.

In 2015, producers in PLC have an additional option. Producers enrolling in PLC, and who also participate in the federal crop insurance program, may, beginning with the 2015 crop, make the annual choice whether to purchase additional crop insurance coverage called the Supplemental Coverage Option (SCO). SCO provides the producer the option of covering a portion of his or her crop insurance deductible and is based on expected county yields or revenue. The cost of SCO is subsidized and indemnities are determined by the yield or revenue loss for the county or area.

COTTON TRANSITION

For the 2014 crop year, transition payments are provided to cotton producers on farms that had cotton base acres in 2013. For the 2015 crop year, transition payments will only be offered in counties where STAX is unavailable.

MARKETING ASSISTANCE LOANS (MALS) AND SUGAR LOANS

The Act extends the authority for sugar loans for the 2014 – 2018 crop years and nonrecourse marketing assistance loans (MALs) and loan deficiency payment (LDPs) for the 2014 – 2018 crops of wheat, corn, grain sorghum, barley, oats, upland cotton, extra-long staple cotton, long grain rice, medium grain rice, soybeans, other oilseeds (including sunflower seed, rapeseed, canola,

FACT SHEET

What's In the 2014 Farm Bill for FSA Customers March 2014

safflower, flaxseed, mustard seed, crambe and sesame seed), dry peas, lentils, small chickpeas, large chickpeas, graded and nongraded wool, mohair, honey, unshorn pelts and peanuts. Provisions are mostly unchanged from the 2008 Farm Bill, except marketing loan gains and loan deficiency payments are subject to payment limitations.

DAIRY PROGRAMS

The Act extends the Milk Income Loss Contract Program (MILC) from Oct. 1, 2013, through the earlier of the date on which the Secretary certifies that the Dairy Margin Protection Program is operational or Sept. 1, 2014. Dairy producers who were enrolled in 2013 do not need to re-apply. MILC payments are issued when the Boston Class I milk price falls below $16.94 per hundredweight (cwt), as adjusted by a dairy feed ration formula.

The Dairy Margin Protection Program replaces MILC and will be effective not later than Sept. 1, 2014, through Dec. 31, 2018. The margin protection program offers dairy producers: (1) catastrophic coverage, at no cost to the producer, other than an annual $100 administrative fee; and (2) various levels of buy-up coverage. Catastrophic coverage provides payments to participating producers when the national dairy production margin is less than $4 per hundredweight (cwt). The national dairy production margin is the difference between the all-milk price and average feed costs. Producers may purchase buy-up coverage that provides payments when margins are between $4 and $8 per cwt. To participate in buy-up coverage, a producer must pay a premium that varies with the level of protection the producer elects.

In addition, the Act creates the Dairy Product Donation Program. This program is triggered in times of low operating margins for dairy producers, and requires USDA to purchase dairy products for donation to food banks and other feeding programs.

Dairy Indemnity Payment Program (DIPP)

The DIPP provides payments to dairy producers when a public regulatory agency directs them to remove their raw milk from the commercial market because it has been contaminated by pesticides and other residues.

CONSERVATION RESERVE PROGRAM (CRP)

The Act continues CRP with modifications. The acreage cap is gradually lowered to 24 million acres for fiscal years 2017 and 2018. The requirement to reduce rental payments under emergency haying and grazing is eliminated. Rental payment reductions of not less than 25 percent are required for managed haying and grazing.

Producers also are given the opportunity for an "early-out" from their CRP contracts, but only in fiscal year 2015. The rental payment portion of the Grassland Reserve Program enrollment has been incorporated into the CRP.

The Transition Incentive Program (TIP) continues to allow for the transition of CRP land to a beginning or socially disadvantaged farmer or rancher so land can be returned to sustainable grazing or crop production. TIP now includes eligibility for military veterans (i.e., veteran farmers).

BIOMASS CROP ASSISTANCE PROGRAM (BCAP)

BCAP provides incentives to farmers, ranchers and forest landowners to establish, cultivate and harvest eligible biomass for heat, power, bio-based products, research and advanced biofuels. Crop producers and bioenergy facilities can team together to submit proposals to USDA for selection as a BCAP project area. BCAP has been extended through 2018 and is funded at $25 million per fiscal year.

NONINSURED CROP DISASTER ASSISTANCE PROGRAM (NAP)

NAP has been expanded to include buy-up protection, similar to buy-up provisions offered under the federal crop insurance program. Producers may elect coverage for each individual crop between

FACT SHEET
What's In the 2014 Farm Bill for FSA Customers March 2014

50 and 65 percent, in 5 percent increments, at 100 percent of the average market price. Producers also pay a fixed premium equal to 5.25 percent of the liability. The waiver of service fees has been expanded from just limited resource farmers also to include beginning farmers and socially disadvantaged farmers. The premiums for buy-up coverage are reduced by 50 percent for those same farmers. Grazing land is not eligible for buy-up coverage. NAP is also made available to producers that suffered a loss to a 2012 annual fruit crop grown on a bush or tree in a county declared a disaster by the Secretary due to a freeze or frost.

RTCP FOR GEOGRAPHICALLY DISADVANTAGED FARMERS AND RANCHERS

The Reimbursement Transportation Cost Payment Program (RTCP) is re-authorized to provide assistance to geographically disadvantaged farmers and ranchers for a portion of the transportation cost of certain agricultural commodities or inputs.

EMERGENCY LOANS

A Secretarial disaster designation or a Presidential declaration provides producers with emergency loans to help cover the recovery costs for physical and production losses. Farm bill revisions expand the type of entities eligible for loans.

FARM OPERATING LOANS AND MICROLOANS

Farm Operating Direct and Guaranteed Loan Programs provide low-interest financing for producers to purchase farm and ranch operating inputs. The FSA is authorized to implement the program through the Consolidated Farm and Rural Development Act, also known as the Con Act. The 2014 Farm Bill revisions expand the types of entities eligible, provide favorable interest rates for joint financing arrangements, increase loan limits for microloans, make youth loans available in urban areas, and eliminate term limits for guaranteed operating loans.

FARM OWNERSHIP LOANS

Farm Ownership Direct and Guaranteed Loan Programs provide low-interest financing for producers to purchase farms and ranches and other real estate related needs. The FSA is authorized to implement the program through the Consolidated Farm and Rural Development Act, often referred to as the Con Act. The 2014 Farm Bill revisions expand the types of entities eligible, provide favorable interest rates for joint financing arrangements, provide a larger percent guarantee on guaranteed conservation loans, increase the loan limits for the down payment program, and authorize a relending program to assist Native American producers purchase fractionated interests of land.

DISASTER PROGRAMS

The following four disaster programs authorized by the 2008 Farm Bill have been extended indefinitely (beyond the horizon of the Act). The programs are made retroactive to Oct. 1, 2011. Producers are no longer required to purchase crop insurance or NAP coverage to be eligible for these programs (the risk management purchase requirement) as mandated by the 2008 Farm Bill.

Livestock Forage Disaster Program (LFP): LFP provides compensation to eligible livestock producers that have suffered grazing losses due to drought or fire on land that is native or improved pastureland with permanent vegetative cover or that is planted specifically for grazing. LFP payments for drought are equal to 60 percent of the monthly feed cost for up to five months, depending upon the severity of the drought. LFP payments for fire on federally managed rangeland are equal to 50 percent of the monthly feed cost for the number of days the producer is prohibited from grazing the managed rangeland, not to exceed 180 calendar days.

Livestock Indemnity Program (LIP): LIP provides benefits to livestock producers for livestock deaths in excess of normal mortality caused by adverse weather or by attacks

FACT SHEET

What's In the 2014 Farm Bill for FSA Customers March 2014

by animals reintroduced into the wild by the federal government. LIP payments are equal to 75 percent of the average fair market value of the livestock.

Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish (ELAP): ELAP provides emergency assistance to eligible producers of livestock, honeybees and farm-raised fish for losses due to disease (including cattle tick fever), adverse weather, or other conditions, such as blizzards and wildfires, not covered by LFP and LIP. Total payments are capped at $20 million in a fiscal year.

Tree Assistance Program (TAP): TAP provides financial assistance to qualifying orchardists and nursery tree growers to replant or rehabilitate eligible trees, bushes, and vines damaged by natural disasters.

FEEDSTOCK FLEXIBILITY PROGRAM (FFP)

FFP is continued through fiscal year 2018. Congress authorized the FFP in the 2008 Farm Bill, allowing for the purchase of sugar to be sold for the production of bioenergy in order to avoid forfeitures of sugar loan collateral under the Sugar Program.

NON-FARM BILL PROGRAMS

The following programs continue under laws other than the 2014 Farm Bill.

Emergency Conservation Program (ECP)
ECP is authorized by Title IV of the Agricultural Credit Act of 1978, Section 401 (P.L. 95-334)(16 U.S.C. 2201). ECP provides emergency cost-share assistance to farmers and ranchers to help rehabilitate farmland and ranchland damaged by natural disasters and to carry out water conservation measures during periods of severe drought. Cost-share assistance may be offered only for emergency conservation practices to restore land to a condition similar to that existing prior to the natural disaster.

Emergency Forest Restoration Program (EFRP)
EFRP is authorized by Title IV of the Agricultural Credit Act of 1978, Section 407 (16 U.S.C. 2206). EFRP was established to provide financial and technical assistance to owners of non-industrial private forest land damaged by natural disaster to carry out emergency measures to restore damaged forests and rehabilitate forest resources.

Farm Storage Facility Loan Program (FSFL)
FSFL provides low-interest financing for producers to build or upgrade farm storage and handling facilities.

Sugar Storage Facility Loan Program (SSFL)
SSFL provides low-interest financing for processors to build or upgrade farm storage and handling facilities for raw or refined sugar.

2011 Montana FSA Farmer & Rancher Handbook

Farm Service Agency

USDA United States Department of Agriculture

Fact Sheet

February 2008

Rural Youth Loans

Overview

The U.S. Department of Agriculture's Farm Service Agency (FSA) makes operating loans of up to $5,000 to eligible individual rural youths age 10 through 20 to finance income-producing, agriculture-related projects. The project must be of modest size, educational, and initiated, developed and carried out by rural youths participating in 4-H clubs, FFA, or a similar organization.

The project must be an organized and supervised program of work. It must be planned and operated with the assistance of the organization advisor, produce sufficient income to repay the loan, and provide the youth with practical business and educational experience in agriculture-related skills.

Who May Borrow

To qualify for a loan, the applicant must:

- comply with FSA's general eligibility requirements;
- reside in a rural area, city or town with a population of 50,000 or fewer people; and
- conduct a modest income-producing project in a supervised program of work.

How Loan Funds May Be Used

These loans can finance many kinds of income-producing agricultural projects. The loan fund may be used to:

- buy livestock, seed, equipment and supplies;
- buy, rent or repair needed tools and equipment; and
- pay operating expenses for the project.

What Details to Know

To apply, the applicant must submit completed plans and budgets signed by the project advisor and parent or guardian along with the FSA application for loan assistance. These loans:

- have a maximum loan amount of $5,000 (total principal balance owed at any one time cannot exceed this amount);
- have an interest rate which is determined periodically, based on the cost of money to the federal government,
  - after the loan is made, the interest rate for that loan will not change;
- will be secured, in addition to promissory notes, by liens on the products produced for sale and on chattel property, including livestock, equipment and fixtures purchased with loan funds; and
- have a repayment schedule which varies depending on the type of project for which the loan is made,
  - for example, if it involves raising livestock or crops, the loan is paid when the animals or produce are normally sold.

For More Information

To apply or find out more, visit your local USDA Service Center. A listing of centers, and more information about youth and other loan programs, are available on the FSA website at http://www.fsa.usda.gov. USDA Service Center offices are also usually listed in telephone directories under "U.S. Department of Agriculture.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

October 2013

Loans for Beginning Farmers and Ranchers

Overview

The U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA) makes and guarantees loans to beginning farmers who are unable to obtain financing from commercial lenders. Each fiscal year, FSA targets a portion of its direct and guaranteed farm ownership (FO) and operating loan (OL) funds to beginning farmers.

A beginning farmer is an individual or entity who:

- Has not operated a farm for more than 10 years;
- Meets the loan eligibility requirements of the program to which he/she is applying;
- Substantially participates in the operation and;
- For FO purposes, does not own a farm greater than 30 percent of the median size farm in the county.

(Note: All applicants for direct FO loans must have participated in the business operations of a farm for at least three years out of the 10 years prior to the date the application is submitted). If the applicant is an entity, all members must be related by blood or marriage, and all entity members must be eligible beginning farmers.

Maximum Loan Amounts

- Direct FO: $300,000
- Direct OL: $300,000; Microloan: $35,000
- Guaranteed FO or OL: $1,355,000 (Amount varies annually based on inflation).

Downpayment Program

FSA has a special loan program to assist socially disadvantaged (SDA) and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.
- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm to be acquired; (b) the appraised value of the farm to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).
- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent.
- The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.
- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Joint Financing Arrangement

Beginning farmers may choose to participate in a joint financing arrangement. With this arrangement FSA lends up to 50 percent of the amount financed and another lender provides 50 percent or more. The applicant will use funds from the joint financing arrangement along with FSA funds for any authorized FO purpose. The interest rates for such arrangements can be obtained from the local FSA office. The term of the loan will not exceed 40 years or the useful life of the security.

FACT SHEET

Loans for Beginning Farmers and Ranchers

October 2013

Land Contract Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or SDA farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Sale of Inventory Farmland

FSA advertises inventory property within 15 days of acquisition. Eligible SDA and beginning farmers are given first priority to purchase these properties at the appraised value. If one or more eligible SDA or beginning farmer offers to purchase the same property in the first 135 days, the buyer is chosen randomly.

Where to Apply

Applications for direct loan assistance may be submitted to the local FSA office serving the area where the operation is located. Local FSA offices are listed in the telephone directory under U.S. Government, Department of Agriculture or Farm Service Agency. For guaranteed loans, applicants must apply to a commercial lender who participates in the Guaranteed Loan Program. Contact your local FSA office for a list of participating lenders.

For More Information

Further information about this and other FSA programs is available from local FSA offices or on the FSA website at www.fsa.usda.gov.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

August 2013

Microloans

Overview

The Farm Service Agency (FSA) developed the Microloan (ML) program to better serve the unique financial operating needs of beginning, niche and the smallest of family farm operations by modifying its Operating Loan (OL) application, eligibility and security requirements. The program will offer more flexible access to credit and will serve as an attractive loan alternative for smaller farming operations like specialty crop producers and operators of community supported agriculture (CSA). These smaller farms, including non-traditional farm operations, often face limited financing options.

Use of Microloans

Microloans can be used for all approved operating expenses as authorized by the FSA Operating Loan Program, including but not limited to:

- Initial start-up expenses;
- Annual expenses such as seed, fertilizer, utilities, land rents;
- Marketing and distribution expenses;
- Family living expenses;
- Purchase of livestock, equipment, and other materials essential to farm operations;
- Minor farm improvements such as wells and coolers;
- Hoop houses to extend the growing season;
- Essential tools;
- Irrigation;
- Delivery vehicles.

Simplified Application Process

The application process for microloans will be simpler, requiring less paperwork to fill out, to coincide with the smaller loan amount that will be associated with microloans. Requirements for managerial experience and loan security have been modified to accommodate smaller farm operations, beginning farmers and those with no farm management experience. FSA understands that there will be applicants for the ML program who want to farm but do not have traditional farm experience or have not been raised on a farm or within a rural community with agriculture-affiliated organizations. ML program applicants will need to have some farm experience; however, FSA will consider an applicant's small business experience as well as any experience with a self-guided apprenticeship as a means to meet the farm management requirement. This will assist applicants who have limited farm skills by providing them with an opportunity to gain farm management experience while working with a mentor during the first production and marketing cycle.

Security Requirements

For annual operating purposes, microloans must be secured by a first lien on a farm property or agricultural products having a security value of at least 100 percent of the microloan amount, and up to 150 percent, when available. Microloans made for purposes other than annual operating expenses must be secured by a first lien on a farm property or agricultural products purchased with loan funds and having a security value of at least 100 percent of the microloan amount.

Rates and Terms

Eligible applicants may obtain a microloan for up to $35,000. The repayment term may vary and will not exceed seven years. Annual operating loans are repaid within 12 months or when the agricultural commodities produced are sold. Interest rates are based on the regular OL rates that are in effect at the time of the microloan approval or microloan closing, whichever is less.

Obtaining Forms and Submitting an Application

FSA Microloan application forms can be obtained from the local FSA office or can be downloaded and printed from the USDA website. Applicants who are having problems gathering information or completing forms should contact their local FSA office for help. After completing the required paperwork, an applicant should submit the farm loan application to the local FSA office.
The following form must be completed:

FSA 2330 – Request for Microloan Assistance

(Instruction Form for FSA 2330)

FACT SHEET

Microloans

August 2013

What Happens After a Loan Application is Submitted?

After a loan application is submitted, FSA reviews the application and determines if the applicant is eligible for the requested loan. The applicant will receive written notification of each step in the process, such as when the application is received, when more information is needed, when an eligibility determination is made, and when a final decision is made. If the application is approved, FSA makes the loan and funds are distributed as needed. If the application is denied, the applicant is notified in writing of the specific reasons for the denial, and provided reconsideration and appeal rights.

Eligibility Criteria and Additional Information

To qualify for assistance, the applicant must not be larger than a family-sized farmer, have a satisfactory history of meeting credit obligations, be unable to obtain credit elsewhere at reasonable rates and terms, and meet all other loan eligibility requirements. Additional information on the FSA microloan program may be obtained at local FSA offices or through the FSA website at www.fsa.usda.gov.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

September 2013

How to Complete an FSA Loan Application

Overview

This fact sheet describes how farmers can apply for a direct farm loan with the U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA). FSA must follow all relevant federal credit, environmental, and debt collection laws and policies when making farm loans.

Applying for a Loan

Farmers interested in applying for a loan should contact their local FSA office. FSA employees determine loan eligibility and approval. FSA direct farm ownership and operating loan funds can assist farmers with such needs as purchasing farmland, livestock, equipment, feed and other materials essential to farm operations; paying normal operating and family living expenses; and refinancing certain debts. FSA loans cannot be used to refinance personal debts, buy personal vehicles, or start and operate ineligible enterprises.

FSA employees at the local office can explain what information is needed and how to obtain it. In some areas, FSA can arrange for an outside organization to help the applicant gather the information and complete the forms. If available, this help is provided at no cost to the applicant. Providing all of the following information will help the loan application process flow smoothly. (Please note that other information may be required depending on each individual situation).

FSA Forms

The following forms must be completed:

- FSA 2001: Request for Direct Loan Assistance
  If the applicant is a cooperative, corporation, partnership, joint operation, trust, or limited liability company, additional information will be required of each member of the entity. Applicants will need to discuss the structure of the business with an agency official. (Applicants will need to provide a credit report fee, which will vary in amount depending on how many individuals are applying and/or the business structure).
- FSA-2002: Three Year Financial History
- FSA-2003: Three Year Production History
- FSA-2004: Authorization to Release Information
- FSA-2005: Creditor List
- FSA-2006: Property Owned and Leased
- FSA 2037: Farm Business Plan Worksheet-Balance Sheet
- FSA 2038: Farm Business Plan Worksheet-Projected Income and Expense
- FSA-2302: Description of Farm Training and Experience.

Additional Information

In addition to forms, an applicant must provide FSA the following information as part of the loan process (Note: If the applicant is already an FSA borrower, this information should be on file with the FSA):

- Proof that the applicant cannot obtain credit from private sources at reasonable rates and terms. A referral letter from a bank or other local lending institution serves as proof and may or may not be necessary depending on the applicant's financial situation.
- Three years of federal income tax returns.
- Copies of any leases, contracts or agreements.
- Documentation showing compliance with regulations governing certain environmental programs. The local FSA office can assist the applicant with meeting this requirement.

For information on the Microloan operating loans, see the Microloan fact sheet.

FACT SHEET

How to Complete an FSA Loan Application

September 2013

Emergency Loans (EM)

EM loans help cover production and physical losses for producers in counties declared as disaster or quarantine areas. Applicants requesting an EM loan based on losses in declared areas should also provide the following forms:

- FSA 2309: Certification of Disaster Losses
- FSA 2310: Request for Lender's Verification of Loan Application

Actual Production History (APH) yields must be established by a producer's crop insurance company and will be used to calculate losses. If APH yields are not available, three years of the producer's production history will be used.
Obtaining Forms and Submitting Loan

Obtaining Forms and Submitting Loan Applications

FSA forms can be obtained from the local FSA office or can be downloaded and printed from USDA's E-forms website at http://forms.sc.egov.usda.gov/eForms/.

Applicants who are having problems gathering information or completing forms should contact their local FSA office for help. After completing the required paperwork, an applicant should submit the farm loan application to the local FSA office.

What Happens After a Loan Application is Submitted?

After a loan application is submitted, FSA reviews the application and determines if the applicant is eligible for the requested loan. The applicant will receive written notification of each step in the process, such as when the application is received, when more information is needed, when an eligibility determination is made, and when a final decision is made. If the application is approved, FSA makes the loan and funds are distributed as needed. If the application is denied, the applicant is notified in writing of the specific reasons for the denial, and provided reconsideration and appeal rights.

More Information

Visit FSA's website, www.fsa.usda.gov, for details on the types of loans and loan amounts offered, as well as for information about all FSA programs.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

November 2012

Loans for Socially Disadvantaged Farmers and Ranchers

Overview

The U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA) makes and guarantees loans to eligible socially disadvantaged farmers (SDA) to buy and operate family-size farms and ranches. Each fiscal year, the Agency targets a portion of its direct and guaranteed farm ownership (FO) and operating loan (OL) funds to SDA farmers. Non-reserved funds can also be used by SDA individuals.

An SDA farmer or rancher is a group whose members have been subject to racial, ethnic or gender prejudice because of their identity as members of a group without regard to their individual qualities. These groups consist of American Indians or Alaskan Natives, Asians, Blacks or African-Americans, Native Hawaiians or other Pacific Islanders, Hispanics and women.

The agency:

- Helps remove barriers that prevent full participation of SDA farmers in FSA's farm loan programs;
- Provides information and assistance to SDA farmers to help them develop sound farm management practices, analyze problems and plan the best use of available resources essential for success.

Types of Loans and Uses of Loan Funds

Direct farm ownership loans (FO) and farm operating loans (OL) are made by FSA to eligible farmers. Guaranteed FO and OL loans are made by lending institutions subject to federal or state supervision (banks, savings and loans, and units of the Farm Credit System) and guaranteed by FSA. Typically, FSA guarantees 90 percent of any loss the lender might incur if the loan fails. FO funds may be used to purchase or enlarge a farm or ranch, purchase easements or rights of way needed in the farm's operation, erect or improve buildings, implement soil and water conservation measures and pay closing costs. Guaranteed FO funds also may be used to refinance debt.

OL funds may be used to purchase livestock, poultry, farm equipment, feed, seed, fuel, fertilizer, chemicals, insurance, and other operating expenses. The funds also may be used for training costs, closing costs and to reorganize and refinance debt.

Terms and Interest Rates

Repayment terms for direct OL depend on the collateral securing the loan and usually run from one to seven years. Repayment terms for direct FO vary but never exceed 40 years.

Interest rates for direct loans are set periodically according to the government's cost of borrowing.

Guaranteed loan terms are set by the lender. Interest rates for guaranteed loans are established by the lender.

Downpayment Program

FSA has a special loan program to assist socially disadvantaged and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.
- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm or ranch to be acquired; (b) the appraised value of the

FACT SHEET

Loans for Socially Disadvantaged Farmers and Ranchers November 2012

farm or ranch to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).

- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent. The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.
- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Land Contract (LC) Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or socially disadvantaged farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Sale of Inventory Farmland

FSA advertises inventory property within 15 days of acquisition. Eligible SDA and beginning farmers are given first priority to purchase these properties at the appraised market value. If one or more eligible SDA or beginning farmer offers to purchase the same property in the first 135 days, the buyer is chosen randomly.

Where to Apply

Applications for direct loan assistance may be submitted to the local FSA office serving the area where the operation is located. Local FSA offices are listed in the telephone directory under U.S. Government, Department of Agriculture or Farm Service Agency. For guaranteed loans, applicants must apply to a commercial lender who participates in the Guaranteed Loan Program. Contact the local FSA office for a list of participating lenders.

For more information

More information is available from local FSA offices or on the FSA website at www.fsa.usda.gov.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

October 2013

Farm Loans

Overview

The U.S. Department of Agriculture's Farm Service Agency (FSA) makes and guarantees loans to family farmers and ranchers to promote, build and sustain family farms in support of a thriving agricultural economy. FSA maintains its headquarters in Washington, DC, with offices located in each state, usually in a state capital or near a state land-grant university, as well as in most agriculturally productive counties. Farmers may apply for direct loans at local FSA offices. Guaranteed loans may be available from commercial lenders who apply for loan guarantees from FSA. Although general information may be obtained from headquarters and state offices, all programs are administered through local offices.

The goal of FSA's farm loan programs is to graduate its borrowers to commercial credit. Once a farmer is able to obtain credit from the commercial lending sector, the Agency's mission of providing temporary, supervised credit is complete.

FSA Farm Loans

FSA's loan programs are designed to help family farmers to start, purchase or expand their farming operation. In many cases, these are beginning farmers who need additional financial and business acumen to qualify for commercial credit. In other cases, they are farmers who have suffered financial setbacks from natural disasters, or who need additional resources with which to establish and maintain profitable farming operations.

Some farmers obtain their credit needs through the use of loan guarantees. Under a guaranteed loan, a commercial lender makes and services the loan, and FSA guarantees it against loss up to a maximum of 90 percent in most cases. In certain limited circumstances, a 95 percent guarantee is available. FSA has the responsibility of approving all eligible loan guarantees and providing oversight of lenders' activities.

For those not yet meeting the qualifications for a loan guarantee from a commercial lender, FSA also makes direct loans, which are serviced by an FSA official. FSA has the responsibility of providing credit counseling and supervision to its direct borrowers by making a thorough assessment of the farming operation. FSA helps applicants evaluate the adequacy of the real estate and facilities, machinery and equipment, financial and production management, and the applicant's goals. FSA assists the applicant in identifying and prioritizing areas needing improvement in all phases of the operation. An FSA official then works one-on-one with the applicant to develop and to help strengthen the identified areas that ultimately result in the applicants graduation to commercial credit.

Unlike FSA's commodity loans, most farm loans must be fully secured and can only be approved for those who have repayment ability.

Farm Ownership Loans

Eligible applicants may obtain direct loans up to a maximum indebtedness of $300,000. Maximum indebtedness for guaranteed loans is $1,355,000 (amount adjusted annually for inflation). The maximum repayment term is 40 years for both direct and guaranteed farm ownership loans. In general, loan funds may be used to purchase a farm, enlarge an existing farm, construct new farm buildings and/or improve structures, pay closing costs, and promote soil and water conservation and protection.

Farm Operating Loans

Eligible applicants may obtain direct loans for up to a maximum indebtedness of $300,000 and a direct operating Microloan for up to a maximum indebtedness of $35,000. Maximum indebtedness for a guaranteed loan is $1,355,000 (amount adjusted annually for inflation). The repayment term may vary, but typically it will not exceed seven years for intermediate-term purposes. Annual operating loans are generally repaid within 12 months or when the commodities produced are sold. In general, loan funds may be used for

FACT SHEET
Farm Loans

October 2013

normal operating expenses, machinery and equipment, minor real estate repairs or improvements, and refinancing debt.

Targeted Funds to Socially Disadvantaged and Beginning Farmers

Each year Congress targets a percentage of farm ownership and farm operating loan funds to socially disadvantaged (SDA) and beginning farmers. For more information, refer to the FSA Fact Sheet, "Loans for Socially Disadvantaged Farmers."

Downpayment Program

FSA has a special loan program to assist SDA and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.

- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm to be acquired; (b) the appraised value of the farm to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).

- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent.

- The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.

- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Rural Youth Loans

These are available as direct loans only and have a maximum loan amount of $5,000. Rural youth loans may be made to individuals who are sponsored by a project advisor, such as a 4-H Club, FFA or local vocational instructor. Individuals must be at least 10 but not more than 20 years old to be eligible and reside in a town or city with a population of 50,000 or fewer people.

Emergency Loans

These loans are available only as direct loans from FSA. Emergency Loans assist farmers who have suffered physical or production losses in areas declared by the President as disaster areas or designated by the Secretary of Agriculture as disaster or quarantine areas (for physical losses only, the FSA Administrator may authorize Emergency Loan assistance). For production loss loans, applicants must demonstrate a 30 percent loss in a single farming enterprise. Applicants may receive loans up to 100 percent of production or physical losses.

Loan purposes include operating and real estate, restoring/replacing essential property, production costs for disaster year, essential family living expenses, reorganization and refinancing certain debts.

The maximum indebtedness under the Emergency Loan program is $500,000.

Conservation Loans

Conservation loans are available as guaranteed loans only. Eligible applicants may use Conservation Loan funds to complete any conservation activity included in a conservation plan or Forestry Management Plan, and may be used to refinance debts related to implementing any conservation activity if refinancing will result in additional conservation benefits. Maximum indebtedness is $1,355,000 (amount adjusted annually for inflation) and the maximum repayment term is 30 years.

Note: The family farm and test for credit requirements are not applicable to Conservation Loans.

Land Contract Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or socially disadvantaged farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

FACT SHEET
Farm Loans

October 2013

Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Loan Servicing and Supervised Credit

FSA's mission is not limited to providing just credit - it is to provide supervised credit. This means that FSA works with each direct loan borrower to identify specific strengths and opportunities for improvement in farm production and management, and then works with the borrower on alternatives and other options to address the areas needing improvement to achieve success. Learning improved business planning and financial acumen through supervised credit is the difference between success and failure for many farm families.

To help keep borrowers on the farm, FSA may be able to provide certain loan servicing benefits to direct loan borrowers whose accounts are distressed or delinquent due to circumstances beyond their control. These benefits include:

- Reamortization, rescheduling, and/or deferral of loans;
- Rescheduling at the Limited Resource (lower interest) rate;
- Acceptance of conservation contracts on environmentally sensitive land in exchange for reduction of debt; and
- Writing down the debt (delinquent borrowers only).

If none of these options results in a feasible farm operating plan, borrowers may be offered the opportunity to pay off their debt at the current market value of the security. If this is not possible, other options include:

- Debt settlement based on inability to repay.
- In some cases, where a feasible operating plan cannot be developed, FSA works with commercial lenders to help the borrower retain the homestead and up to 10 acres of land.

Farms that come into FSA ownership are sold at market value, with preference given to SDA and beginning farmers.

Who May Borrow

To qualify for assistance, applicants must meet all loan eligibility requirements including:

- Be a family farmer;
- Have a satisfactory history of meeting credit obligations;
- For direct OL loans, have sufficient education; training, or at least 1-year's experience in managing or operating a farm or ranch within the last 5 years. For direct FO loans, all applicants must have participated in the business operations of a farm for at least three years out of the 10 years prior to the date the application is submitted;
- Be a citizen of the United States, including Puerto Rico, the U. S. Virgin Islands, Guam, American Samoa, Commonwealth of the Northern Mariana Islands, Republic of Pallau, Federated States of Micronesia and the Republic of Marshall Islands, a U.S. non-citizen national, or a qualified alien under federal immigration law;
- Be unable to obtain credit elsewhere at reasonable rates and terms to meet actual needs;
- Possess legal capacity to incur loan obligations;
- Not be delinquent on a federal debt;
- Not have caused FSA a loss by receiving debt forgiveness (certain exceptions apply) and;
- Be within the time restrictions as to the number of years they can receive FSA assistance.

In the case of an entity, certain eligibility requirements apply. The entity must:

- Meet applicant eligibility requirements;

Page 3

FACT SHEET
Farm Loans

October 2013

- Be authorized to operate a farm in the state where the actual operation is located and;

- Be owned by U.S. citizens, U.S. non-citizen nationals or qualified aliens.

For SDA members, they must hold a majority interest in the entity applicant to receive SDA benefits.

If the individuals holding a majority interest in the entity are related by blood or marriage, at least one member or partner must operate the family farm. If they are not related by blood or marriage, the member holding a majority interest must operate the farm.

For More Information

Additional information may be obtained at local FSA offices or through the FSA website at www.fsa.usda.gov.

Oklahoma Sheep and Goat Report

Mr. Wilbert Hundl

State Statistician

United States Department of Agriculture
National Agricultural Statistics Service

Oklahoma Sheep and Goat Report

Southern Plains Regional Field Office
Cooperating with the Oklahoma Department of Agriculture, Food and Forestry
P.O. Box 528804 · Oklahoma City, OK 73152-8804
(800) 842-1331 · FAX (855) 270-2725 · www.nass.usda.gov/ok

Estimates in this report are the result of data collected during the January Sheep and Goat Survey from a random sample of producers across the nation. Survey procedures ensured that all sheep and goat producers, regardless of size, had a chance to be included in the survey. Data provided by Oklahoma producers are the foundation of these estimates made for the state. We would like to thank all who responded to the survey and made these estimates possible.

Inventory, lamb and kid crop estimates for the previous year were also reviewed using official slaughter data, import and export data, and the relationship to of the current survey indications to previous surveys. Prior year inventory, lamb and kid crop items were revised at the U.S. level and in most states.

Sheep , Lambs and Goats: Inventory by Class, Oklahoma and United States, January 1, 2015-2016

Class	Oklahoma			United States		
	2015	2016	Percent of Previous Year	2015	2016	Percent of Previous Year
	1,000 Head	*1,000 Head*	*Percent*	*1,000 Head*	*1,000 Head*	*Percent*
All Sheep and Lambs	53.0	46.0	87	5,280	5,320	101
Breeding Sheep	42.0	37.0	88	3,935	3,965	101
Ewes 1 Year +	31.0	29.0	94	3,110	3,125	100
Rams 1 Year +	3.0	2.0	67	175	175	100
Replacement Lambs	8.0	6.0	75	650	665	102
Market Sheep and Lambs	11.0	9.0	82	1,345	1,355	101
Market Sheep 1 Year +	1.0	0.5	50	85	75	88
Market Lambs	10.0	8.5	85	1,260	1,280	102
Under 65 pounds	7.0	5.5	79	327	330	101
65-84 pounds	1.0	1.0	100	163	179	110
85-105 pounds	1.0	1.0	100	267	264	99
Over 105 pounds	1.0	1.0	100	503	507	101
Annual Lamb Crop [1]	36.0	31.0	86	3,440	3,440	100
Goats						
Angora Goats	([2])	([2])	([2])	160	150	94
Milk Goats	6.9	6.6	96	365	375	103
Meat and Other Goats	95.0	91.0	96	2,125	2,095	99

[1] Lamb crop refers to lambs born the previous year.
[2] Not published for Oklahoma.

Wool: Sheep Shorn, Weight per Fleece, Production, Price and Value, Oklahoma and United States, 2014-2015

	Sheep Shorn	Weight per Fleece	Wool Production	Price per Pound	Value of Production [1]
	1,000 head	*Pounds*	*1,000 pounds*	*Dollars*	*1,000 dollars*
Oklahoma					
2014	21	5.5	115	0.70	81
2015	17	5.6	95	0.70	67
United States					
2014	3,680	7.3	26,680	1.46	38,909
2015	3,680	7.4	27,050	1.45	39,298

[1] Production multiplied by marketing year average price.

Pack Goats

Mr. Dwite and Mrs. Mary Sharp

Paradise Ranch

Introduction to Dwite and Mary Sharp

Dwite and Mary Sharp have raised and trained pack goats for over 18 years. They own and operate Paradise Ranch in the Flint Hills near the historical town of Council Grove, Kansas. Their family has lived in Morris County for eight generations. Although they grew up in southern California they have returned to the Flint Hills several times to live. The last time they moved to the Flint Hills was in 1997 when they moved from Charlotte, North Carolina; this time to stay.

In 2000 Dwite retired from auto racing where he had been a Design and Fabrication Engineer for over 30 years. Involved with NASCAR's Winston Cup Division he designed and built cars for Felix Sabotos, Rick Hendricks, Richard Childress and many others.

Mary had been in restaurant management for many years before returning to Kansas and after returning to the Flint Hills she opened her own café. After a year she called it quits and decided to stay home and raise pack goats. Since 1999 Mary has been the working force at Paradise Ranch tending to the chores on a daily basis.

In 2001 Dwite took a job with BNSF Railway in the engineering department, but his true passion now is the creatures of Paradise Ranch. There they raise pack goats, high end Boer goats, Mammoth Donkeys, guineas, and Doberman Pinschers.

Introduction to Goat Packing

Goat packing was first invented in 1972 out of necessity by John Mionczynski, a scientific researcher for the U.S. Forrest Service. His job was to follow and stay close to a band of Rocky Mountain big horn sheep and to observe and record their food habits and behavior in the wild. The sheep had been fitted with radio collars. John was on his own and at first he used horses to carry his equipment and supplies. The horses didn't work very well, they did a good job getting to base camp, but they couldn't get near the terrain where

the sheep lived. There wasn't enough grass in that country to leave them picketed out for more than a day. He would have to come back once a day to move and water them. This was not going to work.

So the horses went and he started backpacking. Carrying a backpack in that terrain was dangerous enough but after weighing his pack it weighed over one hundred pounds.

He was at a high level of desperation, after a particularly difficult day in the mountains, he imagined a goat packed up like a horse. At first he laughed at the idea, but he was desperate. Several days later he returned home for a few days off. He had several goats, he liked goat milk. One was an eleven year old wether named Wethervane that he harnessed and used to haul water on a travois from a creek to a cabin. He knew Wethervane could haul a couple hundred pounds on a travois using an old upside down horse halter for a harness. He had no idea how he would react to carrying a load on his back. He started slowly using a saddle bag, adding a little weight at a time, leading him around. Wethervane acted as though he was carrying nothing. So John got some bigger bags and loaded them with his gear. He slung them over Wethervane's back, using a horse saddle pad for padding. It worked, this was becoming exciting. After a day of walking Wethervane around and increasing the weight, it became evident that with a few refinements he could probably take Wethervane back to the mountains with him. He made the first pack goat saddle out of some 1"x6" boards and cross bucks from a sawed up shovel handle. It became clear that with the saddle to help distribute the load more evenly, Wethervane could easily carry even more weight.

Back in the mountains Wethervane followed faithfully and silently. He was so quiet John let him stay at camp and even at the observation posts. Wethervane's true test came the day the sheep decided to migrate. Could he keep up? It started before daybreak. The radio signals were clear; they were on the move. Wild sheep can go thirty miles in one move and you have no idea where they will end up. John and Wethervane hiked for several days along escarpments and over mountains. Although Wethervane had a few new things to learn, he performed beautifully. John was ecstatic. You can teach and old goat new tricks!

Each day Wethervane worked and became stronger and could carry more weight. John could see Wethervane's muscles growing and firming up. In time John was packing Wethervane, a doe named Jessie (a milk goat), and several kids as trainees. John's greatest pleasure came from seeing how healthy, alert, and handsome a goat can look when it's being worked. Also how much like a wild animal it can act; testing the air for scents, twitching the ears, looking around ,curious about every new sound, scent, and movement. They were a different animal entirely from the sloth like, pot bellied barn potatoes.

Several years later Wethervane, the first pack goat, was killed by a hunter in the opening day of deer season.

John went on to run his own goat-centered outfitting/guide service, building and selling custom pack saddles, and raising pack goats. John Mionczynski is known as the father of goat packing.

Facts about Goats

1. Goats are quite picky about what they eat.
2. Goat's eyesight is seven times better than a human.
3. Goats can smell with their mouth (called the Flehman response), using an organ in the roof of their mouth called the Jacobsens organ. When they curl up their upper lip with their mouth slightly open, they are smelling.
4. Goats can be very social animals making them wonderful companions.
5. Goats will follow with out being led.
6. Goats are the most surefooted animal on the planet.
7. Goats are one of the most intelligent creatures on the planet.

8. Goats are thought to have been domesticated more than 10.000 years ago. 5,000 years before the horse and probably the first wild animal to be domesticated.
9. Goat's primary diet consists of weeds and brush.
10. Goats are browsers not grazers.
11. Goats can go 3 or 4 days without water. The only animal better is a camel.
12. While in the desert a large wether can carry enough water for you and itself to last a week.
13. Goats can adjust their metabolism as the need arises.
14. An exercising goat has up to 12% heat loss through their horns. (They are like radiators)
15. Generally there is no need to carry feed for goats on a pack trip.
16. Goats are herd animals and should be kept with at least one other goat.
17. Goats have the ability to regain all their natural instincts when taken into the wilderness.
18. Goats have the widest variety of food preferences.
19. When danger approaches pack goats will surround you and face the danger. They will not flee.
20. Horned goats are capable of killing predators, and will if forced to do so.
21. Wildlife has been known to follow and get extremely close to pack goats in the wild. This makes for great photo opportunities.
22. When given a large selection of plants in a pasture a goat is capable of eating the correct amount of the right plants to be at optimum health. A nutritionist can not compete with this ability.

Preparing the Facilities for Pack Goats

So as not to get the cart in front of the goat, we must get the facilities in order before bringing the goats home. Packgoats are no different than other goats as far as their needs.

Their needs are:

1. Goats need housing that will protect them from rain and wind, but is not so tight as to be unventilated. Goats are susceptible to respiratory problems, because they will urinate and defecate in their living quarters. Their housing should be well ventilated. A three sided structure will work just fine. Face the opening so the wind doesn't blow in. You can even build a wall in front of the opening 3'-4' out. Leave the eaves under the roof open so the air can circulate. Use your imagination. There is no set rule as to what the goathouse should look like, so lots of different buildings will work. If you have one goat that is aggressive you might want to have an escape door on each end. The size of the house will depend on the number of goats to be housed. A minimum of 15 square feet per goat is needed and more if you have horned goats.

2. Pens and Pastures; the goat house should have a pen or corral on the side or sides that are open, so you can contain the goats as needed. I recommend using 2"x4" woven wire or even 2"x4" horse panels. These two are five feet tall. My reasoning for this is to protect the goats inside the pens from predators. The 2"x4" openings will not allow the small kids to get their heads through the fence and be grabbed by something on the other side. This is a very common way for goats to be killed. We have had very bad luck using cattle panels and woven field wire (sometimes called hog wire) which have 6"x6" openings. Newborns have been known to crawl through these fences and as they get older and have horns they get their heads stuck in the fence and then they are at the mercy of what ever is on the outside. The wire with the 6"x6" opening is cheaper but don't take the chance! Spend the money at the beginning before you loose something precious to you! Also don't use welded wire. The welds will eventually break loose and your fence will come apart. We use T posts everywhere we use panels. With the woven wire you must have braced, hedge corner posts. The reason for this is because the wire must be stretched and if they are not cemented and braced the tension of the wire will pull the posts over. We use 4 12' round tubular gates and cover the side the goats are on with 4' chain link. You could also use chain link gates. All the materials can be bought at a farm and ranch store. Remember to put the fence on the side of the post that will be pushed on most. For example, if you have

cows on one side and goats on the other, then the fence should be on the side the cows are on. If you have nothing on the other side the fence should be on the goat side. Let the post support the fence not the wire that is holding the fence to the post. When putting the T posts in the ground do not forget to face the T post the correct way for the side the fence will be on.

Pasture fence can be a real challenge for keeping goats in. No other animal will point out your fence building short comings faster than a goat. It is said that if you build a 10' high solid wood wall all the way around the pasture and then go 3' inside that wall and build another one just like it. Now fill the 3' space between the walls full of cement. After it dries fill the pasture with water all the way to the top of the walls. If it holds water it might hold a goat!

My experience with goat fencing is vast. I've made every mistake I think I could have. I think I finally have it under control. Goats are brilliant escape artists and eating machines. These two attributes make them tough to fence. You might think you've beat them but you'll only know for sure when the eating looks better on the other side of the fence. That is why they will show you your deficiencies in fence building. I have had way more Boer goats over the years than pack goats but it seems to be the trained pack goats that instigate the major break outs. These very large goats have escaped through the places I would not have believed if I had not seen it with my own eyes. They have shorted out electric fences and led one hundred goats into the neighbor's bean field. They have done this more than once.

If you have no pasture fencing at all and must start from scratch I recommend not using electric fences. If you have existing fences and can't afford to replace all of them electric fences are usually the cheapest option.

If you are putting up a completely new fence I would use goat and sheep woven wire. There are two kinds of this wire. The best is the one with 4"x4" openings. The other has 6"x12" openings. The 4"x4" wire will actually keep the goats heads on your side of the fence. The 6"x12" wire will allow the goats to put there heads through the fence but the opening is large enough to allow them to remove their heads easily. The 4'x4' wire is my first choice but because it has so much more wire, it is also more expensive. I use the 48" width. Both of these products are manufactured by Oklahoma Wire and Steel and come in 330' rolls.

I space the T post 10' to 15' apart and use cemented braced hedge posts on the corners. If the fence goes down into a low spot and then back up, you will probably need to cement a hedge post on both sides of the low areas to keep the tension of the fence from pulling the T post out of the ground (specially when it rains).

If you have an existing fence and you need to goat proof it you have several options. If it is barbed wire you can add more wires to the fence. Goats almost always go under the fence so adding wires to the bottom will help. Then stretch a wire (it can be the barbless wire) about 3" to 4" off the ground. Space it so they are closer together at the bottom and a little wider as they go up. If the wires are stretched tightly and spaced correctly, seven wires will work.

The next option is to install an electric fence on the inside of the existing fence. I've had a lot of experience with this. The first thing to do is select the fence charger. I highly recommend using a low impedance charger. Although the testers for electric fences test in volts, it is not the voltage that shocks. It is the amps that shock. A low impedance charger turns up the amperage (makes it hotter) as the fence is contacted by vegetation or wet grass. If you tested it with a tester it would show the voltage has dropped but, actually the fence is very hot. With the non low impedance fence charger the fence would have been colder. Low impedance chargers use joules to measure the power. I suggest at least 6 joules for goats. To get this you will need a charger that is rated for about 100 miles of fence. Battery operated fence chargers will not be hot enough. The lesser ones will work for a while and then the pack goats will figure it out and they will escape. I use

a 100 mile low impedance Zareba fence charger. Orschlins and Tractor Supply sell them. My pastures are only about 25 acres total.

We attempted to place insulators on the same T posts that the existing barbed wire was on. This failed miserably. The pack goats went between the fence posts. They seemed to be able to tell when the fence surged. In between the surges they used their horns to push the hot wire over and hooked it on the barbwire. This shorts the fence out. They then kneel down and push their nose under the bottom wire of the barbed wire fence, which is about 6" off the ground, and they escaped. Once again there were one hundred goats in the bean field! All of this took about 30 seconds. I counter attacked! I bought ½" rebar and cut it into 4' lengths. I placed the rebar 20' to 25' apart and 1' inside the barbed wire fence. I then placed one 14 gage galvanized steel wire about 8" to 10" above the ground and another one 16" above the first. I stretched the wire as tight as a banjo string. I then released the goats from the corral. They slowly walked out of the corral and headed to the scene of the crime. Remembering the taste of the bean field, they broke into a full run. As they approached the new electric fence they skidded to a halt, looked up and down the new fence, and then turned and walked away. That was about six years ago and I haven't had a goat out since.

The bad part about electric fences is that they need constant attention. You must walk the fence to make sure that the insulators haven't broken and fallen off, or moved up or down the rebar. We have learned to use ceramic corner insulators. The plastic ones pull through and short out in time, killing the fence. Tree branches fall on the hot wires and push the fence to the ground stretching the wire. We have had our Anatolian Shepherd chase coyotes through the fence, damaging it. So if you can fence your goats with less maintenance you will make it easier on yourself.

Choosing Your Pack Goats

Not everyone who would like the benefits of a pack goat should actually own one. If you are short on patience and aren't a big fan of Mother Nature, then goat packing will not be for you. To find out how you feel about pack goats you might want to rent one for a small outing and see how it goes.

If you decide you would like to own a pack goat you need to get at least two. Goats are herd animals and need at least one other goat in their life to be emotionally healthy.

You can buy an experienced pack goat from a breeder/ outfitter. If you do you will miss out on all the fun and experiences of seeing these wonderful creatures mature and blossom with your interaction.

The majority of our pack goats started bonding with us at birth or within the first week. A few of our pack goats were actually purchased and restructured into pack goats at a much older age. Four of them were actually two years old before becoming pack goats. I would not recommend this for the beginner. Two of these four were completely wild animals and quite dangerous. These two have turned out quite well but the amount of time required was immense. I would be willing to say that we will probably not do that again.

If you don't have a lot of experience caring for baby goats you may opt to purchase you pack goat pre-trained at about six months of age. This way he has a head start in the right direction (That is if you purchase him from a good pack goat breeder; they are not all equal). You can continue his training and learn together.

You need to learn about good pack goat conformation. This will be beneficial in selecting a goat with good potential. Don't think that all Dairy goat breeders know about good pack goat conformation, because this is not likely. They breed for milk production, utter attachment, etc. They do not breed for pack goat conformation. If you are going to spend all the time, effort, and money on a quality pack goat let a reputable pack goat breeder help you get started.

It is possible to get good pack goat kids from outside the pack goat industry but without the knowledge it's difficult to make an accurate choice.

We do sell pack goat kids, but only in advance. Meaning we discuss what you want and then we breed the kid, to be delivered a few days after birth or at six months. We take our responsibility seriously.

Training

Training is something that is best if it begins shortly after birth. It's best for the bonding with humans aspect if the human becomes mom right away. That is not to say a good pack goat can't be achieved later. Removing the kid immediately after birth has a negative impact on the mental well being of the doe. Also the kids seem to learn about eating hay, grain, and minerals better with their mother. Mom really does know best. The sooner the kids start eating hay, grain, etc., the better they will grow. When you remove the kids from the doe you become their mother; you have to teach them the most important thing in a goats life, EATING! Sometimes it can be a real struggle to get them to eat enough. We have had bottle babies that at three months were eating very little grain. We feared they would starve if we weaned them. You must spend a lot of time with the kids and teach them by placing the grain in their mouth over and over again. You must do this before giving them their bottle. This seems sometimes like they aren't going to figure it out and then one day they finally get it. When you cut back the number of times a day they get a bottle they will think a little bit more about eating grain, hay, etc…

So why don't you just let the doe raise the kid? After all letting the doe raise the kid would be much easier. You would not have to get up in the middle of the night, get dressed, heat up the milk, go out in the cold, and feed the kids. When the doe does the work the kids tend to become wild goats and are not dependent on you. You want your pack goats to be completely dependent on you for food, water, and emotional support. Oh yes you have to become a goat!

You should spend a lot of time with the kids besides the feeding time. Go in to the pen, sit on a milk crate, talk to them, call them by name, pick them up, and hold them as long as you can. Soon they will be too large for this so do it while you can. For the first few weeks it is okay to let them jump on you. After a few weeks do not allow the goats to even put their front feet on the fence. Now start teaching them that it is not okay to jump on you, the gate, the fence, the car, or anything else. The word "down" should be taught at a young age.

Goats don't tolerate violence. Don't make the mistake of loosing your patience and yelling at or striking them. You will go from the top of the hill to the bottom, in their eyes. It could take weeks to regain their trust. Goats have a good memory and will get even. It may not be today or even tomorrow, but it will happen.

After a couple weeks you can put a small collar and leash on them. Let them get used to this slowly. Do not try to lead them until they are comfortable being tied (held by you). NEVER, NEVER, leave the collar on unless you are right there. Goats can strangle quickly. In time the goat and you will learn to deal with the safety issues of collars and horned goats.

Books

"The Pack Goat"
by John Mionczynski
Published by Pruett Publishing Co.
Boulder, Colorado

"Goat Medicine"
by Mary C. Smith & David M. Sherman
Published by Lea & Febiger

"Meat Goat Production Handbook"
Available from Langston University
www.luresext.edu/GOATS/mgph.html

"Practical Goat Packing"
by Carolyn Eddy for $17.95
"Diet for Wethers" by Carolyn Eddy for $14.95
Shipping for one or both for $3.50
Order from: Eagle Creek Pack Goats
PO BOX 755
Estacada, Oregon, 93023

"Field First Aid for Goats" $24.95
by Carolyn Eddy & Alice Beberness
"Packable Guide for First Aid for Goats" $16.95 by Carolyn Eddy & Alice Beberness
Order from: Alice Beberness
PO BOX 4
Alvadore, Oregon 97409
Check, money order, or pay pal ID # Carolyn@goattracks.com

Magazine

"Goat Tracks Journal of the Working Goat"
owned and published by Larry Robinson
13 Norwood Place
Boise, ID 83716-3283

To become a member of the "North American Pack Goat Association"
Log on to www.napga.org

CURRENT PROGRAM SUMMARY

E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, Oklahoma 73050

- **EXTENSION OVERVIEW**
- **INTERNATIONAL OVERVIEW**
- **RESEARCH OVERVIEW**
- **USDA/CSREES PROJECTS**
- **EXPERIMENTS**
- **ABSTRACTS**
- **ARTICLE SUMMARIES**
- **VISITING SCHOLARS, GRADUATE STUDENTS, AND INTERNS**

[This page intentionally left blank.]

Extension Overview

Dr. Terry A. Gipson
Goat Extension Leader

The year 2015 was a busy year for the Langston Goat Extension program. The goat extension specialists have answered innumerable producer requests for goat production and product information via the telephone, letters and e-mail, have given numerous presentations at several state, regional, national and international goat conferences for potential, novice and veteran goat producers, and have produced quarterly newsletters. They have also been busy with several major extension activities. These activities include the annual Goat Field Day, Langston Goat Dairy Herd Improvement (DHI) Program, grazing demonstrations, and various goat workshops on artificial insemination, tanning hides, and on internal parasite control.

Goat Field Day

Our annual Goat Field Day was held on Saturday, April 25, 2015 at the Langston University Goat Farm with registration beginning at 8:00 a.m. This year's theme was Taking Control of Marketing. Last year, our featured speakers were Ms. Tess Caudill, Dr. Stephanie Clark, and Ms. Yvonne Zweede-Tucker.

Ms. Tess Caudill is the Sheep and Goat Marketing Specialist for the Kentucky Department of Agriculture where she developed a system of co-mingled, graded sales for the marketing of Small Ruminants. She travels around the state of Kentucky conducting these sales as well as providing education for small ruminant producers. In addition, Tess owns and operates a 200+ acre farm in Mercer County, Kentucky where she rotationally grazes beef cattle, hair sheep and goats. Tess received her B.S. in Animal Science from the University of Kentucky.

Dr. Stephanie Clark grew up on a small farm in Massachusetts, where she first started making cheese from milk of her Nubian dairy goats. She received her BS in Animal Science from Cornell University in 1990, and continued on for a MS in Food Science, which she earned in 1993. Stephanie earned her PhD in Food Science from Cornell University in 1997, then joined the faculty at Washington State University (WSU) in 1998. She was promoted to Associate Professor, with tenure, in 2004. Dr. Clark joined the faculty of Iowa State University (ISU) in August, 2009. She serves as the Associate Director of the Midwest Dairy Foods Research Center, where she oversees the ISU-associated dairy research component of the three-institution center. Her research, which centers broadly around dairy products chemistry, microbiology, processing and sensory evaluation, has been presented in over 55 publications and over 65 posters and presentations. Stephanie teaches courses in dairy products, scientific communication, and sensory evaluation of foods. She has been the research advisor of more than 20 undergraduate, 15 MS, and 5 PhD students. Stephanie has advised successful food product development and dairy products evaluation teams at WSU and at ISU. She is an active member of the Institute of Food Technologists and the American Dairy Science Association. Dr. Clark has served as Editor for the Journal of Dairy Science and Food Bioscience. She has been the technical advisor of the American Cheese Society Judging & Competition since 2011. In addition to serving as a visiting professor in China, Dr. Clark has also shared her dairy foods and cheese making expertise in Armenia, India, and Mexico.

Ms. Yvonne Zweede-Tucker received her BS in International Relations in 1982 from University of California, Davis. She worked in the corporate world for several years before she left southern California for Montana. In 1991, she started Smoke Ridge, a meat goat operation, in Choteau. In the third year of operation, she brought Smoke Ridge into profitability, expanding the herd from 30 head in 1991 to over 500 by the early 2000s. Along with husband, Craig, she manages the operation for production of both breeding

stock for raising profitable meat goats and production of market (slaughter) animals, cooperating with nearby producers to offer quantities of animals beyond what could produce on the limited land base (220 acres) of Smoke Ridge. She organized and conducted a day-long "Making Meaty Meat Goats" field day-seminar in Choteau in 2008 aimed at acquainting area livestock growers with the potential for meat goat production in the Rockies. Subsequently organized a four-state goat producer cooperative to collect, and haul, slaughter goats to a commercial packing plant in northwest Illinois. Producer payment was based on-the-rail carcass quality grade and reflected live-prices paid at the San Angelo, TX goat/sheep auction (the nation's largest). The IL plant currently buys/pays for goats from IA, MO, MN, and WI as well as MT. She also organized The Profitable Meat Goats Conference in Indianapolis in March, 2010. She wrote and sourced photographs for The Meat Goat Handbook, published by Voyageur Press in January of 2011. She organized the first Great Goat Gathering on October 18, 2014. Since August of 2007, she has been a monthly columnist for Goat Rancher Magazine, sharing their experiences with readers about life on a meat goat ranch on north-central Montana.

In the afternoon session, participants broke into small-group workshops. There was a total of fifteen workshops; however, participants were only have time enough to attend three. The afternoon workshops include:

1. Factors affecting the marketability of meat goat kids - breed for successful market kids with Ms. Tess Caudill.
2. What IS a goat worth? - determine if your asking price or the auction's offer is good enough with Ms. Yvonne Zweede-Tucker (1:30 p.m. ONLY).
3. The other 8/9 of your Business Plan - what other factors are important with Ms. Yvonne Zweede-Tucker (2:30 p.m. ONLY).
4. Good news! We've got customers. Reaching them on paper, on-line, and on a trailer - customer relationships and how to build them with Ms. Yvonne Zweede-Tucker (3:30 p.m. ONLY).
5. The art of cheesemaking - basics of cheesemaking with Dr. Stephanie Clark.
6. Internal Parasite Control - sustainable internal parasite control program with Dr. Barry Whitworth.
7. Basic Herd Health - herd health program including vaccinations, injection sites, and approved drugs with Dr. Lionel Dawson.
8. Basic Goat Husbandry - hoof trimming, body condition scoring, FAMACHA scoring, farm management calendar, etc. with Mr. Jerry Hayes.
9. Nutrition for Health and Production - calculations of feed intake and of energy and protein requirements with Dr. Steve Hart.
10. DHI Training - supervisor/tester training for dairy goat producers including scale certification with Ms. Eva Vasquez.
11. USDA Government Programs #1 - USDA/NASS: Animal inventories with Mr. Wil Hundl and USDA/AMS: Market strategies with Mr. Cole Snider (1:30 p.m. and 2:30 p.m. ONLY).
12. USDA Government Programs #2 - USDA/NRCS: Conservation programs with Mr. Kenneth Hitch and USDA/FSA: Farm loans with Mr. Phil Estes (1:30 p.m. and 3:30 p.m. ONLY).
13. USDA Government Programs #3 - USDA/WS: Wildlife programs with Mr. Kevin Grant and OK Depart of Ag: Home Slaughtering regulations with Mr. Stan Stromberg (2:30 p.m. and 3:30 p.m. ONLY).
14. Tanning Goat Hides - basic tanning and leather treatment of goat skins with Dr. Roger Merkel.
15. Fitting and Showing for Youth and Adults - tips and pointers on fitting and show ring etiquette with Messrs. Robbie and Coleman Sanders (this is a half-day afternoon workshop).

Ms. Shirlene Hurte hosted a full day of activities for youth ages 5-12 in Old-fashioned Fun. This allowed the parents and older teens to enjoy the workshops knowing that their little ones were having fun in a safe environment.

Cheese Manufacturing Workshop

An Annual Cheese Manufacturing Workshop was held in the pilot creamery at Langston University on April 24, 2015. Because of the tremendous interest in the workshop, more attendants than the original limit of 15 were admitted. In all, twenty participants from OK, KS and TX enjoyed this hands-on workshop. Dr. Steve Zeng, Dairy Product Specialist, demonstrated basic cheesemaking principles and skills by making Cheddar cheese, Feta cheese, and various soft cheeses (Chevrè, cream cheese, etc.) with our very own wholesome Grade "A" goat milk. This workshop was designed for beginners. Ideas and techniques were also shared with some experienced cheese makers in attendance. In the end, everyone had chance to make cheeses and take some cheeses home for aging. It surely was a fun and learning day for all.

Goat DHI Laboratory

This past year was a year of change for the Langston Goat Dairy Herd Improvement (DHI) Program as it became independent and expanded its record processing capabilities. In 1996, the Langston DHI program launched under the umbrella of the Texas DHIA. That partnership was not mutually beneficial and Langston Goat Dairy DHI elected to operate independently. In addition, the dairy records processing software that had been initially acquired from Texas DHIA had reached well beyond it capabilities and could not be modernized. Thus, Langston Goat Dairy DHI has partnered with Dairy Records Management System (DRMS) of Raleigh, NC to conduct the record processing.

DHI Program	
State	Number of herds
AL	3
AR	1
AZ	3
CO	1
FL	13
GA	9
ID	1
IL	2
IN	2
KS	3
KY	4
LA	1
MA	2
MD	2
MI	10
MN	6
MO	4
MS	5
NC	3
NE	1
NM	1
OH	5
OK	18
OR	1
PA	1
TX	12
VA	5
WI	2
WY	2

The Langston DHI program became the first DHI program to introduce forms and reports in goat terminology to dairy goat producers in the United States. A national Dairy Herd Improvement Association (DHIA) has been in existence for a number of years. However, until 1996 DHIA catered only to cow dairies. The Langston DHI program has been very popular with dairy goat producers and has grown significantly since its establishment in 1996. Goat producers are now able to get records for their animals that reflect accurate information with the correct language. Currently we are serving a 29 state-area that includes a majority of the eastern states. Currently, we have 123 producer herds in these 30 states enrolled in the Langston Goat Dairy DHI Program. In 2015, the DHI laboratory processed more than 9,000 samples. Langston University continues to serve the very small-scale dairy goat producer. The average herds size on test with Langston University is 10 animals. This is significantly smaller than the herd size average for the five other processing centers.

For those interested in becoming a Langston goat DHI tester, training is available either in a formal classroom setting or through a 35-minute video (see additional information in the YouTube section). Every tester is required to attend the DHI training session or view the tape and take a test. Upon completion of the DHI training, the milk tester can start performing monthly herd tests.

Goat Newsletter

To date, the Goat Extension program published four issues of the 8-page Goat Newsletter in 2015. Interest in the newsletter has grown and we currently have over 1,400 subscribers to our free quarterly Goat Newslet-

ter and the subscription list continues to increase every year. The Goat Newsletter is mailed to every state in the nation and to 10 countries overseas. Ninety-eight percent of the mailings go to American households. At least one newsletter is mailed to a household in every state in the nation. Thirty-five percent of the newsletters are mailed to Oklahoma households. An additional thirty percent of the newsletters are mailed to households to state adjacent to Oklahoma.

Artificial Insemination Workshop

The use of superior sires is imperative in improving the genetic composition of breeding stock. Artificial insemination has long been used in the dairy cattle industry and is a simple technology that goat producers can acquire. However, opportunities for goat producers to the necessary skills via formal and practical instruction are not widespread. Langston University has instituted a practical workshop for instruction in artificial insemination in goats. Producers are instructed in the anatomy and physiology of the female goat, estrus detection and handling and storage of semen. Producers participate in a hands-on insemination exercise. An understanding of the anatomy and physiology enable the producer to devise seasonal breeding plans and to troubleshoot problem breeders. An understanding of estrus detection enables the producer to effective time inseminations for favorable conditions for conception and to effectively utilize semen. An understanding of semen handling and storage enables the producer to safeguard semen supplies, which can be scarce and costly. The experience of actually inseminating a female goat enables the producer to practice the knowledge that they have gained. The acquisition of these inseminating skill will allow producers the use of genetically superior sires in their herds that they normally would not have access to. It also allows producers to save money by conducting the inseminating themselves instead of hiring an inseminator. In 2015, two AI workshops were held; one in September and one in October at the Langston University campus. Seventeen participants were trained.

Meat Goat Production Handbook

The first edition Meat Goat Production Handbook has been sold-out and the revised second edition is available. Even though Langston University has taken the lead in this revision project, this handbook is not the product of one person nor of a single university. Our collaborating project institutions/organizations, which include Alcorn State University, American Boer Goat Association, American Meat Goat Association, Florida A&M University, Fort Valley State University, Kentucky State University, Langston University, Prairie View A&M University, Southern University, Tennessee Goat Producers Association, Tennessee State University, Tuskegee University, United States Boer Goat Association, University of Arkansas Pine Bluff, and Virginia State University. Handbook contributing institutions/organizations include Allen Veterinary Clinic, American Boer Goat Association, American Meat Goat Association, BIO-Genics, Ltd., Bountiful Farm, Cornell University, Fort Valley State University, Kentucky State University, Langston University, Law Office of Wheeler and Mueller, Louisiana State University, Louisiana State University AgCenter, NCAT / ATTRA National Sustainable Agriculture Information Service, North Carolina State University, Oklahoma State University, Texas A & M University, United States Boer Goat Association, and Virginia State University. The Meat Goat Production Handbook was partially funded by USDA/FSIS/OPHS project #FSIS-C-10-2005.

Meat Goat Production Basics

An illustrated and scaled-down version of the Meat Goat Production Handbook is available. Our collaborating project institutions/organizations include Kentucky State University and the University at Puerto Rico at Mayagüez. Partial funding to develop the Meat Goat Production Basics was from USDA/NIFA grant #2010-38821-21581 (OKLX-GIPSON10).

Controlling Internal Parasites Workshop

Internal parasites (Barberpole worm, *Haemonchus contortus*) is the leading cause of death in goats in the Southern US, accounting for as many deaths as the total of the next three leading causes of death in goats. Several factors contribute to the high mortality caused by internal parasites.

Goats which originated in dry areas where there was no internal parasite challenge have been brought to the humid South where there is great parasite challenge. Only a few animals have good genetic resistance against internal parasites. In addition, goats are forced to graze rather than browse which provides greater opportunity to consume infective larvae and especially so when animals overgraze. Producers are not familiar with monitoring animals for signs of parasitism and do not understand how animals get infected. In addition internal parasites have developed a high level of resistance to dewormers from the overuse of dewormers in goats. To address these concerns, Langston developed a parasite workshop to educate producers about internal parasites. It includes 3 hours of lecture on biology of the parasite, pasture management to avoid worms and monitoring parasite infection using the FAMACHA chart which assesses the degree of anemia. This is a cooperative effort with OSU Extension Veterinarian who addresses dewormer resistance and correct use of dewormers. Producers get hands-on instruction in use of the FAMACHA card, taking fecal samples and running fecal egg counts.

YouTube Channel

Created in 2005,YouTube is a video-sharing website on which users can upload, view and share videos. YouTube now has over 120 million videos, including movie clips, TV clips, and music videos, as well as amateur content such as video blogging and short original videos. The Goat Program at Langston University has created its own YouTube channel (https://www.youtube.com/user/taglu01) The following are the YouTube videos that are available and you can quickly access them on a mobile device by using the QR (2D barcode) to the right. Additional videos will be added to the channel in the future

Artificial Insemination (AI) in Goats (length 8:47)

This video describes the steps involved in artificial insemination in goats.

AI Kit (length 6:28)

This video describes the equipment needed for artificial insemination in goats.

Basic Hoof Care (length 10:48)

This video explains basic hoof care for goats.

Body Condition Scores in Goats (length 2:11)

This video describes how to evaluate body condition score in goats.

Buck Effect (length 1:53)

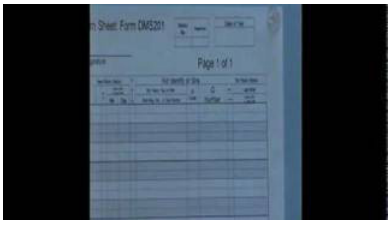
This video describes the buck effect and its use in estrus synchronization.

Estrous Synchronization in Goats (length 5:08)

This video explains estrous synchronization for artificial insemination in goats.

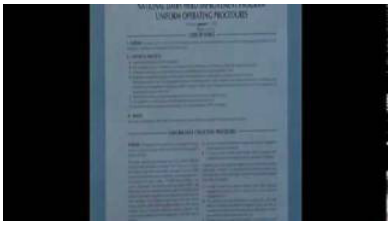
Langston DHI Tester Training - Part 1 (length 9:24)

This video describes how to conduct proper DHIA testing procedures for milk sampling.



Langston DHI Tester Training - Part 2 (length 9:48)

This video describes how to conduct proper DHIA testing procedures for milk sampling.



Langston DHI Tester Training - Part 3 (length 9:19)

This video describes how to conduct proper DHIA testing procedures for milk sampling.

Langston DHI Tester Training - Part 4 (length 8:28)

This video describes how to conduct proper DHIA testing procedures for milk sampling.

Semen Tank (length 6:39)

This video explains semen tank handling and semen storage for artificial insemination in goats.

Signs of Does (female goats) in Estrus (length 0:35)

This video shows an example of signs of estrus (flagging) in goats.

Nutrient Requirements of Goats

Under a research project which developed equations for energy and protein requirements for goats, as well as prediction of feed intake, an extension sub-project developed a website calculation system for "Nutrient Requirements of Goats" (http://www2.luresext.edu/goats/research/nutreqgoats.html). Most calculators were based on studies of the project reported in a Special Issue of the journal Small Ruminant Research. For calculators with score inputs (i.e., grazing and body conditions), pictures are available to aid in determining most appropriate entries. Realistic examples are given, as well as discussion of appropriate and inappropriate usage. However, for the experienced user there is an option to hide text and examples and to view only inputs and outputs.

In 2005, a calculator for calcium and phosphorus requirements was added to the existing calculators for metabolizable energy, metabolizable protein, and feed intake for suckling, growing, mature, lactating, gestating, and Angora goats. Also in 2005, the interface of the calculators was unified into a single calculator with the English measurement system used. This will encourage the use of the calculators by American producers. The least-cost ration balancer was modified so that it incorporates the least-cost feed percentage into the diet. Also, calculators are equipped with printable version commands to obtain inputs and outputs in hard copy format. In 2007, the calculators were continued to be updated.

Langston University's popular web-based nutrient calculator is now available for free on the iPad. To install this version, simply go the App Store and search for "Goat Nutrient Calculator". Once installed on your iPad, you will be able to calculate the nutrient requirements for any goat in any age, breed or stage of production, as well as, calcium and phosphorus requirements.

The original web-based nutrient calculators were developed under a research project and were only accessible via the website (http://www2.luresext.edu/goats/research/nutreqgoats.html). This iPad version is the first stand alone version of the calculators available.

The web-based version has a feed library and a least-cost ration balancer so that rations can be formulated to meet nutrient requirements. Currently, the iPad version does not have these attributes but it is planned to update this version with those capabilities with the next release.

For these calculators to be of value, they must be readily accessible and reasonably simple. It is hoped that this iPad version will enjoy widespread usage and enhance feeding practices for goats.

Tanning Goat Hides

People express interest in tanning skins for a variety of reasons. Some sheep and goat producers wish to tan skins of animals they raise. Other people are hunters who wish to tan deerskins. Reasons for this interest include: wanting to use as much of the animal as possible, disliking the waste of an animal's skin; ownership of an exceptionally pretty goat that they wish to tan after harvest for home use; learn new skills; wish to use tanning skills on other mammals such as deer; wishing to learn "old-time" skills, and some producers see a source of potential income through tanning goat skins and selling handicrafts. Some attendees already tan skins but want to expand their knowledge. All of these producers wish to learn to tan skins. There is no other tanning skins course in the nearby area. Langston University instituted a tanning goat skins course that teaches tanning skills to persons wishing to tan skins as a hobby. The workshop uses readily available chemicals and all processes are done by hand. Thus, it is a low cost process that producers can try at home. The hands-on nature of the course whereby participants work with actual skins in most of the tanning steps ensures skill transfer. This format allows students to work with and learn from each other and receive practical knowledge of the tanning process that will help them when trying tanning skins at home. In 2015, one tanning goatskins workshop was held at Langston University in March.

Internet Website

In order to deliver program to an international audience, an Internet presence was established many years ago. In an effort to deliver that information in a timely, efficient manner, and more appealing format, the Internet presence has been updated. However, the process is very time consuming and therefore two Internet sites has been established temporarily. The older web server (***http://www2.luresext.edu***) is built upon HTML code, javascript, and PERL scripts, which have become difficult to administer as the site has expanded over the years. The new web server (***http://www.luresext.edu***) is built upon Drupal, which is a content management system (CMS) that is much easier to maintain. This transition will last until all the information has been successfully ported over from the old server to the new server. This is a time-consuming process because the two server basically do no speak the same language and do not understand each others content packages.

Capabilities of both web sites include a document library with the complete proceedings of the annual Goat Field Day and the quarterly newsletter for the past several years. Both the proceedings and newsletters are also available in portable document format (pdf), which allows for the viewing and printing of documents across platform and printer without loss of formatting.

Information, recent abstracts and scientific articles of completed and current research activities in dairy, fiber and meat production are available for online viewing and reading. Visitors will be able to take a Virtual Tour of the research farm and laboratories, complete with digital photos and narrative. Visitors will also be able to browse a digital Photo Album. Visitors will also be able to subscribe to our free quarterly newsletter online. Visitors will be able to read about research interests of faculty and will be able to contact faculty & staff via email.

Web-based Training for Meat Goat Producers

Meat goat production is one of the fastest growing sectors of the livestock industry in the United States. New producers, as well as some established ones, have an expressed need for current, correct information on how to raise goats and produce safe, wholesome products in demand by the public. As the meat goat industry grows and evolves, a quality assurance program is essential. Such a QA program ensures the production of a wholesome product that satisfies consumers and increases profit for the meat goat industry.

Langston University was awarded funding by the Food Safety and Inspection Service of USDA to develop training and certification for meat goat producers. Langston University organized and led a consortium of

1890 universities and producer associations in this project. The consortium identified the subject topics most pertinent and pressing for the instructional modules. The consortium then identified experts on the selected subject topics and pursued these experts as module authors. These authors represent the most qualified persons in their field in academia as well as in the industry. Langston University translated the sixteen instructional modules into web pages with accompanying images, and pre- and post tests for those producers wishing to pursue certification. All modules are also available in pdf for easy printing and the introductory module is available as a podchapter for downloading and listening on your favorite mp3 player. The web-site (http://www2.luresext.edu/goats/training/qa.html) was unveiled in late 2005.

Even though this web-site (http://www2.luresext.edu/goats/training/qa.html) was only unveiled in 2007, more than 1,500 producers have enrolled for certification and 292 have completed the certification process. These instructional materials will best serve meat goat producers in assisting them to produce a safe, wholesome, healthy product for the American consumer. Funding source for this project was USDA/FSIS/OPHS project #FSIS-C-10-2004 entitled "Development of a Web-based Training and Certification Program for Meat Goat Producers."

State/Country	***Number Certified***
UNITED STATES	
AL	5
AR	10
AZ	1
CA	6
CO	2
CT	1
FL	25
GA	17
IA	5
ID	1
IL	5
IN	8
KS	11
KY	9
LA	3
MA	1
MD	4
MI	9
MN	4
MO	12
MS	2
MT	2
NC	14
NE	3
NH	1
NJ	2

State/Country	***Number Certified***
NV	3
NY	6
OH	10
OK	33
OR	7
PA	9
SC	5
SD	2
TN	13
TX	39
UT	2
VA	11
VT	1
WA	5
WI	5
WV	6
WY	3
CANADA	
AB	2
BC	4
MB	3
NS	1
ON	3
Botswana	1
England	2
India	1
Malaysia	4
Mexico	1
Pakistan	1
Saudi Arabia	1
South Africa	1
Suriname	1
Zimbabwe	2
Total	***351***

Current Extension Projects

Title:	Enhancing Capabilities of Socially Disadvantaged and Underserved Farmers via Low Literacy Materials in English and Spanish
Type:	USDA 1890 Institution Capacity Building Grants Program
Project Number:	OKLX-GIPSON10
Period:	2010-2015
Investigators:	T.A. Gipson[1], R.C. Merkel[1], M. Simon[2], J. Fernandez Van Cleve[3]
Institutions:	[1]Langston University; [2]Kentucky State University; [3]University of Puerto Rico - Mayaguez
Funding amount:	$282,000
Objectives:	utilize existing core chapters from the Meat Goat Production Handbook to develop a low-literacy training manual for meat goat production. translate the low-literacy meat goat production training manuals into Spanish. develop supplemental explanatory and "how to" demonstration materials to the English and Spanish manuals in video format (DVD and web-based) for use by extension agents, outreach specialists and individual farmers.

Title:	Extension Education Delivery Tools for Dairy Goat Producers: A Web-Based Certification Program and E-Book
Type:	USDA 1890 Institution Capacity Building Grants Program
Project Number:	OKLXMERKEL11
Period:	2011-2016
Investigators:	R.C. Merkel[1], T.A. Gipson[1], S. Hart[1], Y. Park[2], C.M. Mikolayunas[3]
Institutions:	[1]Langston University; [2]Fort Valley State University; [3]University of Wisconsin
Funding amount:	$350,000
Objectives:	develop scientific-based content for a dairy goat web-based certification program and e-book. design and construct a web-based certification program based upon the developed content. develop a printed handbook based on the web-based program develop an e-book version of the handbook.

Title:	Rehabilitation of Urban And Suburban Landscapes: An Eco-Friendly Partnership Between Langston University and Tribal and Municipal Governments
Type:	USDA Renewable Resources Extension Act Program
Project Number:	OKLUOKLXRREAGIPSON14
Period:	2014-2016
Investigators:	T.A. Gipson[1], S. Hart[1]
Institutions:	[1]Langston University
Funding amount:	$40,500
Objectives:	establish partnerships between Langston University and tribal and municipal governments, and will establish demonstration sites using goats for biological control with Langston University providing technical assistance.

Title:	Comparison of Biological Control of Red Cedar with Goats to Conventional Methods of Control
Type:	USDA 1890 Institution Capacity Building Grants Program
Project Number:	OKLUSHART2014
Period:	2014-2017
Investigators:	S.P. Hart[1], T.A. Gipson[1], R.C. Merkel[1], C. Clifford-Rathert[2], J. Pennington[3], C. Williams[1]
Institutions:	[1]Langston University; [2]Lincoln University; [3]Crowder College
Funding amount:	$565,784
Objectives:	compare various methods for redcedar control, specifically for efficacy, environmental impact and costs to property managers and policy makers with information to enable them to make informed decisions on redcedar control evaluate factors affecting redcedar consumption by goats so that goats can be managed more effectively to control redcedar utilize near-infrared spectroscopy (NIR) to predict volatile oil content of redcedar and to predict the digested redcedar content of feces (enables prediction of quantity of redcedar consumed by the goat)

Research Overview

Dr. Arthur Goetsch
Goat Research Leader

There has been and is a wide array of research areas addressed by our program. All major types of goats produced in the US are considered, i.e., ones raised for meat, milk, and(or) fiber, both cashmere and mohair. The increasing demand for goat meat and decline in the mohair industry in recent years have resulted in an expansion of research topics with meat goats, but because the future is unknown, all goat industries will continue to receive attention. The Institute has and will in the future conduct research to increase levels and efficiencies of goat production, enhance utilization of goat products, and improve use of goats for specific purposes such as vegetation management. There is intent to increase economic returns to those raising goats or processing their products, as well as providing other benefits such as enhanced sustainability of livestock production systems.

A large proportion of the Institute's research program is made possible by grants, many of which are through USDA programs. Although dissemination of information generated from all of these projects occurs, some entail strong extension components. Likewise, there are projects listed in our international section that entail significant research components.

To provide an idea about our research program since the last Field Day, listed below are research projects and experiments we have been involved with in 2015 and 2016, some of the abstracts to be presented at meetings in 2016, and summaries of scientific articles that were published in 2015 or have been accepted for publication.

Standard Abbreviations Used

BW = body weight
CP = crude protein
dL = decaliter
DMI = dry matter intake
kg = kilogram
M = mole
MEI = ME intake
mm = millimeters
ng = nanogram
OM = organic matter
SE = standard error
wt = weight
vs = versus
cm = centimeters
d = day
DM = dry matter
g = gram
L = liter
ME = metabolizable energy
mL = milliliter
mo = month
NDF = neutral detergent fiber
P = probability
TDN = total digestible nutrients
vol = volume
μ = micro

2015 and Current Research Projects

Title: Factors Influencing Goat Production and Products in the South-Central U.S.
Type: USDA NIFA Evans-Allen
Project Number: OKLXSAHLU2012
Period: 2012-2017
Investigators: T. Sahlu, A. L. Goetsch, R. Puchala, R. C. Merkel, T. A. Gipson, S. P. Hart, S. Zeng, and Z. Wang
Institution: Langston University
Objective: Study goat feeding and management, relevant health issues, and milk product technologies in order to increase the level and efficiency of goat productivity for increased profitability from goat production and lower costs to consumers of goat products.

Title: Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats
Type: USDA 1890 Institution Capacity Building - Research
Project Number: OKLXWANG10
Period: 2010-2015
Investigators: Z. Wang[1], A. L. Goetsch[1], S. P. Hart[1], T. Sahlu[1], and G. Chen[2]
Institutions: [1]Langston University and [2]Oklahoma State University
Objectives: Investigate immune regulation by H. contortus and reversing this regulation by nutritional components in small ruminants

Title: Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites
Type: USDA 1890 Institution Capacity Building - Integrated Extension and Research
Project Number: OKLXSAHLU12
Period: 2012-2016
Investigators: T. Sahlu[1], A. L. Goetsch[1], T. A. Gipson[1], S. P. Hart[1], Z. Wang[1], R. Mateescu[2], and E. DeVuyst[3]
Institutions: [1]Langston University, [2]University of Florida, and [3]Oklahoma State University
Objectives:
1) Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-station' and 'on-farm'
2) Characterize changes performance due to selection; develop and implement a new second generation central sire performance test for small ruminants at Langston University
3) Develop early-life genetic indicators of resistance and assess changes in physiological conditions affected by selection
4) Evaluate economic and management considerations of whole herd/flock selection; disseminate potential benefits of selection and associated economic and management considerations for adoption by small ruminant producers

Title: Genomics of Resilience in Sheep to Climatic Stressors
Type: USDA 1890 Institution Capacity Building
Project Number: OKLXGOETSCH13
Period: 2013-2017
Investigators: A. L. Goetsch[1], T. A. Gipson[1], R. Mateescu[2], S. Zeng[1], R. Puchala[1], M. Rolf[3], T. Sahlu[1], and P. Oltenacu[2]
Institutions: [1]Langston University, [2]University of Florida and [3]Oklahoma State University
Objectives:
1) Gain a better understanding of the genetic basis of adaptation in sheep to change in climate
2) Through a landscape genomics phase, document that some allele frequencies of otherwise genetically similar populations vary as a function of environmental climatic conditions
3) Evaluate traits expected to be important for resilience to climatic stressors under identical conditions with sheep of four breeds randomly selected from four different locations with varied environmental conditions

4) In a genome-wide association phase, ascertain if these resilience traits are genetically based and heritable
5) Compare and rank genomic breeding values for these resilience traits of oldest sheep of each location and bred to elucidate how different environmental climatic conditions affect the importance of these traits to fitness
6) Investigate change in the mean value of each resilience trait along environmental gradients, possibly consistent with climatic variation

Title: Comparison of Biological Control of Red Cedar with Goats to Conventional Methods of Control
Type: USDA 1890 Institution Capacity Building – Research and Extension
Project Number: OKLXHART14
Period: 2014-2017
Investigators: S. P. Hart[1], T. A. Gipson[1], R. C. Merkel[1], J. Pennington[2], C. Clifford-Rathert[2], and C. Williams[1]
Institutions: [1]Langston University and [2]Lincoln University
Objectives: 1) Learn more about factors affecting red cedar consumption by goats so that they can be more effectively for control red cedar
2) Compare the degree of control and cost of use of goats versus alternative methods of clipping, burning, and herbicide

Title: Enhancing Wellbeing and Productivity of Dairy Goats Using Smart Technology
Type: USDA 1890 Institution Capacity Building - Research
Project Number: OKLXGIPSON14
Period: 2014-2017
Investigators: T. A. Gipson[1], S. P. Hart[1], R. Puchala[1], E. Loetz[1], L. J. Dawson[2], and B. Ardrey[3]
Institutions: [1]Langston University, [2]Oklahoma State University, and [3]Smartsock
Objectives: 1) Validate the appropriate use of a rumen bolus for real-time monitoring of rumination and ruminal temperature
2) Model rumination time and rumen movement using the rumen bolus
3) Examine temperature and rumination time in relation to estrus using the rumen bolus
4) Examine temperature and rumination time in relation to mastitis using the rumen bolus

Title: Sustainable Control of Greenhouse Gas Emission by Ruminant Livestock
Type: USDA 1890 Institution Capacity Building - Research
Project Number: OKLXGOETSCH14
Period: 2014-2017
Investigators: A. L. Goetsch[1], R. Puchala[1], T. Sahlu[1], M. Flythe[2], and G. E. Aiken[2]
Institutions: [1]Langston University and [2]USDA ARS Forage-Animal Production Research Institute
Objectives: Characterize long-term effects of lespedeza condensed tannins in combination with other substances potentially reducing ruminal methane emission by sheep and goats

2015/2016 Experiments

Title:	Intake of red cedar by goats
Project Number:	OKLUSHART2014
Experiment Number:	SH-15-01
Investigators:	S. Hart and T. A. Gipson
Objectives:	Develop a near-infrared reflectance spectrophotometry method of predicting red cedar intake from fecal samples
Title:	Effects of initial body condition and diet nutritive value on performance by lactating dairy goats
Project Number:	OKLXSAHLU2012
Experiment Number:	LR-15-02
Investigators:	L. P. S. Ribeiro, R. Puchala, T. A. Gipson, T. Sahlu, I. Portugal, A. Manley, E. Loetz, L. J. Dawson, and A. L. Goetsch
Objectives:	Determine effects and interactions of initial body condition and diet nutritive value on performance and associated conditions by Alpine goats in early and mid-lactation
Title:	Effects of method of intermittent supplementation of growing meat goat kids with the tree legume mimosa (Albizia julibrissin)
Project Number:	OKLXSAHLU2012
Experiment Number:	SPL-15-03
Investigators:	S. P. Lama, R. Puchala, T. A. Gipson, I. Portugal, T. Sahlu, Z. Wang, J. D. Hayes, G. E. Aiken, and A. L. Goetsch
Objectives:	Determine effects of supplementation with the tree legume mimosa (Albizia julibrissin) by periodic access to pastures with live trees compared with a cut-and-carry approach on performance, nutrient utilization, and behavior of young growing meat goats
Title:	Quantifying IgG in goat colostrum using a Brix refractometer
Program:	Oklahoma State University, Center for Veterinary Health Sciences
Experiment Number:	RO-15-04
Investigators:	R. Oman, R. Streeter, and L. J. Dawson
Objectives:	Validate the use of a digital Brix refractometer for quantifying IgG in first-milking goat colostrum samples
Title:	Effects of restricted periods of diet access on production by dairy goats in mid- to late lactation
Project Number:	OKLXSAHLU2012
Experiment Number:	NS-15-05
Investigators:	N. C. D. Silva, T. A. Gipson, R. Puchala, T. Sahlu, I. Portugal, A. Manley, E. Loetz, Y. Tsukahara, L. J. Dawson, and A. L. Goetsch
Objectives:	Determine effects of different types of restricted feed access on feed intake, milk yield and composition, efficiency of feed utilization, and feeding behavior of Alpine dairy goats in early to mid-lactation
Title:	Sustainable small ruminant production through selection for resistance to internal parasites – on-farm and on-station selection and use of a small ruminant central performance test in year 3
Experiment Numbers:	YT-15-06
Project Number:	OKLXSAHLU12
Investigators:	Y. Tsukahara, A. L. Goetsch, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, and T. Sahlu
Objectives:	General: Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-farm' and 'on-station' in the southeast and south-central US; characterize 'on-farm' and 'on-station' performance due to selection of small ruminants for resistance to internal parasites; and develop and implement a new second generation central sire performance test for small ruminants,

	focusing on resistance to internal parasites, but also retaining attention to feed intake, average daily gain, and efficiency of feed utilization Specific: Specific objectives are to determine phenotypic diversity of resistance to internal parasitism, such as through FEC, FAMACHA score, and immunoglobulin concentrations in serum and growth performance among the resistant groups for each flock/herd established in the preceding year, in addition to implementation of the second generation central performance test including larval challenge, female selection 'on-farm' and 'on-station,' establishment of breeding groups, and the second and third year breeding
Title:	Comparison of biological control of red cedar with goats to conventional methods of control
Project Number:	OKLUSHART2014
Experiment Number:	SH-15-07
Investigators:	S. Hart, M. Sawalhah, T. Gipson, R. Merkel, and C. Williams
Objectives:	Overall: Learn more about factors affecting cedar consumption so that goats can be used more effectively to control red cedar and to transfer this knowledge to property managers who need it. Specific: 1)Develop NIR prediction equations using fecal samples to predict consumption of red cedar and use browse samples to predict terpene content and consumption of browse 2)Measure the degree of control of red cedar by goats 3)Examine the effect of seasonal changes in terpenes on intake of red cedar 4)Compare the cost of control of red cedar by goats vs. conventional methods 5)Organize state-wide meetings for land managers and cattlemen to showcase red cedar control using goats and discuss how goats can be used for controlling red cedar
Title:	Effects of salinity of drinking water on feed intake, digestion, and efficiency of energy utilization by Katahdin sheep wethers and Boer goat wethers of different ages
Project Number:	OKLXSAHLU2012
Experiment Number:	HY-15-10
Investigators:	H. Yirga, R. Puchala, I. Portugal, D. Tadesse, S. LeShure, Y. Tsukahara, L. J. Dawson, T. Sahlu, and A. L. Goetsch
Objectives:	Determine effects of level of a brackish water source and increased levels of total dissolved solids in saline drinking water on feed intake, digestion, efficiency of energy utilization, ruminal methane emission, and ruminal and blood constituent levels in mature Katahdin sheep wethers compared with mature and growing Boer goat wethers
Title:	Evaluation of resilience of hair sheep breeds from different regions of the USA to high heat load – trial 1 and animal set 1
Project Number:	OKLXGOETSCH2013
Experiment Number:	DT-15-12
Investigators:	D. Tadesse, R. Puchala, T. A. Gipson, L. J. Dawson, Z. Wang, T. Sahlu, and A. L. Goetsch
Objectives:	Evaluate resilience to high heat load index of three hair sheep breeds (Dorper, Katahdin, and St. Croix), four ecotypes from different eco-climate domains of the USA (Upper Midwest, Central Texas, Southeast, Pacific Northwest), and individual animals
Title:	Comparison of cytokine gene profiles in parasitic antigen-stimulated white blood cells from different breeds of hair sheep
Project Number:	OKLXGOETSCH2013
Experiment Number:	AH-15-13
Investigators:	A. Hussein, D. Tadesse, Z. Wang, A. L. Goetsch, and T. Sahlu
Objectives:	Characterize cytokine gene expression in white blood cells stimulated with antigen of Haemonchus contortus of individual hair sheep of three breeds (Dorper, Katahdin, and St. Croix) and four ecotypes from different climatic zones of the USA (Upper Midwest, Central Texas, Southeast, Pacific Northwest)

Title:	Effects of forage quality and breed on rumination time in goats
Project Number:	OKLUTGIPSON2014
Experiment Number:	SL-15-14 and SL-16-01
Investigators:	S. LeShure, T. A. Gipson, R. Puchala, A. L. Goetsch, and T. Sahlu
Objectives:	Model rumination time based on video observation in goats

Title:	Acclimatization of sheep to limited drinking water availability – trial 1 and animal set 3
Project Number:	OKLXGOETSCH2013
Experiment Number:	AH-15-15
Investigators:	A. Hussein, A. L. Goetsch, R. Puchala, T. A. Gipson, D. Tadesse, and T. Sahlu
Objectives:	Evaluate resilience to limited drinking water availability of three hair sheep breeds (Dorper, Katahdin, and St. Croix), four ecotypes from different eco-climate domains of the USA (Upper Midwest, Central Texas, Southeast, Pacific Northwest), and individual animals

Title:	Evaluation of resilience of hair sheep breeds from different regions of the USA to limited feed intake – trial 1 and animal set 3
Project Number:	OKLXGOETSCH2013
Experiment Number:	DT-15-16
Investigators:	D. Tadesse, A. Hussein, R. Puchala, T. A. Gipson, Z. Wang, T. Sahlu, L. J. Dawson, and A. L. Goetsch
Objectives:	Evaluate resilience to limited feed intake of three hair sheep breeds (Dorper, Katahdin, and St. Croix), four ecotypes from different eco-climate domains of the USA (Upper Midwest, Central Texas, Southeast, Pacific Northwest), and individual animals

Title:	Reproductive performance of time-bred cycling nulliparous goats estrus/ovulation synchronized by a progestogen or prostaglandin-based protocol using laparoscopy or scope-aided transcervical insemination
Project Number:	OKLXSAHLU2012
Experiment Number:	EL-15-17
Investigators:	E. Loetz, B. Coffman. L. Dawson, A. Manley, J. Hayes, and I. Portugal
Objectives:	Determine effects of two estrus and ovulation synchronization protocols of timed artificial insemination cycling multi-breed doelings and two breeding techniques (scope-aided transcervical vs. laparascopic-aided artificial insemination) on reproductive performance

Title:	Immune response of white blood cells from heat-stressed hair sheep
Project Number:	OKLXGOETSCH2013
Experiment Number:	ZW-15-18
Investigators:	Z. Wang, D. Tadesse, R. Puchala, A. L. Goetsch, and T. Sahlu
Objectives:	Determine effects of heat stress on cytokine production by white blood cells stimulated with mitogens in vitro and cytokine profiles obtained from three breeds of hair sheep (Dorper, Katahdin, and St. Croix) and four ecotypes from different climatic zones of the USA

Abstracts

2016 Southern Section Meetings of the American Society of Animal Science in San Antonio, Texas
(The American Society of Animal Science has copyright ownership and the Journal of Animal Science is the source of this information.)

Use of fecal NIRS to predict red cedar intake by goats

S. P. Hart and M. Sawalhah

American Institute for Goats Research, Langston University, Langston, Oklahoma

The objective of this study was to develop a NIRS calibration equation for fecal samples so that the percent red cedar in the diet could be predicted in a vegetation management study. Thirty Boer yearling wethers (45.3, SD = 9.4 kg initial BW) were penned individually and assigned to one of 5 basal diets (basal concentrate, alfalfa pellets, chopped native grass hay, chopped mixed hay or chopped wheat hay). Five levels of fresh harvested red cedar needles (0, 6, 12, 18, and 24% of dietary DM) were substituted for the basal diet, 1 week at each level. Five basal diets were used to make the prediction equation robust across diets (prevent confounding between cedar level and basal diet level). Fecal samples were collected for the last 3 days during each feeding week using fecal bags for approximately 2h/d. Fecal samples were dried at 65oC and ground in a Cyclotectm mill to pass a 1 mm screen. Fecal samples were scanned from 680 nm to 2500 nm using a Unity Spectra Starm NIR spectrophotometer. Wethers fed chopped wheat hay had lower total feed intake ($P<0.01$) compared to all other basal diets. Total feed intake and basal diet intake were not affected by red cedar levels ($P>0.05$). Basal diet intake was higher ($P<0.01$) for wethers consuming the basal concentrate or alfalfa pellets compared to wethers fed any of the chopped hays. Red cedar intake was lower ($P<0.01$) for wethers fed basal concentrate compared to all other diets. A prediction equation was developed using red cedar intake reference data and fecal spectra data using UCaltm software. The predictive equation had a R2 of 0.83 and a standard error of calibration of 3.37%. This equation should be suitable for predicting red cedar intake from fecal samples of grazing goats.

2016 National Meetings of the American Society of Animal Science in Salt Lake, City Utah
(The American Society of Animal Science has copyright ownership and the Journal of Animal Science is the source of this information.)

Conditions to evaluate differences among individual sheep and goats in resilience to restricted drinking water availability

U. L., Mengistu,[1,2] R. Puchala,[1] T. Sahlu,[1] T. A. Gipson,[1] L. J. Dawson,[1,3] and A. L. Goetsch[1]

[1]American Institute for Goats Research, Langston University, Langston, Oklahoma
[2]Department of Animal and Range Sciences, Haramaya University, Dire Dawa, Ethiopia
[3]Center for Veterinary Health Sciences, Oklahoma State University, Stillwater, Oklahoma

Thirty-six yearling Boer goat (BOE), Katahdin sheep (KAT), and Spanish goat wethers (SPA) were used to study appropriate conditions to evaluate resilience to restricted drinking water availability. Moderate quality grass hay was consumed ad libitum with concentrate (80% corn, 20% soybean meal) supplemented at 0.5% BW. Baseline conditions were determined in the last 2 wk of a 3-wk period (i.e., 100% level). Thereafter, water availability was decreased by 10% every 1 (1X) or 2 wk (2X) to 40% of baseline intake (i.e., 90, 80, 70, 60, 50, and 40% levels), but also with 2 wk at 40% for the 1X restriction treatment. There was an interaction ($P < 0.001$) between animal type and restriction level in hay DMI, with values of 346, 360, 358, 276, 286, 235, and 176 g/d for BOE, 656, 592, 592, 469, 522, 407, and 307 g/d for KAT, and 392, 390, 368, 273, 298, 298, and 219 g/d for SPA at levels of 100, 90, 80, 70, 60, 50, and 40%, respectively (SE = 29.1). Moreover, hay DMI by 2X wethers was much

lower in wk 2 vs. 1 at the 40% level (week × level interaction, P = 0.008; 409, 369, 345, 377, 336, and 276 g/d in wk 1 and 428, 398, 312, 352, 310, and 203 g/d in wk 2 at 90, 80, 70, 60, 50, and 40% levels, respectively; SE = 23.4). Restriction level affected (P < 0.001) plasma cortisol concentration in 2X wethers on the last day at each level (12.4, 14.0, 23.3, 26.4, and 32.6 nmol/l for 100, 70, 60, 50, and 40% levels, respectively; SE = 3.62). Plasma vasopressin concentration in 2X wethers at the end of each week at 60, 50, and 40% levels was affected by an interaction (P = 0.006) between week and restriction level (3.98, 5.61, and 7.84 in wk 1 and 6.40, 7.22, and 7.06 pmol/l in wk 2, respectively; SE = 0.564). In conclusion, there was some indication that DMI by KAT was more subject to adverse effects of very low water availability but not mild restriction compared with goats. Based on vasopressin concentration, a length of at least 2 wk rather than 1 with a set level(s) of restricted water availability seems desirable, which might also increase meaningfulness of measures such as BW. Results for DMI and cortisol concentration suggest appropriateness of a maximum restriction level of 50%.

Factors influencing estimates of energy used for activity by grazing meat goats

M.-E. Brassard,[1,2] R. Puchala,[1] T. A. Gipson,[1] T. Sahlu,[1] and A. L. Goetsch[1]

[1]American Institute for Goat Research, Langston University, Langston, Oklahoma
[2]Université Laval, Québec, QC, Canada

Ten yearling Boer goat wethers (45.4 ± 0.92 kg) consuming fresh Sudangrass ad libitum while grazing (GRA) a 0.8-ha pasture or individually confined (CON) were used in a crossover experiment with 3-wk periods to evaluate factors influencing estimates of energy used for activity (AEC) when grazing. Fresh forage offered to CON wethers was 15.9 and 13.4% CP and 65.0 and 67.4% NDF in periods 1 and 2, respectively. Based on forage and fecal AIA, forage DE concentration for CON averaged 67.9 and 56.5% in periods 1 and 2, respectively. From these values and fecal DM, least squares means of ME intake were 405 and 484 kJ/kg $BW^{0.75}$ for CON and GRA, respectively (SE = 15.4). Heat energy (HE) determined from heart rate (HR) measured over 1 d and the ratio of HE to HR estimated earlier was less (P < 0.001) for CON than for GRA (482 and 642 kJ/kg $BW^{0.75}$; SE = 17.2). The AEC estimated by subtraction from HE of ME used for maintenance (ME_m; 427 kJ/kg $BW^{0.75}$), HE expended for tissue energy gain based on recovered energy (RE) when greater than 0, an efficiency of ME use for gain (i.e., [0.0423 × forage ME in MJ/kg DM] + 0.006; 0.40 ± 0.009), and the same efficiency of use for maintenance (k_m; [0.019 × forage ME in MJ/kg DM] + 0.503; 0.68 ± 0.004) of energy from forage and mobilized tissue with RE less than 0 was 39 and 213 kJ/kg $BW^{0.75}$ for CON and GRA, respectively (SE = 21.9). Slightly greater values resulted from assuming that mobilized tissue energy was used for maintenance more efficiently (i.e., 0.80) than forage ME, with values of 57 and 241 kJ/kg $BW^{0.75}$ for CON and GRA, respectively (SE = 23.9). The former AEC value for GRA and that determined simply from the difference between GRA and CON HE were much greater than AEC based on time spent in different activities (i.e., resting-lying, resting-standing, grazing, and walking) multiplied by corresponding HE and assuming that AEC resulted from HE when resting-standing, grazing, and walking (217 ± 19.7, 165 ± 19.3, and 46 ± 4.85 kJ/kg $BW^{0.75}$, respectively). In conclusion, determining the AEC of meat goats while grazing by subtraction of other sources of HE is influenced by specific assumptions of energy requirements and efficiencies of use for different physiological functions.

Effects of forage quality and breed on rumination time in goats

S. LeShure, T. A. Gipson, R. Puchala, A. L. Goetsch, and T. Sahlu

American Institute for Goat Research, Langston University, Langston, Oklahoma, USA

Rumination time is one of the many key factors in determining animal wellbeing. The objective was to investigate effects of forage quality and breed on rumination time in goats. The experiment was 2 simultaneous 4 x 4 Latin squares having a 2 x 4 factorial treatment arrangement with 2 breeds (Alpine and Spanish) and 4 treatments [24 h fasting (FAST), low-quality hay (LOW; mixed grass), LOW plus concentrate [CONC; 80% corn and 20% soybean meal at 1% BW(DM)], and high-quality hay (HIGH; alfalfa)]. Twelve mature does of each breed were placed in individual metabolic crates and given free access to hay unless fasting. There were 4 periods of 72 h with 3 rotations of 8 does/day (24 h x 3 d). Does were digitally recorded for 24 h, then observations were encoded for ruminating bouts and bout duration. Data were analyzed using a mixed model consisting of DMI as a covariate, treatment, breed, and treatment x breed as fixed effects and animal within square as a random effect. Feed

intake relative to $BW^{0.75}$ was 0, 17, 28, and 21 g/kg BW0.75 for FAST, LOW, CONC, and HIGH, respectively (SEM = 1.6) and 17 and 16 g/kg $BW^{0.75}$ for Alpine and Spanish, respectively (SEM = 1.4). Total rumination duration was affected by breed ($P < 0.01$) and treatment ($P < 0.01$). Alpine goats ruminated longer ($P < 0.01$) than Spanish (310 vs. 249 min, respectively; SEM=12.8) and rumination duration while fasting was lower ($P < 0.01$) than for other treatments (229, 313, 282, and 295 min for FAST, LOW, CONC, and HIGH, respectively; SEM = 17.6). Treatment did not affect ($P > 0.10$) the number of rumination bouts; however, Alpines had a greater ($P < 0.01$) number of bouts than Spanish (29 vs. 20 bouts, respectively; SEM = 1.9). Average bout duration was affected by both treatment ($P < 0.01$) and breed ($P < 0.01$). Average bout while fasting was shorter ($P < 0.01$) than for other treatments (10, 13, 13, and 15 min for FAST, LOW, CONC, and HIGH, respectively; SEM = 0.9). Spanish had longer ($P = 0.03$) rumination bouts than Alpine (14 vs. 11 min, respectively; SEM = 0.8). In conclusion, similar dry matter intake among non-fasting treatments may have prevented effects on rumination, although greater differences between breeds and fasting state had marked influences.

Effects of pasture access regime on grazing behavior and energy utilization by Alpine goats

A. Keli, L. P. dos Santos Ribeiro, T. A. Gipson, R. Puchala, and A. L. Goetsch

American Institute for Goat Research, Langston University, Langston, Oklahoma, USA

Twenty-eight Alpine goats (initially 53.2 ± 1.80 kg BW and 26 ± 2.5 days in milk; 11 primiparous) were used to evaluate effects of different pasture access regimes on grazing behavior and energy utilization in a 16-wk experiment with 4-wk periods. Treatments were access to grass and(or) legume pasture from 0800 h, after the morning milking at 0700 h, to 1600 h (SET); continually other than during milking (CG); from the time of no moisture on leaf surfaces until milking at 1600 h (ND-M); and from the time of no leaf surface moisture until sunset (ND-D). The SET, CG, and ND-M goats were supplemented with 1.5% BW (DM) of concentrate immediately after the afternoon milking, whereas ND-D goats were supplemented at sunset. The ND-M and ND-D goats were fed alfalfa hay when length of pasture access was less than 6 h, with the level based on length of pasture access. Digestibility of OM determined each period from fecal DM and AIA in feedstuffs and feces was 77.0, 79.1, 81.3, and 77.8%, respectively (SE=1.46), and ADG was similar among treatments (-12, -15, 2, and -6 g for CG, ND-D, ND-M, and SET, respectively; SE=10.9). Neither fecal egg count nor FAMACHA score was affected by treatment ($P>0.05$). Based on data from GPS collars and leg activity monitors, treatment affected ($P<0.05$) time spent grazing (7.43, 6.93, 5.86, and 6.18 h, respectively; SE=0.343), resting while lying (8.48, 8.82, 10.63, and 9.11 h, respectively; SE=0.480) and standing (6.33, 7.29, 6.85, and 7.82 h, respectively; SE=0.338), and walking (1.75, 0.95, 0.66, and 0.90 h for CG, ND-D, ND-M, and SET, respectively; SE=0.093). Intake of ME was similar among treatments ($P>0.05$; 26.73, 24.54, 26.25, and 22.37 MJ/d, respectively; SE=1.522), although heat energy determined from heart rate and heat energy per heart beat was greatest for CG ($P<0.05$; 14.41, 13.11, 12.90, and 13.03 MJ/d for CG, ND-D, ND-M, and SET, respectively; SE=0.392). Milk energy yield was similar among treatments (5.41, 5.06, 5.34, and 5.55 MJ/d, respectively; SE=0.35), but milk energy:ME intake was greatest ($P<0.05$) for SET (0.228, 0.219, 0.220, and 0.275 for CG, ND-D, ND-M, and SET, respectively; SE = 0.0104). In conclusion, restricting time of pasture access from the morning to afternoon milking appeared to favorably affect efficiency of energy utilization for lactation, not relating to internal parasitism, but rather by limiting time spent and heat energy associated with grazing.

The response to artificial infection with Haemonchus contortus and growth performance of sheep and goat progeny of selected parents in a central performance test

Y. Tsukahara, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, T. Sahlu, and A. L. Goetsch

American Institute for Goat Research, Langston University, Langston, Oklahoma, USA

Fifteen Katahdin (KS-A; 4.0 mo old, 38 kg), 5 Katahdin (KS-B; 3.0 mo, 20 kg), 16 Dorper (DS; 3.4 mo, 25 kg), and 17 St. Croix sheep (CS; 4.2 mo, 18 kg) and 20 Kiko (KG; 3.9 mo, 19 kg), 16 Boer (BG; 4.4 mo, 16 kg), and 18 Spanish goat (SG; 4.3 mo, 18 kg) males from 5 commercial farms in KS, MO, and AR and Langston University (LU) were used to investigate growth performance and response to artificial infection with Haemonchus contortus in year 3 of a central test at LU. Animals tested were progeny of dams (based on on-farm data) and sires classified as Resistant and Moderate in year 2. The test entailed an adjustment period of 2 wk followed by 8 wk of data collection. Animal groups were housed separately in adjacent pens with

automated feeders allowing free-choice access to a 15% CP diet. During adaptation, anthelmintic treatment resulted in low fecal egg count (FEC; <600 eggs/g), after which 10,000 larvae were administered orally. Packed cell volume (PCV) was measured weekly and FEC was determined 5 times in wk 5-9. The cubic clustering criterion of SAS® categorized resistance classes. The GLM procedure included animal group and resistance classification, initial BW, PCV, and FEC were covariates, and the logarithmic transformation ln(x+100) was used for mean FEC. Animal group affected (P<0.01) ADG (308, 264, 321, 254, 139, 243, and 147 g; SEM=14.6), DMI (2.34, 1.65, 1.65, 1.32, 0.79, 1.28, and 0.94 kg/d; SEM=0.069), and PCV (25.4, 24.3, 28.6, 29.3, 25.8, 22.9, and 25.7% for KS-A, KS-B, DS, CS, KG, BG, and SG, respectively; SEM = 0.65). The resistant males had highest (P=0.04) ADG (256, 237, and 225 g for Resistant, Moderate, and Susceptible, respectively; SEM=8.8). There was an animal group×resistance classification interaction (P=0.04) on FEC (270, 2,346, and 4,633 with KS-A, 1,088, 5,272, and 8,263 with KS-B, 442, 1,140, and 2,370 with DS, 209, 870, and 2,368 with CS, 248, 994, and 2,431 with KG, 1,182, 2,164, and 4,523 with BG, and 215, 1,203, and 3,132 eggs/g (untransformed) with SG for Resistant, Moderate, and Susceptible classes, respectively; SEM=295.0). The correlation coefficient between sire and progeny FEC was 0.27 (P=0.004) and that of PCV was 0.44 (P<0.001). In conclusion, selection for resistance did not adversely affect performance of males, and there were moderate relationships between indices of parasite infection of sires and progeny.

Species and breed differences of small ruminant in response to experimental infection with Haemonchus contortus and growth performance in a centralized performance test

Y. Tsukahara, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, T. Sahlu, and A. L. Goetsch

American Institute for Goat Research, Langston University, Langston, Oklahoma, USA

The response to experimental infection with Haemonchus contortus and growth performance of small ruminant males were compared in a central performance test at Langston University (LU). Seventy five Boer (3.8 mo of initial age, 19 kg), 51 Kiko (3.7 mo, 19 kg), and 50 Spanish goats (3.9 mo, 18 kg) and 43 Dorper (3.9 mo, 29 kg), 75 Katahdin (3.7 mo, 28 kg), and 42 St. Croix sheep (4.2 mo, 20 kg) from 8 commercial farms in AR, KS, MO, and OK and LU were housed separately in adjacent pens with automated feeders allowing free-choice access to a 15% CP (DM) and 50% concentrate pelletized diet. The test entailed an adjustment period of 2 wk followed by 8 wk of data collection. Body weight was determined weekly. During adaptation, anthelmintic treatment resulted in low fecal egg count (initial FEC = 64 eggs/g; SEM = 7.0), after which a dose of 10,000 larvae was administered orally. After the infection, packed cell volume (PCV) was measured weekly and FEC was determined 5 times in wk 5-9. Data were analyzed using the GLM procedure of SAS® with fixed effects of species and breed within species. Initial BW, PCV, and FEC were covariates and the logarithmic transformation was used for individual mean FEC. Species differed in ADG (P < 0.01; 176 and 305 g; SEM = 4.1), DMI (P < 0.01; 1.14 and 1.81 kg/d; SEM = 0.032), FEC (P = 0.02; 1,897 and 1,488 eggs/g in untransformed scale; SEM = 135.1), and PCV (P < 0.01; 26.7 and 29.1% for goat and sheep; SEM = 0.20). Dorper and Katahdin had greatest (P < 0.01) ADG (231, 154, 144, 329, 316, and 270 g; SEM = 6.8) and DMI (1.37, 0.94, 1.11, 1.98, 1.94, and 1.51 kg/d for Boer, Kiko, Spanish, Dorper, Katahdin, and St. Croix, respectively; SEM = 0.054). St. Croix had the lowest (P < 0.05) FEC (1,701, 2,548, 1,442, 1,957, 1,587, and 921 eggs/g; SEM = 233.9) and highest (P < 0.01) PCV (25.8, 27.8, 26.5, 29.0, 27.7, and 30.7% for Boer, Kiko, Spanish, Dorper, Katahdin, and St. Croix, respectively; SEM = 0.34). In conclusion, there was considerable variability between species, among breeds, and within breeds in resistance to internal parasite based on FEC and PCV after an artificial challenge with H. contortus larvae in a standardized environment.

Responses of hair sheep breeds to high heat load index conditions

D. Tadesse, R. Puchala, T. A. Gipson, Y. Tsukahara, and A. L. Goetsch

American Institute for Goat Research, Langston University, Langston, Oklahoma, USA

Fourteen Dorper (D; 59±3.2 kg), 13 Katahdin (K; 58±2.5 kg), and 8 St. Croix (SC; 50±3.0 kg) female sheep (>1.5 yr) were used to evaluate responses to high heat load index (HLI) conditions. After 4 wk of thermoneutral conditions (70 HLI), in sequential 2-wk periods daytime HLI was regulated near 85, 90, and 95 and that at night was 70, 77, and 81, respectively. Data were analyzed with a mixed model containing breed, week within period, measurement time (0700, 1300, and 1700 h), three-way interactions, and baseline covariates. Rectal temperature (RT) at 1300 and 1700 h was lowest for SC (38.36, 38.87,

and 38.96 for D, 38.31, 38.85, and 38.87 for K, and 38.29, 38.64, and 38.66 ºC for SC at 0700, 1300, and 1700 h, respectively; SE=0.046). A similar interaction (P=0.052) occurred in panting score (PS, 0-4.5; 0.10, 0.64, and 0.54 for D, 0.09, 0.70, and 0.58 for K, 0.02, 0.42, and 0.40 for SC at 0700, 1300, and 1700 h, respectively SE=0.064). Breed differences in PS resulted from highest HLI in period 3 (0.07, 0.17, and 1.03 for D, 0.08, 0.15, and 1.14 for K, 0.04, 0.06, and 0.73 for SC in period 1, 2, and 3, respectively; SE=0.080). Period, week, and time interacted (P<0.001) in respiration rate (RR) (period 1: 41, 102, and 97 in wk 1, 50, 124, and 115 in wk 2; period 2: 56, 158, and 124 in wk 1, 65, 160, and 134 in wk 2; period 3: 76, 219, and 161 in wk 1, 130, 164, and 148 in wk 2 at 0700, 1300, and 1700 h, respectively; SE=6.6). There was a corresponding interaction (P<0.001) in RR:RT as an index of energy expended to minimize RT (period 1: 0.40, 1.00, and 0.96 in wk 1, 0.05, 1.22, and 1.14 in wk 2; period 2: 0.57, 1.55, and 1.22 in wk 1, 0.66, 1.58, and 1.31 in wk 2; period 3: 0.75, 2.14, and 1.58 in wk 1, 1.28, 1.61, and 1.44 in wk 2 at 0700, 1300, and 1700 h, respectively; SE=0.064). In conclusion, some measures suggest greater tolerance of high HLI by SC than D or K. There appeared considerable adaptation in RR from wk 1 to 2 of period 3 to minimize RT in the early afternoon, which was at least partially facilitated by higher RR in the early morning before HLI increased.

Genome-wide association analysis of residual feed intake and milk yield in dairy goats

C. B. Wasike[1], M. M. Rolf[2], N. C. D. Silva[1], R. Puchala[1], T. Sahlu[1], A. L. Goetsch[1], and T. A. Gipson[1]

[1]American Institute for Goat Research, Langston University, Langston, Oklahoma, USA
[2]Department of Animal Sciences, Oklahoma State University, Stillwater, Oklahoma

Interest in both dairy and meat goat production in the US has been increasing, and there is tremendous opportunity for genetic progress in traits that are easy to measure (e.g. milk yield) and those that are more difficult (e.g. residual feed intake, RFI). However, there is little research or infrastructure within the goat industry for implementation of large-scale genetic evaluation. The objective of this study was to conduct a genome-wide association study (GWAS) for RFI and total milk yield in dairy goats. Forty-eight Alpine females (56.4 ± 7.15 kg BW; 423 ± 146.1 kg milk; 225 ± 20.9 d in milk; 16 primiparous) were used. Data in mid- to late lactation were used to calculate RFI. Milk yield and components were collected over a 12-week period in mid- to late lactation and were used to calculate energy-corrected milk yield (ECMY). ECMY DMI, and BW from the same period were used to calculate RFI, which ranged from -794 to 594 g. DNA was collected via venipuncture and stored on Whatman™ FTA™ cards. Genotypes were assayed using the Illumina 52K goat SNP chip. SNPs with a minor allelic frequency < .01 were removed, resulting in 48,632 SNPs available for analysis. Missing genotypes were imputed using BEAGLE and SNP effects were estimated using GenSel on the iPlant platform. For RFI, the posterior mean of the residual variance was 47,934 and the posterior mean of genetic variance was 14,428, giving an estimated heritability of 0.23. For total milk yield, the posterior mean of the residual variance was 10,141 and the posterior mean of genetic variance was 9,826, giving an estimated heritability of 0.49. The 100 SNP with the greatest effects contributed 3.1% and 3.3% of the total genetic variance for RFI and total milk yield, respectively. Although the sample size in this study is very small and the ideal usage of genomic information would be to supplement large-scale genetic evaluation programs, it illustrates the potential of utilizing genomic selection with phenotypes on large populations of dairy goats to make genetic improvement. Genetic selection for RFI and milk yield in dairy goats may be expedited by selection programs that incorporate genomic information, particularly in the absence of large, nationwide breeding value prediction programs.

12th International Conference on Goats, September, 2016 (Antalya, Turkey)

Effects of level of brackish water on feed intake, digestion, and heat energy with growing Boer and Spanish goat wethers

Y. Tsukahara, R. Puchala, T. Sahlu, and A. L. Goetsch

American Institute for Goat Research, Langston University, Langston, Oklahoma, USA

Twenty Boer (6.1 mo and 21.3 kg) and 20 Spanish goat wethers (6.6 mo and 19.7 kg) were used to determine effects of levels of brackish (BR) and fresh water on feed intake, digestion, and heat energy. BR had 6900, 1884, 75, 1854, 2478, and 9 mg/l of total dissolved salts, Ca, Mg, chloride, sulfate, and boron, respectively. BR levels were 0 (0-BR), 33 (33-BR), 67 (67-BR), and 100% (100-BR). Water and a moderate quality grass hay (8.5% CP and 68% NDF) were offered free-choice. The experiment consisted of 14 days of adaptation, 5 days for metabolizability measures, and 2 days for determining gas exchange and heat energy. There were no interactions ($P > 0.05$) between breed and water treatment. Water (897, 906, 911, and 851 g/day; SE = 58.3) and DM intakes (525, 556, 571, and 527 g/day for 0-BR, 33-BR, 67-BR, and 100-BR, respectively; SE = 31.0) were similar among treatments ($P = 0.883$ and 0.667, respectively). Urinary water was greater for BR treatments than for fresh water ($P = 0.003$; 211, 317, 319, and 285 g/day; SE = 25.6) and water in feces was similar among treatments ($P = 0.530$; 247, 251, 276, and 257 g/day for 0-BR, 33-BR, 67-BR, and 100-BR, respectively; SE = 19.0), implying less water loss by other means such as evaporation when BR was consumed. Total tract OM digestibility was lower ($P = 0.049$) for treatments with than without BR (64.2, 61.5, 58.6, and 59.3%; SE = 1.86), although ME intake was similar among treatments ($P = 0.940$; 4.61, 4.57, 4.60, and 4.31 MJ/day for 0-BR, 33-BR, 67-BR, and 100-BR, respectively; SE = 0.394). Daily heat energy in kJ/kg $BW^{0.75}$ was less with than without BR ($P = 0.001$; 474, 436, 446, and 445; SE = 7.7), although values in MJ were similar among treatments ($P = 0.588$; 4.36, 4.12, 4.22, and 4.18 for 0-BR, 33-BR, 67-BR, and 100-BR, respectively; SE = 0.124). BW of wethers consuming BR decreased less than that of wethers consuming fresh water ($P = 0.006$; -37, -14, -7, and -16 g/day; SE = 7.2), but recovered energy was similar among treatments ($P = 0.923$; 0.25, 0.45, 0.38, and 0.13 MJ/day for 0-BR, 33-BR, 67-BR, and 100-BR, respectively; SE = 0.356). In conclusion, BR inclusion in drinking water had a number of effects, but it does not appear that consumption of this source would adversely impact performance of growing meat goats.

Cohesive behavior of a small herd of goats in a woodland pasture

T. A. Gipson,[1] and C. Clifford-Rathert[2]

[1]American Institute for Goat Research, Langston University, Langston, Oklahoma
[2]Lincoln University, Jefferson City, Missouri

The cohesive behavior (CB) of animals in a small herd or flock can provide an indication of the animals' ease with their environment and their willingness to explore and efficiently utilize their grazing resources. However, the spatial evolution of CB over time is unknown. The objective of this study was to evaluate CB in a small herd of goats over time. Twenty-one mature, female goats were fitted with GPS collars and released into one of three 0.5 ha wooded paddocks, with seven goats per paddock (replicate). Goats were assigned to the same paddocks each year, unless a substitution was necessary. Collars that recorded a fix every 5-min were deployed for 10 days during the late spring for three consecutive years (max=29°C, min=16°C for year 1; max=24°C, min=13°C for year 2; max=26°C, min=14°C for year 3). The inter-animal distance (IAD), a measure of the CB of the small herd, was calculated for each 5-min interval for animals within the same paddock. A total of 211,156 IAD were available for analysis. To test if CB of the small herds changed over time, that is, day of exposure to the paddock across years, heterogeneity of slopes was evaluated using mixed model methodology with day of exposure to the paddock (1 . . . 10) as covariate, year (1, 2, 3), hour of the day (0 to 23 h), and all two-way interactions as fixed effects and with animal and paddock as random effects. IAD increased linearly with day of exposure to paddock ($P < .05$) with the greatest increase in years 1 and 3 at 0.83 m/day (SE ± 0.025) and year 2 the slowest at 0.41 m/day (SE ± 0.024). For day 1, the IAD was greatest for year 3 (19.6 m ± 1.37) with years 1 and 2 similar (16.8 m ± 1.43 and 17.1 m ± 1.41, respectively). The IAD was smallest in the early morning hours (23.0 m ± 1.30 at 03:00 h) and greatest shortly after sunrise (29.9 m ± 1.30 at 08:00 h). However, daytime or nighttime had no effect ($P > 0.10$) upon IAD. These results indicate that a small herd of goats tends to exhibit less CB as time progresses

and with familiarity to their environment due to previous exposure. This relaxation of CB might indicate a level of comfort that the small herd has with its environment.

Preliminary study on anthelmintic potential of methanol extracts of certain plants

Y. Guo,[1] Z. Wang,[1] Jifu Zhao,[2] A. L. Goetsch,[1] and T. Sahlu[1]

[1]American Institute for Goat Research, Langston University, Langston, Oklahoma
[2]AZ Nature Art LLC, San Diego, California

We recently screened more than 900 plant extracts for anthelmintic potential using an egg-hatching inhibition procedure. Dried plant materials were ground to a particle size of no larger than 1 mm and a portion of 30 g was then transferred to an Erlenmeyer flask and extracted with 250 mL of methanol. The mixture was shaken for 1 h and filtered to derive the crude plant extract. The latter was suspended in 50 mL of Tetrahydrofuran (THF), stirred for 15 min and filtered. The THF solution was evaporated and the concentrated extract was dried by using a Savant SpeedVac Vaccum Concentrator System. The dried extract was weighed and dissolved in dimethyl sulfoxide (DMSO) before use. With a sucrose step gradient procedure, worm eggs were harvested from fresh feces of goats naturally infected with parasitic nematodes in which more than 90% were Haemonchus contortus. The eggs in phosphate buffered saline (PBS) were distributed into 96-well plates at 30-40 eggs/well in 98 μL. Two μL of plant extracts in DMSO was added to each well in duplicate and mixed. The final concentration of extracts in the wells was 400 μg/mL and untreated eggs in PBS plus 2 μL DMSO served as negative control. The test plates were kept in an incubator at 27°C for 48 h. Hatched larvae (dead or alive) and unhatched eggs (embryonated and non-embryonated) were then counted under a microscope at a 40 × magnification. The percentage of inhibition of egg hatching was calculated as: inhibition (%) = number of egg / (number of egg + number of larvae) × 100. We found that 16 extracts showed inhibitive effects (> 50%) at the concentration of 400 μg/mL. The extract of black pepper (Piper Nigrum L.) was particularly effective and examined further. The egg-hatching inhibition rate for the black pepper extract was 5, 11, 26, 70, 78, 86, 97, 96, and 98% at concentrations of 0, 3.9, 15.6, 31.3, 62.5, 125, 250, 500, and 1000 μg/mL, respectively. The results suggest that more work is needed to evaluate the anthelmintic efficacies of solvent extracts of black pepper and other plants.

Conditions to evaluate differences in resilience of sheep and goats to high heat load

U. L. Mengistu,[1,2] R. Puchala,[1] T. Sahlu,[1] T. A. Gipson,[1] L. J. Dawson,[1,3] and A. L. Goetsch[1]

[1]American Institute for Goats Research, Langston University, Langston, Oklahoma
[2]Department of Animal and Range Sciences, Haramaya University, Dire Dawa, Ethiopia
[3]Center for Veterinary Health Sciences, Oklahoma State University, Stillwater, Oklahoma

Thirty-three yearling Katahdin sheep (KAT) and Boer (BOE) and Spanish goat wethers (SPA) were used to study conditions for evaluating resilience to high heat load index (HLI). Moderate quality grass hay was consumed ad libitum with concentrate (80% corn, 20% soybean meal) at 0.5% BW. There was a 2-wk period with a target HLI of 70 (period 1), followed by 1-wk periods with target HLI of 80, 90, 95, and 100 during daytime and 70, 76.5, 80.75, and 85 at night in periods 2, 3, 4, and 5, respectively. Actual values averaged 66, 80, 92, 97, and 101 during the day and 66, 75, 84, 86, and 89 at night in periods 1, 2, 3, 4, and 5, respectively. Respiration rate was affected by an interaction ($P < 0.001$) between animal type and period (18, 71, 83, 121, and 105 for BOE, 25, 104, 101, 139, and 126 for KAT, and 22, 105, 104, 129, and 109 breaths/min for SPA; SE = 4.2), as well as was rectal temperature (38.4, 39.2, 39.4, 39.9, and 39.5 for BOE, 38.9, 39.1, 39.2, 39.6, and 39.6 for KAT, and 38.6, 39.4, 39.6, 40.0, and 39.6º C, for SPA in periods 1, 2, 3, 4, and 5, respectively; SE = 0.065). Change with advancing period varied with time of measurement ($P < 0.001$) for respiration rate (20, 71, 32, 83, and 37 at 06:00 h, 24, 100, 131, 150, and 151 at 13:00 h, and 32, 110, 136, 155, and 151 breaths/min at 17:00 h; SE = 3.5) and rectal temperature (38.2, 38.9, 38.6, 39.0, and 38.7 at 06:00 h, 38.8, 39.4, 39.7, 40.1, and 39.8 at 13:00 h, and 38.9, 39.4, 40.0, 40.4, and 40.2º C at 17:00 h in period 1, 2, 3, 4, and 5, respectively; SE = 0.056). Respiration rate at 06:00 h differed more (interaction, $P < 0.001$) among days of period 5 than at 13:00 or 17:00 h (82, 101, 118, 93, 57, 58, and 37 at 06:00 h, 152, 161, 165, 158, 151, 142, and 151 at 13:00 h, and 158, 162, 171, 161, 153, 152, and 151 breaths/min at 17:00 h on day 1, 2, 3, 4, 5, 6, and 7, respectively; SE = 3.9). In conclusion, a HLI in the range of 95/80.75 and 100/85 seems appropriate to investigate differences in resilience to high HLI, periods longer

than 1 wk appear necessary for adequate adaptation, and measurements minimally should be during nighttime and the latter half of the daytime period.

Progress in resistance to internal parasitism and growth performance of Boer, Kiko, and Spanish goat kids through selection in a central sire test

Y. Tsukahara, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, T. Sahlu, A. L. Goetsch

American Institute for Goat Research, Langston University, Langston, Oklahoma

Boer, Kiko, and Spanish male kids from farms in the south-central US were tested for response to artificial infection with Haemonchus contortus larvae (categorized as resistant [R], of moderate resistance [M], and susceptible [S]) and growth performance in a central test at Langston University. There were 16, 13, and 16 Boer (initial age 3.8 mo and 20 kg), 16, 14, and 20 Kiko (3.7 mo and 19 kg), and 14, 17, and 18 Spanish goats (3.9 mo and 19 kg) in yr 1, 2, and 3, respectively. Males were randomly selected in yr 1, whereas offspring of R and M sires were tested in yr 2 and 3. The test entailed 2 wk of adjustment and 8 wk of data collection, with free access to a 15% CP and 50% concentrate diet in automated feeders. During adaptation, anthelmintic treatment resulted in low fecal egg count (FEC; < 600/g), after which 10,000 infective larvae were administered orally. BW and packed cell volume (PCV) were measured weekly, and FEC was determined 4 to 5 times in wk 6-8. Data were analyzed by the GLM procedure with use of covariates and logarithmic transformation of FEC. DM intake was greatest for M in yr 2 ($P < 0.01$) but similar among resistance groups in yr 3 ($P > 0.05$). There was a resistance group by breed interaction in ADG ($P = 0.03$), with values highest for R and(or) M (236, 267, and 212 g for Boer, 140, 174, and 134 g for Kiko, and 167, 131, and 130 g for Spanish of R, M, and S, respectively; SE = 13.2). There were interactions in FEC of breed × and resistance group ($P < 0.01$; 962, 1492, and 2774 eggs/g for Boer, 1258, 1968, and 3338 for Kiko, and 276, 1149, and 2373 for Spanish of R, M, and S, respectively), breed × year ($P < 0.01$; 1102, 1436, and 2690 for Boer, 3577, 1664, and 1323 for Kiko, and 1328, 952, and 1518 for Spanish in yr 1, 2, and 3, respectively), and resistance group × year ($P < 0.01$; 1164, 746, and 585 for R, 1878, 1261, and 1470 for M, 2965, 2045, and 3476 for S in yr 1, 2, and 3, respectively). PCV was greatest ($P < 0.01$) for R (27.2, 25.3, and 24.7% for R, M, and S, respectively). In conclusion, selection of meat goat sires through a central performance test improved resistance to internal parasitism without negative influence on growth performance, although change varied among breeds and years.

Summaries of Recent Journal Articles and Book
(2015 and In Press)

Effects of supplementation and body condition on intake, digestion, performance, and behavior of yearling Boer and Spanish goat wethers grazing grass/forb pastures

A. R. Askar, T. A. Gipson, R. Puchala, K. Tesfai, G. D. Detweiler, A. Asmare, A. Keli, T. Sahlu, and A. L. Goetsch

Small Ruminant Research. 125:43-55. 2015.

Sixteen Boer and 16 Spanish (Span) yearling wethers were used, with eight of each breed in different initial body condition (IBC; High and Low). Initial BW was 40, 25, 29, and 22 kg (SE = 1.4) and body condition score (BCS; 1 = extremely thin and 5 = very obese) was 3.9, 2.4, 3.6, and 2.7 (SE = 0.12) for Boer-High, Boer-Low, Span-High, and Span-Low, respectively. There was one wether per breed × IBC treatment in each of eight 0.4-ha grass/forb pastures. Wethers in four control (Con) pastures were not supplemented with concentrate, whereas those in supplement (Sup) pastures received 0.9% BW (DM basis) of concentrate. The experiment was 126 days, with four periods 39, 28, 37, and 22 days in length. Forage mass was 2466, 2496, 3245, and 2495 kg/ha for Con and 2226, 2378, 3100, and 2724 kg/ha for Sup in periods 1, 2, 3, and 4, respectively (SE = 199.0). The difference in intake of digested OM between breeds was much greater with than without supplemental concentrate (485 and 741 g/day for Boer and 413 and 561 g/day for Span without and with supplementation, respectively; SE = 23.2). In accordance, supplementation increased ($P < 0.05$) ADG by Boer but not Span wethers (6, 32, 82, and 51 g for Boer-Con, Span-Con, Boer-Sup, and Span-Sup, respectively; SE = 13.1). There was a trend ($P = 0.070$) for greater ADG by Low vs. High IBC wethers (56 vs. 30 g; SE = 0.4), in agreement with overall greater ($P < 0.05$) total DM intake relative to BW by Low IBC wethers (3.16 and 2.78% BW; SE = 0.065). However, converse to the breed comparison, IBC and supplement treatment did not interact in ADG. Grazing time was less ($P < 0.05$) with than without supplementation (5.8 vs. 6.9 h; SE = 0.22) and greater ($P < 0.05$) for Boer vs. Span in period 1 (8.0, 6.9, 6.3, and 7.2 h for Boer and 4.7, 5.9, 5.7, and 6.4 h for Span in periods 1, 2, 3, and 4, respectively; SE = 0.45), although IBC did not influence grazing time (6.2 and 6.6 h for High and Low, respectively; SE = 0.22) despite the difference in ADG and greater total DM intake relative to BW. In conclusion, supplementation increased ADG by Boer but not Spanish wethers and lessened grazing time, low IBC resulted in compensatory growth with increased DM intake relative to BW and ADG without affecting grazing time, and supplementation interacted with breed though not IBC.

Effects of supplemental concentrate level and forage source on intake, digestion, and behavior of growing and yearling Boer goat wethers and evaluation of a method of predicting negative feedstuff associative effects

A. T. Dolebo, R. Puchala, T. A. Gipson, L. J. Dawson, T. Sahlu, and A. L. Goetsch

Journal of Applied Animal Research. 2016.

Effects of supplemental concentrate level and three sources of grass hay were determined to evaluate a method (www2.luresext.edu/goats/research/suppconc.html) of predicting impact of negative associative effects between feedstuffs on metabolizable energy (ME) intake by Boer goat wethers. Forage DM intake (g/kg $BW^{0.75}$) was similar between growing and yearling wethers (34.9 and 30.8) and ranked 0 and 15 > 30 > 45 g/kg $BW^{0.75}$ of concentrate dry matter (48.5, 41.8, 25.9, and 15.2, respectively). Age and concentrate level interacted in NDF digestibility (57.3, 60.6, 61.4, and 58.4% for growing and 56.6, 62.9, 56.8, and 30.0% for yearling wethers with 0, 15, 30, and 45 g/kg $BW^{0.75}$, respectively). There was a tendency ($P = 0.074$) for an interaction in ME intake between age and concentrate level (361, 530, 634, and 709 for growing and 363, 547, 541, and 555 kJ/kg $BW^{0.75}$ for yearling wethers with 0, 15, 30, and 45 g/kg $BW^{0.75}$; values predicted for treatments with supplement were 563, 631, and 619 for growing and 575, 684, and 697 kJ/kg $BW^{0.75}$ for yearling wethers with 15, 30, and 45 g/kg $BW^{0.75}$, respectively. In conclusion, ME intake was accurately predicted for the low level of supplementation and moderate level with growing wethers.

Simple methods to estimate the maintenance feed requirement of small ruminants with different levels of feed restriction

A. L. Goetsch, R. Puchala, A. T. Dolebo, T. A. Gipson, Y. Tsukahara, and L. J. Dawson

Journal of Applied Animal Research. 2016.
(Available at http://dx.doi.org/10.1080/09712119.2015.1129342).

Ten Katahdin sheep and ten Spanish goat wethers were used to develop a simple method to estimate dry matter intake (DMI) required for maintenance (DMI_m) with feed restriction. Grass hay was fed in a 5-wk Maintenance phase, initially at 51 and 54 g/kg $BW^{0.75}$ for Katahdin and Spanish, respectively, and then varied by 0-5% every 2-3 days to maintain constant body weight (BW). Individual wether DMI_m was the intercept of regressing DMI against BW change in 2- and 3-day periods of wk 3 and 4. In the subsequent 8 wk, wethers consumed hay at 70 or 55% of their Maintenance DMI_m. Restricted DMI_m was average DMI in wk 8 when no individual wether intercept of regressing BW against day differed from 0. Maintenance DMI_m was not influenced by animal type (52.0 and 49.6 g/kg $BW^{0.75}$ for Katahdin and Spanish, respectively; S.E.M. = 0.73). Animal type and restriction level tended (P = 0.084) to interact in Restricted DMI_m (34.1, 38.6, 30.7, and 39.0 g/kg $BW^{0.75}$ for Katahdin-55%, Katahdin-70%, Spanish-55%, and Spanish-70%, respectively; S.E.M. = 1.03), suggesting greater ability of Spanish to lessen energy use with appreciable feed restriction. Correlation coefficients of 0.89, -0.06, 0.96, and 0.85 (P = 0.041, 0.927, 0.009, and 0.066, respectively) between DMI_m in the two phases for Katahdin-55, Katahdin-70, Spanish-55, and Spanish-70, respectively, suggest preference for the 55% level for evaluating resilience to feed restriction. In conclusion, frequent determinations of BW and DMI can be used to compare DMI_m of individual animals with restricted feeding.

Effects of method of conditioning on behavior of Boer and Spanish goats in pens with barbed wire and electric fence strands

Y. Tsukahara, R. Puchala, J. Hayes, T. A. Gipson, T. Sahlu, A. L. Goetsch

Small Ruminant Research. 2016.

In the first experiment, 40 Boer (B) and 40 Spanish (S) does were used to evaluate effects of treatments in the interval (IT) between periods of a Latin square design on behavior when exposed to fences with barbed wire strands for cattle and added electric fence strands for goats. The desire was to determine if an IT would eliminate period or carryover effects so that a Latin square could be used for consistent and accurate evaluation of different electric fence strand treatments. Breeds were split into two sets with five groups of four does. Evaluation pens (5; 2.4 × 3.7 m) had one side of barbed wire strands at 30, 56, 81, 107, and 132 cm from the ground. Fence treatments (FT) were electrified strands (6.0 kV) at 15 and 43 (LowHigh), 15 and 23 (LowMed), 15 (Low), 23 (Med), and 43 cm (High). Behavior was assessed once every 2 wk with different FT in the five periods of a 5 × 5 Latin square experiment. In the week between measurements, one set of each breed was exposed to a pen with no electric strands as IT-Yes and other sets were not (IT-No). There were interactions ($P < 0.05$) in the percentage of goats exiting pens of IT × period (28, 38, 18, 0, and 18% with IT-Yes and 45, 13, 0, 0, and 0% with IT-No in period 1, 2, 3, 4, and 5, respectively; SE = 4.9), IT × FT (5, 8, 15, 33, and 40% with IT-Yes and 5, 3, 18, 23, and 10% with IT-No for LowHigh, LowMed, Low, Med, and High, respectively; SE = 4.9), and IT × breed (8 and 32% with IT-Yes and 15 and 8% with IT-No for B and S, respectively; SE = 3.8). In the second study, 80 B and 75 S wethers and doelings were used to investigate effects of preliminary treatments (PT) on behavior when later exposed to different FT. Breeds were divided into two sets, each with five groups consisting of three or four animals and use of the same FT. The PT were imposed in five weekly and sequential exposures to evaluation pens: a common treatment for one set of each breed with moderate exposure to electric fence strands (BC and SC); mild exposure for the other set of B (BU); and greater exposure for the other set of S (SU). BU was designed to increase and SU to decrease later interaction with fence strands and pen exit relative to BC and SC, respectively. Each group was thereafter exposed to one FT for 1 h in period 1 and 7 wk later in period 2. Set (BC, BU, SC, and SU) affected ($P < 0.05$) pen exit (21, 52, 57, and 8%; SE = 7.0), receipt of a shock (19, 30, 7, and 4%; SE = 4.8), and pen exit with a shock (6, 14, 6, and 2%, respectively; SE = 2.8). Period affected ($P < 0.01$) the percentage of animals exiting with shock (13 and 1%; SE = 2.0) but not the percentage exiting. In conclusion, exposing goats to barbed wire fence without electric strands between measurement periods was not sufficient to eliminate differences among periods of a Latin square design. Use of the same PT for B and

S resulted in different behavior when later exposed to FT. The BU PT affected pen exit as anticipated; however, SU caused animals to be highly reluctant to exit and was not suitable for use.

Regulation of the nutrition and feeding of dairy goats

A. L. Goetsch

Proceedings of The 3rd Asian-Australasian Dairy Goat Conference, May 9-13, 2016, Northwest Agriculture & Forestry University, Yangling, China

Production conditions such as dietary concentrate level and forage quality can have marked effect on tissue loss and gain by lactating dairy goats. Opportunities for enhanced performance with high concentrate levels are greater in early than late lactation with high milk production potential, although there might be an advantage in efficiency of energy use in late lactation when tissue is often replenished. Though use of byproduct feedstuffs can decrease diet cost, substitution of ones high in ruminally degraded fiber for cereal grain can increase ruminal methane emission. An important factor influencing the fatty acid (FA) composition of milk is that of dietary ingredients. In accordance, the unique FA composition of some byproducts can affect the profile in milk. In part because of regulations and(or) concerns regarding products including synthetic anti-microbials, substances high in compounds such as essential oils are receiving attention in goats, although use is not yet widespread and specific factors responsible for effects are in many cases unclear. In addition to the FA profile of feedstuffs, conditions including dietary concentrate level, supplemental FA sources, and levels of plant secondary metabolites can influence levels of some ruminal biohydrogenation intermediates reaching the mammary gland that decrease de novo FA synthesis. Supplementation with sources of conjugated linolenic acid has been studied, but use is not common probably because of limited change in milk fat content and FA composition compared with cattle, relatively less concern regarding tissue mobilization in early lactation with appropriate management practices, and low demand and inadequate incentives for goat milk low in fat. However, inclusion of moderate dietary levels of oils and other fat sources for purposes such as increased energy density, improved palatability, and decreased dustiness is widespread.

Visiting Scholars and Graduate Student (2014 and 2105)

Dr. Yongqing Guo
- Visiting Scholar
- Native of China
- Research Project: Effects of Selected Nutritional Components on Immunity to *Haemonchus* in Goats
- Experiment: YG-14-07

Ms. Amanda Manley
- Graduate Student (MS; cooperative with Oklahoma State University
- Research Project: Boer Goat Selection for Residual Feed Intake

Dr. Yoko Tsukahara
- Visiting Scholar
- Native of Japan
- Research Projects: Establishing a Langston University Testing Center for Electric Fence Modifications of Cattle Barb Wire Fence for Goat Containment; Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites
- Experiments: YT-14-04 and YT-15-06

Dr. Mengistu Urge Letta
- Native of Ethiopia
- Visiting Scholar (Sabbatical)
- Research Project: Resilience in Sheep and Goats to Climatic Stress Factors
- Experiments: MU-14-01 and MU-14-08

Ms. Nhayandra C. D. Silva
- Visiting Graduate Student (PhD; Sandwich program; cooperative with Universidade Estadual Paulista)
- Native of Brazil
- Research Project: Restricted Feed Access Regimes for Lactating Dairy Goats
- Experiments: NS-14-06 and NS-15-05

Dr. Mohammed Sawalhah
- Visiting Scholar
- Native of Jordan
- Research Project: Red Cedar Control with Goats
- Experiment: SH-15-07

Dr. Bridgit S. Muasa
- Borlaug Fellow
- Native of Kenya
- Research Project: Assisted Reproductive Technologies in Goats
- Experiments: EL-14-09 and EL-14-10

Dr. Chrilukovian B. Wasike
- Borlaug Fellow
- Native of Kenya
- Research Project: Residual Feed Intake in Lactating Dairy Goats
- Experiment: NS-14-06

Ms. Luana P. S. Ribeiro
- Visiting Graduate Student (PhD; Sandwich program; cooperative with Federal University of Bahia, UFBA)
- Native of Brazil
- Research Project: Effects of Body Condition at Kidding on Performance of Lactating Dairy Goats
- Experiment: LR-15-02

Dr. Sebastian Lama
- Visiting Scholar
- Native of Argentina
- Research Project: Method of Supplementing Meat Goat Kids While Grazing with Tree Legume Leaves
- Experiment: SL-15-03

Ms. Courtney Jones
- Graduate Student (MS; cooperative with Oklahoma State University, Agricultural Economics)
- Research Project: Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites

Mr. Mesfin M. Gobena
- Graduate Student (MS; cooperative with University of Florida)
- Native of Ethiopia
- Research Project: Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites and Resilience in Sheep and Goats to Climatic Stress Factors

Ms. Marie Negron, Eva Pacheco, and Alexandra Reyes
- Visiting Undergraduate Student Interns
- Native of Puerto Rico
- Research Project: Mortality Composting

Dr. Shirron LeShure
- Visiting Scholar
- Research Projects: Enhancing Wellbeing and Productivity of Dairy Goats Using Smart Technology; Sustainable Control of Greenhouse Gas Emission by Ruminant Livestock
- Experiment: SL-15-14

Ms. Hirut Yirga

Visiting Scholars and Graduate Student (2014 and 2105)

- Native of Ethiopia
- Visiting Graduate Student (PhD; Haramaya University, Ethiopia)
- Research Project: Brackish and Saline Drinking Water for Small Ruminants
- Experiment: HY-15-10

Dr. Dereje Tadesse

- Native of Ethiopia
- Visiting Scholar
- Research Project: Resilience in Sheep and Goats to Climatic Stress Factors
- Experiments: DT-15-12

Mr. Ali Hussein

- Graduate Student (MS; cooperative with Oklahoma State University)
- Research Project: Resilience in Sheep and Goats to Climatic Stress Factors
- Experiment: AH-15-13

International Overview

Dr. Roger Merkel
International Program Leader

Goats and goat products are part of the livelihood of a majority of the world's population and are an important resource for poor farmers in many countries of the world. Part of the mission of the American Institute for Goat Research is to effect positive change in goat production throughout the world. To fulfill this aspect, the Institute has developed and maintains many strong ties with research and academic institutions around the world. In addition to collaborative work with foreign institutions, the Institute has hosted visiting scientists from over 30 foreign countries to conduct research activities. Training for foreign livestock workers and scientists as well as for U.S.-based persons who will travel and work overseas are other ways in which the Institute is active in the international arena.

International research and training, hosting foreign scientists, and training those who will teach others are internationally-focused activities that give the Institute unique opportunities to not only increase knowledge of foreign production systems and constraints, but also to positively impact agricultural development in foreign countries and help alleviate poverty and hunger. General objectives of the Institute's international program are to: 1) increase our knowledge of goat production systems worldwide and current constraints to increased production; 2) build human capacity through training foreign scientists and agricultural workers in goat production, thereby allowing them to more effectively carry out their missions of teaching, research, and extension; 3) increase Langston University and the Institute's involvement in agricultural development and impact on human welfare; and 4) enhance the Institute's knowledge of development and development issues.

2015 Projects

Title:	Applied Reproductive Technologies for Caprine Embryo and Gamete Management:Langston University's Expression of Interest for Borlaug Fellow (Kenya)
Type:	USDA Foreign Agricultural Service
Period:	2014-2016
Investigators:	T. Sahlu and E. Loetz
Objectives:	Provide training in effective assisted-reproductive technologies.
Current Status:	A 12-week training course was accomplished at Langston University and the mentor follow-up visit has taken place.

Title:	Genomic Selection in Dairy Goats: Langston University's Expression of Interest for Borlaug Fellow (Kenya)
Type:	USDA Foreign Agricultural Service
Period:	2014-2016
Investigators:	T. Sahlu and T.A. Gipson
Objectives:	Provide training in effective genomic-enhanced selection
Current Status:	A 12-week training course was accomplished at Langston University and the mentor follow-up visit has taken place.

Supporting the Philippine Goat Industry

During the past year, the Institute has worked with scientists from the Republic of the Philippines in two distinct areas: 1) to support a nationwide dairy goat project through providing specific training to Philippine scientists in the US and 2) participate in a train the trainer program located in the Philippines.

Supporting Philippine dairy goat production research and development

The Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development is implementing a Dairy Goat Science and Technology Program. Central Luzon State University in the Science City of Munoz, Neuva Ecija is working with the Council on this project. In particular, Central Luzon State is working in two areas of this program and the Institute hosted and provided training to several Philippine scientists in 2015.

- *Training a Philippine Scientist in Mastitis Detection and Management*

In August, the Institute hosted Dr. Virginia Venturina from the College of Veterinary Medicine at Central Luzon State for a training program on mastitis detection, prevention, and treatment in dairy goats. Dr. Venturina serves as the Project Leader for the Development of Diagnostic and Management Protocols for Intrammamary Infection in Goats. As such, it is her responsibility to develop and lead the research and extension activities in the areas of mastitis and udder health. Dr. Venturina's visit was designed for her to receive training on different detection methods of udder infection ranging from direct microscopic count to machine cell counters to animal-side indicator tests. Dr. Venturina received training in bacteriological techniques at the Oklahoma Animal Disease Diagnostic Laboratory (OADDL), located at Oklahoma State University in Stillwater, Oklahoma under the tutelage of Dr. Akhilesh Ramachandran, OADDL Section Head of Microbiology/Molecular Biology, and his staff. The OADDL training was very detailed and Dr. Venturina learned a great deal.

Somatic cells found in milk can be an indication of udder infection. Another aspect of Dr. Venturina's training was in various somatic cell detection and estimation methods. The "gold standard" for counting somatic cells in milk is via direct microscopic count. For goat milk, this is the pyronin y-methyl green stain procedure. Dr. Venturina received training in this procedure at the Dairy and Food Safety Laboratory of the Oklahoma Department of Agriculture, Food and Forestry in Oklahoma City. During her visit, laboratory staff also explained the different milk regulatory tests done and how milk and milk product safety is enforced.

To learn about machine somatic cell counts and the workings of Dairy Herd Improvement in the US, Dr. Venturina evaluated milk samples in the Institute DHI lab. In addition to somatic cell counts, she performed milk component analysis and was given background on how producers enroll herds in DHI, tests conducted, and records processed and sent to producers.

Another aspect of Dr. Venturina's training was comparison of various on-farm methods of subclinical mastitis detection. To accomplish that, Dr. Venturina conducted a small research trial comparing results of four different somatic cell tests with a machine count done in the Institute DHI lab. These four tests included three that provided ranges or expected severity of somatic cells (California Mastitis Test, PortaSCC test, and electrical conductivity) and the Delaval Somatic Cell Counter that gives a numerical count of somatic cells. Other tests done by Dr. Venturina were a test for an enzyme that is an indicator of udder infection and bacterial culture of milk. All tests were done on milk from individual udder halves. Dr. Venturina also took rectal temperature of the dairy does, infrared temperature of the udder, and evaluated udder health by palpation and use of a strip cup to look for abnormal milk.

Finally, Dr. Venturina had the opportunity to visit a couple dairy goat farms and talk with producers about management and animal health. Dr. Venturina gained valuable experience from her visit that will greatly benefit her as she continues to work on mastitis detection and management protocols for the Philip-

pine National Dairy Goat Science and Technology Program. The issue of intramammary infection, both subclinical and clinical, is important for all dairy producers to improve animal well-being, increase production levels, and produce milk suitable for making wholesome human food products.

- *Training Philippine Scientists on the Dairy Herd Improvement Program and Data Use for Genetic Evaluation*

In October, the Institute hosted three additional scientists from Central Luzon State University, Dr. Emilio Cruz, Director of the university's Small Ruminant Center, and two of his staff, Drs, Neal del Rosario and Alvin Soriano. These scientists are working to devise a system to collect data on Philippine dairy goat production and to subsequently use that data for genetic evaluation.

The visit of Drs. Cruz, del Rosario, and Soriano was structured to provide them with information on DHI from on-farm sample collection through to genetic evaluation. The scientists spent time with Ms. Eva Vasquez and Dr. Terry Gipson in the DHI laboratory of the Institute. They learned about the DHI process conducted in the lab and the equipment and tests run. The scientists had the opportunity to conduct some of the analyses. They learned about DHI records and their interpretation and the procedures for DHI tester training and scale certification.

During their time at the Institute, the scientists also visited some Oklahoma dairy goat farms and the Oklahoma Department of Agriculture, Laboratory Services Division, Dairy and Food Safety to learn how the safety of goat milk and products is tested and ensured in the state.

From Langston the Philippine team traveled with Dr. Roger Merkel to Spindale, NC to visit the office of the American Dairy Goat Association. The Philippine scientists met Ms. Shirley McKenzie of the ADGA who introduced them to two of ADGA's linear appraisers, Eric Jermain and John White. One morning was spent in a very fruitful discussion of the linear appraisal system and some of the important aspects of it as it relates to goat milk production. Following that discussion, the group visited Spinning Spider Creamery in Marshall, NC.

From western North Carolina, the team traveled east to Raleigh, NC to visit the Dairy Records Management System office and met with Dr. John Clay. Dr. Clay explained how the DRMS processes DHI records, its organization, and the different organizations with which the DRMS works and supplies information. From there, the team traveled to Beltsville, MD for its final visit and met with Dr. George Wiggans of the Animal Genomics and Improvement Laboratory to discuss dairy goat genetic improvement programs and practical aspects of a data recording system.

The group learned a great deal throughout its visit and received many suggestions and ideas to take back to the Philippines. The state of record keeping for dairy goats is in its infancy in the Philippines. Drs. Cruz, del Rosario, and Soriano will work to begin structuring a data collection system for dairy goats that, ultimately, could lead to genetic evaluations for use by Philippine goat producers.

Training Philippine Extension Personnel

In February, 2016, Dr. Roger Merkel traveled to the Philippines to be a trainer and resource person for the Training of Trainers on Meat and Dairy Goat Production Technologies and Infrastructure for Smallhold Farmers. This training was held at the International Training Center on Pig Husbandry (ITCPH), Agricultural Training Institute, Department of Agriculture of the Philippines. Dr. Merkel provided a day of lectures on various aspects of goat husbandry and management. He also served as a resource person during other presentations at the training.

During his time in the Philippines, Dr. Merkel was able to visit a private goat dairy that sells fluid milk and ice cream. This farm was very interesting due to their heavy use of tree legume fodder in the goat's diet. He also visited a dairy goat facility at the University of the Philippines at Los Baños.

The Institute welcomes this collaboration with institutes in the Philippines and looks forward to working with these Philippine organizations further.

Evaluation of Goat Production Practices in Somotillo, Nicaragua

From October 5 to 10, Drs. Roger Merkel and Erick Loetz travelled to Somotillo, Nicaragua at the behest of First Baptist Church in Perkins, Oklahoma to evaluate goat production practices at a mission-run farm. The scientists visited the farm to observe the animals and management practices, look at the pastures and barns, and speak to farm personnel. This area of Nicaragua is characterized by distinct rainy and dry seasons. At this time of the year, forage is abundant but within two months, the rains will cease and both forage and water become pressing issues for production. During the last dry season, three wells ran dry on the farm property. Thus, planning for the dry season is paramount for herd productivity.

The pair of scientists also visited the Somotillo branch of the Universidad Nacional Autonoma de Nicaragua. This university utilizes the mission farmland area and animals for student on-farm practice in crops, horticulture, and animal science. Drs. Merkel and Loetz discussed current activities at the farm with university scientists and future plans.

Drs. Merkel and Loetz also visited some local farms to see village practices and learn more about agriculture in the area. Upon their return to Langston University, the scientists provided their sponsors with a report evaluating the current condition of the farm and recommendations for improvements.

Collaboration with Northwest Agriculture and Forestry University, China

In October, 2015, Dr. Goetsch traveled to the Northwest Agriculture and Forestry University in Yangling, China. The primary purpose of the visit was collaborative research in accordance with a Memorandum of Understanding between the two institutions established many years ago. Dr. Goetsch provided assistance in initiating experiments dealing with emission of the greenhouse gas methane by dairy goats. One of studies was with a portable box system that an individual animal is situated in for 30 minutes, with gas concentrations measured at the beginning and end of the period. The difference in concentration of methane multiplied by volume of the unit is used to determine emission, which is then expressed on a daily basis. The other trial was conducted in environmental chambers allowing quantification of not only consumption and emission of different gases by animals, in this case groups rather than individuals, but also emission of gases such as ammonia from feces and urine. In addition to this collaborative research, Dr. Goetsch gave a presentation on current areas of emphasis of small ruminant research to faculty, staff, and students of the University and on practical feeding considerations for dairy goats to farmers of a local dairy goat association.

Notes