# Sorting Through the Information on Sheep and Goat Parasite Control:

# A Decision-Making Support Tool

***(Version: 1.0)***

This decision-making support tool is designed to help sheep and goat producers sort through the large amount of information available on controlling sheep and goat parasites and to make decisions about specific management options that are relevant to their farm operation. It is not intended to replace your veterinarian with regard to diagnosis of parasitism or specifics of drug use. This information is organized in a "decision tree" or "flow chart" approach where answering one question leads to another question or various management options. Each section of the flow chart is basically organized in the format of Class of animal→ Time of year→ Degree of management flexibility (or availability of resources at the farm level). In some cases, you will be referred to external references or resources providing additional information on selected topics (e.g., the FAMACHA© system or using certain plants in control of parasitism).

This material is also available on the Internet as an interactive, computer-based module (http://vet.osu.edu/extension/decision-tree). This allows us more flexibility to use pictures and diagrams as well as to link to other resources on this topic. We apologize for the fine print in the charts in this document, but we did this to keep the information confined to one page per class of animal and make it more suitable for your review and use. In the following pages you will find a glossary that may help you in understanding the information in the flow charts. Because most people will need an effective dewormer as part of their overall parasite control program, you will also find a chart that helps you determine how to know which product will work on your farm. Next you will find a flow chart that is an overview of the decision-making support tool that shows how it is organized, and lastly are five individual flow charts for the typical classes of sheep or goats we find on most farms.

We value your input and suggestions on how this information might be better organized or how helpful it might be to you or others. Please contact:


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THE OHIO STATE UNIVERSITY EXTENSION

# Glossary

**Egg-to-larval development** – Adult worms expel eggs that pass outward in feces (manure). These eggs hatch into larvae on pastures under favorable conditions of moisture and temperature. When the worm larvae are ingested by sheep and goats, they develop into adult worms in the gastrointestinal tract and begin the cycle all over again.

**DrenchRite® Assay** – uses eggs harvested from manure samples that are representative of your sheep and goats. The larvae developing from these eggs are exposed to differing levels of dewormers and parasitologists can determine which may be effective. All three chemical classes of dewormers can be tested at one time.

**FAMACHA©** – an acronym formed from FAffa MAlan CHArt – a system named in honor of one of its South African developers, Dr Francois "Faffa" Malan. This system uses a patented color chart against which the color of the inner surface of the lower eyelid is compared. The colors are 5 shades of red varying from red to very pale pink or flesh color, and they correspond to levels of circulating red blood cells. Bright red is correlated with normal red cell levels and the paler colors correlate with anemia or shortages of red blood cells. The GIN, *Haemonchus contortus*, is found in the abomasum of sheep and goats and feeds on blood. Large numbers of this worm cause anemia, poor performance, and even death. The FAMACHA© system is one method of targeted selective treatment and is applicable to *Haemonchus contortus* only. This is the most serious worm for sheep and goat producers across much of the United States. FAMACHA© cards and training may be available from your veterinarian or call your Extension educator to request training in your area.

**Fecal egg count reduction testing** – A fecal worm egg count (FEC) is done on manure to look for worm eggs. It is quantitative versus qualitative in that the result is expressed as the number of eggs per gram (epg) of manure as opposed to "positive" or "negative" or "+, ++, or +++" results that are often given from simple flotation procedures. A quantitative result gives us a means to quantify changes over time or in response to a treatment. The three main uses of FECs are to detect dewormer resistance, to monitor pasture contamination, and to select animals for their genetic ability to resist worms.

**GIN** – "gastrointestinal nematodes" – this is a common abbreviation referring to the roundworm parasites of sheep and goats. It does not refer to tapeworms or coccidia which are not covered in this decision support tool and which do not need pasture for transmission. The important GIN of sheep and goats have similar life cycles which require development of larval stages on pastures. It is used in this decision support tool to save space.

***Haemonchus contortus*** – or the "barber pole worm" is a blood sucking internal parasite with an extremely high reproductive rate, a quick life cycle, and an ability to survive on pasture paddocks for a long period of time. Under ideal conditions of moderate to high temperatures and moisture, the entire life cycle can be completed in as little as 23 days. The adult *Haemonchus contortus* parasite can lay up to 5,000 eggs per day, which in a grazing operation are shed on to the pasture where the sheep or goats are grazing.

**Hypobiosis** – In the normal life cycle, worm eggs passed in the feces develop into larvae that are ingested by the sheep, and the larvae develop into adult worms in the sheep's abomasum or intestines. Sometimes the larvae do not complete their development but go into a resting phase in the abomasal or intestinal tissue. They do relatively little harm in this phase which is called hypobiosis. Day length changes or the onset of milk production in pregnant females stimulates them to continue development to the adult stage. This is one strategy for worms to survive harsh environmental conditions such as northern winters or very hot dry summers.

**Leader-follower** – This system of stocking management goes by several names. It is a method of utilizing two or more groups of animals, usually with different nutritional requirements, to graze sequentially on the same land area. The animal group with the highest nutritional need would have first access to a paddock. The groups that follow would have lower nutritional requirements.

**Life cycle** – In the normal life cycle, worm eggs passed in the feces (manure) develop into larvae that are ingested by the sheep, and the larvae develop into adult worms in the sheep's abomasum or intestines. Egg hatching and larval development are dependent on warm temperatures and adequate moisture. The entire life cycle of *Haemonchus contortus*, perhaps the most important worm for us to manage, takes approximately 23-24 days under optimum conditions. The time needed for eggs to reach the infective larva stage can be as quick as 4 days but often is about 7-10 days. We can use this to our advantage in grazing strategies such as strip grazing with a back fence by moving the animals to a fresh strip of forage every 3-4 days. The means the animals move away from infective larvae developing on the pasture.

**Non-persistent dewormer** – Most of the FDA-approved dewormers for sheep and goats are eliminated from the body relatively quickly, and their activity against adult and larval stages of worms is limited to a few hours or a day or so. In contrast, moxidectin, the active ingredient of Cydectin® drench, has a prolonged period of activity against worm larvae that are ingested with pasture forages (perhaps as long as 35 days if resistance has not developed to this chemical on your farm). From the sheep or goat's standpoint, this is a good thing as it may provide a prolonged period of protection against new worm infections. However, because the concentration of this chemical gradually declines over several weeks to less than lethal levels, research has shown that this may select for worms with resistance to this chemical. This has been shown with other dewormers with prolonged or persistent activity in other countries. This means that moxidectin should be used carefully in grazing animals to reduce selection pressure for resistance.

**Refugia** – the proportion of a farm's parasitic worm population that escapes exposure to dewormers when animals are treated and that contributes to future worm generations on that farm. An example of parasite refugia is the worm larvae stages existing on the pasture that have developed from eggs. These larvae can survive through much of the grazing season, and even through typical winter weather, on the pastures. They are the life form of parasites that develop into a new generation of worms after they are consumed. Another example is the adult worms in untreated animals that are using the same pastures as the treated animals. Resistance to dewormers in the worm is a genetic trait that is passed on to future worm generations. Treatment with a dewormer removes the susceptible worms from an animal leaving those with genes for resistance to the dewormer to pass on that trait to future generations. The worms "in refugia" are available to mate with worms which survive treatment and thus help dilute the resistance genes. This is perhaps the most important concept in modern parasite control strategies to understand if we want sheep and goat farming to remain sustainable in the face of increasing resistance of worms to the dewormers we now have as well as any new ones we may get in the future.

**Rotational grazing** – (or rotational stocking) is a method that utilizes recurring periods of grazing and rest among three or more paddocks in a grazing management unit throughout the time when grazing is allowed (Allen, et. al., 2011). Animals are restricted to a smaller pasture (paddock) for a limited time then removed and sent to a different pasture. Usually the movement is based on the amount of forage available in the fields. Typically animals may graze a field for three to seven days and then rotate to another field. Fields can be revisited when the forage re-grows enough to provide the appropriate amount of feed. The type of forage, the target amount of forage desired, how much residual leaf remained when the animals left and the weather while the paddock recovered all impact the time it takes for the paddock to be ready to re-graze. The paddock may be ready to re-graze within 14 to 45 days.

**Safe pasture** – A safe pasture is one on which infective worm larvae are not present or are present in very low numbers. Pastures where sheep or goats have not grazed for the past year are usually safe because worm larvae can only exist for a defined period of time on their stored energy. Conventional tillage of the soil for row crop farming or planting annual forages effectively destroys worm larvae Hayfields grazed in summer or fall after one or two harvests should have very low numbers of worm larvae even if the hayfield was grazed the previous fall. And pastures previously grazed by another species, such as horses or cattle, will be safe for sheep and goats because they do not share the same worms. Sheep, goats, and llamas do share the same worm species.

**Set stocking** – (sometimes called continuous grazing) is a method that allows a specific, non-variable number of animals on a specific, non-variable area of land during the time when grazing is allowed. For example if you had a pasture and turned all your animals into it at the start of spring and left them there for the whole grazing season, you would be set stocking.

**Stocking density** – is the number of pounds of live animals per acre of pasture or forage at one point in time. That takes the class and the size of animals out of the description. This is different from "stocking rate" which is the number of animals per acre over a time period (for example – 5 ewes per acre per year).

**Strip grazing** – is defined as a method that confines animals to an area of grazing land to be grazed in a relatively short time. The strip size is varied to allow access to a specific land area. Typically this method is used when more efficient utilization of the standing forage is desired. It limits access to forage with temporary fencing. If the forage has the potential to re-grow, a back fence would be used to prevent overgrazing the portion already grazed. The size of paddock could change across the field if the amount of forage is not uniform in the whole field.

**Summer annual** – plants that are planted in the spring for grazing during that same growing season. They sprout, flower, produce seed, and die during the warmer months of the year. Examples include sorghum/sudangrass hybrids, pearl millet, forage soybeans, cowpeas, annual sericea lespedeza, and even corn. Turnips and rape, plants in the Brassica family, are not true summer annual plants but are often planted and used as summer annuals in the northern region of the USA.

**TST – "Targeted Selective Treatment"** – Treatment of only those animals that will most benefit from treatment, leaving the rest of the flock or herd untreated. Worm numbers in sheep and goats are not uniform across members of the flock or herd with approximately 70-80% of the worms found in only 20–30% of the animals; the majority of the animals have relatively low worm burdens. TST strategies are directed toward the animals that are clinically affected by parasites, those animals most susceptible to disease, or those that are likely to contaminate the pasture the most. Examples of criteria that can be used to selectively choose animals for treatment include anemia (the FAMACHA© system); thin body condition; reduced live weight gains; elevated worm egg counts in feces; and below average milk production.

**Winter annual** – In the context of a grazing system, these are plants that are planted in the fall and intended for grazing the following spring. They live one year. Examples include wheat and cereal rye.

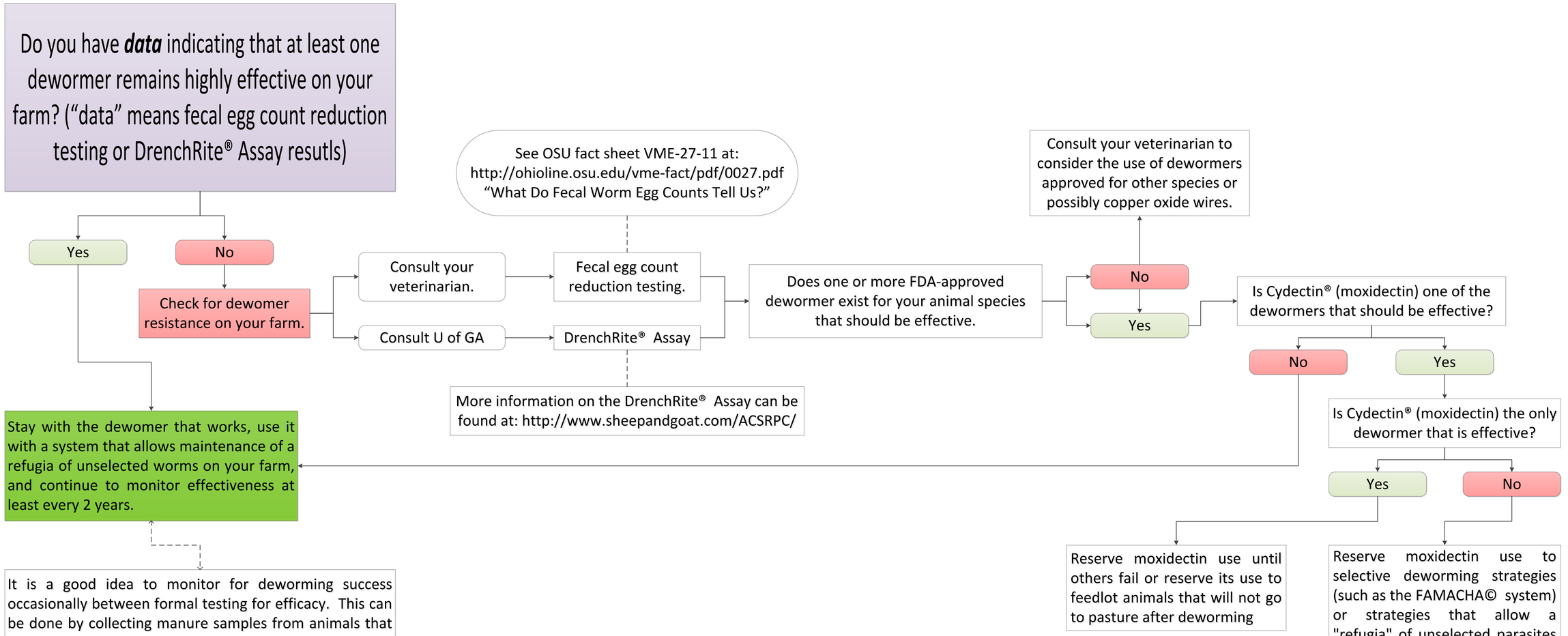
## Fact sheets or other information referenced in this handout:

**American Consortium for Small Ruminant Parasite Control:**
**DrenchRite® Assay** – http://www.sheepandgoat.com/ACSRPC/Resources/DrenchRiteAssay.html
**FAMACHA©** – http://www.sheepandgoat.com/ACSRPC/Resources/famacha.html
**Sericea lespedeza** – http://www.scsrpc.org/SCSRPC/Sericea/sericea.htm

**OSU Extension fact sheets:**
**VME-28-12** - Strategies for Coping with Parasite Larvae on Pastures in the Springtime in Ohio – http://ohioline.osu.edu/vme-fact/pdf/0028.pdf
**VME-30-12** - Use of a Brown Mid-Rib Sorghum x Sudangrass Hybrid in a Small Ruminant Parasite Control Program – http://ohioline.osu.edu/vme-fact/pdf/0030.pdf
**VME-27-11** - What Do Fecal Worm Egg Counts Tell Us? – http://ohioline.osu.edu/vme-fact/pdf/0027.pdf

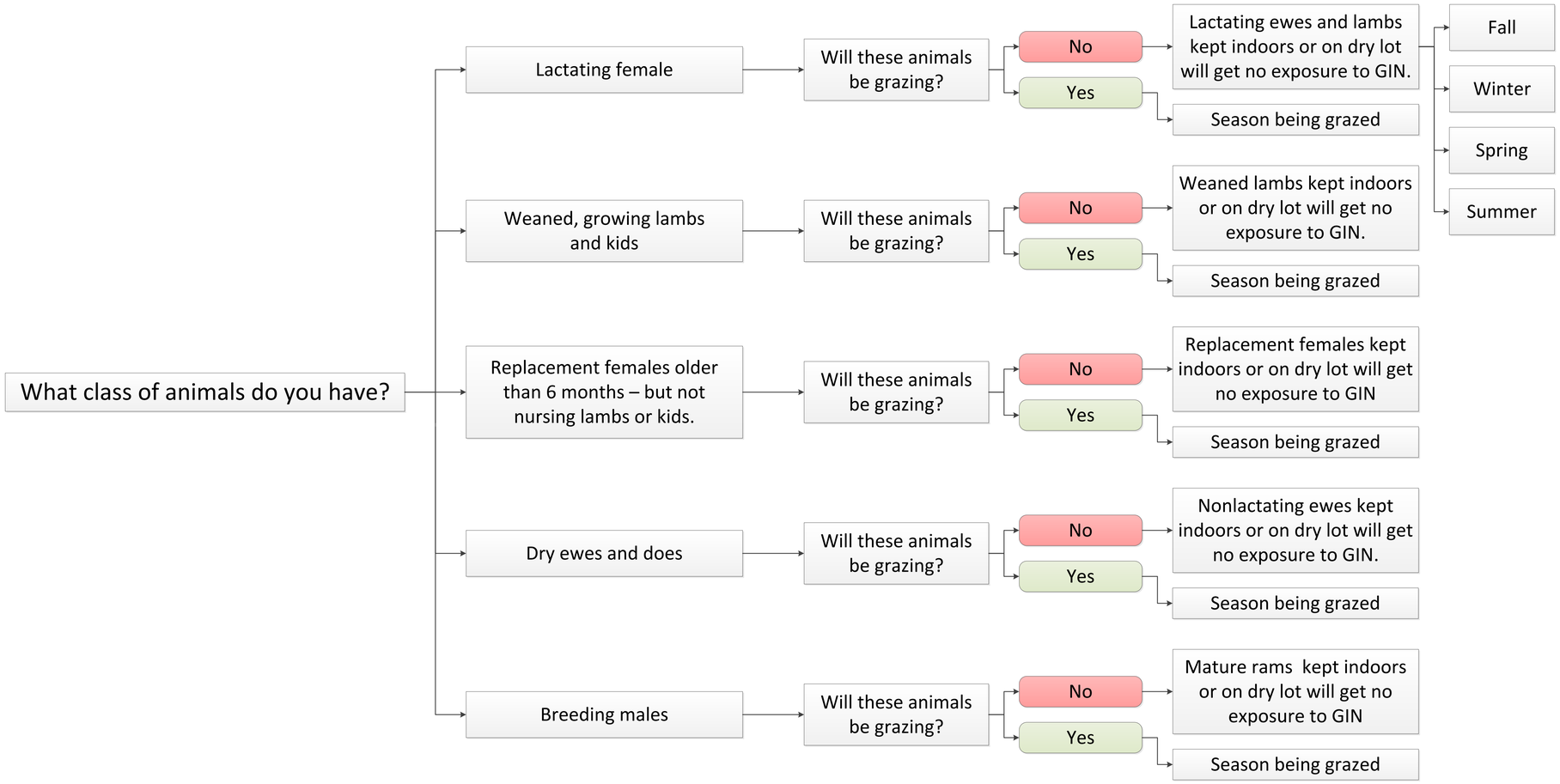
*Computer-based module with short video clips available at http://vet.osu.edu/extension/decision-tree*

Because *some* reliance on chemical dewormers is necessary for most farms,
it is very important to know how well these products perform against the worms on your farm.




| FDA-approved dewormers available for use in sheep and goats in the US as of August, 2012 | | |
|---|---|---|
| **Drug class** | **Active ingredient** | **Trade names** |
| Benzimidazole | Albendazole | Valbazen®[1] |
| | Fenbendazole | Safeguard®[2] |
| Imidazothiazole and Tetrahydropyrimidine | Levamisole | Prohibit®[1], Levasol[1], Tramisol®[1] |
| | Morantel tartrate | Rumatel®[3] |
| Macrocyclic lactones avermectin | Ivermectin | Ivomec Drench for Sheep®[1] |
| milbemycin | Moxidectin | Cydectin®[1] |
| [1]FDA-approved for use in sheep (not for sheep producing milk for human consumption)<br>[2]FDA-approved for use in goats (not for goats producing milk for human consumption)<br>[3]FDA-approved for use in goats (feed supplement only; is approved for lactating does) | | |
| ***Other dewormers are FDA-approved for other species and might be used in sheep and goats, and some products in the table above can be used in both sheep and goats. However, all such uses are considered extra-label and must be by veterinary prescription.*** | | |

This diagram is an illustration of the overall layout of the decision-making support tool.
The general organization is:
Class of animal → Time of year → Degree of flexibility or available resources at the farm level.



# Lactating females with nursing lambs and kids

Will these animals be grazing?

- Yes → Season being grazed
- No → Lactating females kept indoors or on dry lot will get no exposure to GIN.

## Spring

- Permanent pasture
- Winter annual (cereal rye, wheat)
- Hayfield

When was this permanent pasture last grazed by sheep or goats?

- Previous Spring
- Previous Summer
- Previous Fall
- Previous Winter
- Same Spring

Pastures grazed in the spring that were last grazed the previous summer or spring should be relatively worm larvae-free. Worm larvae exposed to summer weather will use up their stored energy and be unlikely to survive winter.

Ewes and lambs grazing these pastures will likely be exposed to overwintered parasite larvae. Use FAMACHA© every two weeks or more frequently if your options for grazing are limited. Consult OSUE Fact Sheet VME-28-12 for more information on managing springtime pastures with lactating females and lambs and kids and especially for larger flocks.

Worm eggs that may have been deposited on the pasture during winters where freezing temperatures are common do not survive well. The first two stages of larvae developing from eggs that do hatch during periods of warm weather in winter are very susceptible to drying. Third stage larvae are the infectious stage and survive winter much better. The risk of pastures grazed during winter will depend on average temperatures in your area, moisture, number of animals grazing, and their egg output.

In addition to exposure to overwintered larvae, ewes and lambs will be exposed to larvae developing from eggs shed in an earlier grazing this spring. If some strategy to minimize egg shedding during the earlier grazing is not employed, these pastures can have high levels of worm larvae. Deworming only thin ewes and ewes with twins and triplets can reduce pasture contamination while still providing a refugia of worms not exposed to dewormer.

Winter annuals are usually planted after tillage of the soil and are usually planted in the fall following harvest of a crop. If they were planted on fields where sheep or goats had grazed that season, tillage will destroy most worm larvae making these pastures safe. If a “no-till” cultivation was used to plant the winter annual, some larvae may survive. No data exists to predict how many, but it is likely to be only small numbers.

If hayfields can be grazed in the spring, thus effectively harvesting “the first cutting” with the sheep, they usually provide a worm larvae-free place to put the animals. If combined with strip grazing and back fencing, hayfield grazing can be even more useful for worm control and be more efficient in forage usage. It takes at least 3-4 days under the most ideal weather conditions for a worm egg to hatch and reach the infective larva stage. If the fences are moved across the clean hayfield at 3-4 day intervals, and the back fence prevents sheep from grazing where eggs may have been deposited, both ewes and growing lambs will not acquire new infections as long as these larvae-free fields are available. Given the difficulty of making good quality first cutting hay in Ohio because of typical weather conditions, this can be a very efficient way of utilizing the forage. If the hay is predominantly alfalfa or clover, a strategy to manage bloat will need to be developed. If the hayfield is not grazed again during the summer or fall, it should be larvae free by the next spring because most infective larvae will use up their stored energy over the summer, and hay making will expose them to drying out. If strip grazing is not possible, deworming the lambs before moving to the clean field, leaving all or most of the ewes untreated, will provide the lambs with some protection against infection. In such situations, infective worm larvae will begin to accumulate to significant levels on the pastures by 30-40 days of grazing. This may not be an important issue on hayfields in which one expects later harvest as it is unlikely one would wish to graze it that long.

## Summer

- Sericea lespedeza
- Summer annual
- Permanent pasture

Information about planting and using sericea lespedeza can be found at the web site for the *American Consortium for Small Ruminant Parasite Control*: http://www.scsrpc.org/SCSRPC/Sericea/sericea.htm

Summer annuals such as turnips, kale, or sorghum/sudangrass hybrids can provide a worm larvae-free place to graze ewes and preweaned lambs. These are most effectively grazed using strip grazing with a back fence to prevent animals having access to previously grazed portions of the field. If the fences are moved across these clean pastures at 3-4 day intervals, and the back fence prevents sheep from grazing where eggs may have been deposited, both ewes and growing lambs will not acquire new infections as long as these larvae-free fields are available. If strip grazing is not possible, deworming the lambs before moving to the clean field, leaving all or most of the ewes untreated, will provide the lambs with some protection against infection and still provide a refugia of unselected worms to help reduce selection for dewormer resistance.

Permanent pastures for lactating ewes and lambs can be very dangerous if they were grazed in the spring with lactating ewes shedding large numbers of parasite eggs. Consider TST of ewes in spring and FAMACHA© every 7-14 days throughout the summer. Also consider alternate species grazing, annual forages, or hayfield grazing to create larvae-free places to graze.

## Fall

- Permanent pasture
- Hayfield

Permanent pastures will likely have significant worm larvae on them if grazed during the spring and summer depending on the class of animals grazing them. Fall lambing ewes, or ewes nursing late spring lambs, grazing these pastures will need to be monitored, preferably with FAMACHA©, until the weather gets cold enough to retard transmission (ground temps below 50oF). Lambs older than about 6 weeks-of-age should also be monitored.

Hayfields not previously grazed during this grazing season can provide a worm larvae-free place to graze sheep in the fall. Strip grazing with backfencing is the preferred technique. If alfalfa or clover is used, a bloat prevention strategy will need to be used. Care must be taken to allow the forage to recover before winter if the field is to be used for hay the following year.

## Winter

Good options in some areas include standing corn, harvested corn fields or other crop aftermath, and stockpiled fescue. Grass pastures previously grazed in the summer and fall, such as stockpiled fescue, may contain worm larvae. Transmission can occur if the animals are forced to eat low to the ground or if the weather is warm for extended periods. Nutritional needs of the ewes and lambs must be met. Supplemental feeding of ewes may be necessary on some forages.

# Weaned growing lambs and kids

Will these animals be grazing?

- Yes
  - Season being grazed
    - Spring
      - It is unusual to graze weaned lambs in early spring on most farms in the North Central region of the USA.
    - Summer
      - Sericea lespedeza
      - Summer annual
      - Permanent pasture
    - Fall
      - Permanent pasture
        - Permanent pastures will likely have significant numbers of worm larvae on them if grazed during the spring and summer depending on the class of animals grazing them. Growing lambs and kids grazing these pastures will need to be monitored, preferably with FAMACHA©, until the weather gets cold enough to retard transmission (ground temps below 50oF). Other forms of TST may also be appropriate especially in larger flocks and herds.
      - Hayfields
        - Hayfields not previously grazed this grazing season can provide a worm larvae-free place to graze lambs in the fall. Strip grazing with backfencing is the preferred technique. If alfalfa or clover is used, a bloat prevention strategy will need to be used. Care must be taken to allow the forage to recover before winter if the field is to be used for hay the following year.
    - Winter
      - Good options in some areas include standing corn, harvested corn fields, and stockpiled fescue. Grass pastures grazed in the summer and fall, such as stockpiled fescue, may contain worm larvae. Transmission can occur if the animals are forced to eat low to the ground or if the weather is warm for extended periods. Nutritional needs of the animals must be met if good gains are expected. In warmer regions, winter annuals (wheat, rye, vetch) can be grazed.
- No
  - Weaned lambs and kids kept indoors or on dry lot will get no exposure to GIN. If they have not been on pastures where other sheep have grazed, they do not need dewormed.

When was this permanent pasture last grazed by sheep or goats?

- Previous Spring
  - In temperate regions, pastures grazed in the spring that were last grazed the previous summer or spring should be relatively worm larvae-free. Worm larvae exposed to summer weather will use up their stored energy and be unlikely to survive winter. In warmer climates of the southeastern USA, there will be fewer larvae but some infective larvae may be found year-round.
- Previous Summer
  - Weaned lambs grazing these pastures will likely be exposed to overwintered parasite larvae. Use the FAMACHA© system every two weeks or more frequently if your options for grazing are limited. Consult OSUE Fact Sheet VME-28-12 for more information on managing springtime pastures with lactating ewes and lambs and especially for larger flocks.
- Previous Fall
  - Worm eggs that may have been deposited on the pasture during winters where freezing temperatures are common do not survive well. The first two stages of larvae developing from eggs that do hatch during periods of warm weather in winter are very susceptible to drying. Third stage larvae are the infectious stage and survive much better. The risk of pastures grazed during winter will depend on average temperatures in your area, moisture, number of animals grazing, and their egg output.
- Previous Winter
  - In addition to exposure to overwintered larvae, these animals will be exposed to larvae developing from eggs shed in an earlier grazing this spring. If some strategy to minimize egg shedding during the earlier grazing was not employed, these pastures can have high levels of worm larvae. Deworming only thin ewes and ewes with twins and triplets can reduce pasture contamination while still providing a refugia of worms not exposed to dewormer.
- Same Spring
  - Permanent pasture
  - Winter annual (cereal rye, wheat)
    - Winter annuals are usually planted after tillage of the soil and are usually planted in the fall following harvest of a crop. If they were planted on fields where sheep or goats had grazed that season, tillage will destroy most worm larvae making these pastures safe. If a “no-till” cultivation was used to plant the winter annual, some larvae may survive. No data exists to predict how many but it is likely to be only small numbers.
  - Hayfield
    - If hayfields can be grazed in the spring, thus effectively harvesting “the first cutting” with the sheep, they usually provide a worm larvae-free place to put the animals. If combined with strip grazing and back fencing, hayfield grazing can be even more useful for worm control and be more efficient in forage usage. It takes at least 3-4 days under the most ideal weather conditions for a worm egg to hatch and reach the infective larva stage. If the fences are moved across the clean hayfield at 3-4 day intervals, and the back fence prevents the animals from grazing where eggs may have been deposited, lambs will not acquire new infections as long as these larvae-free fields are available. Given the difficulty of making good quality first cutting hay in our region because of typical weather conditions, this can be a very efficient way of utilizing the forage. If the hay is predominantly alfalfa or clover, a strategy to manage bloat will need to be developed. If the hayfield is not grazed again during the summer or fall, it should be larvae-free by the next spring because most infective larvae will use up their stored energy over the summer, and hay making will expose them to drying out. If the lambs and kids were born in a barn in winter and placed on hayfields that were not grazed the previous fall, they should stay worm free as long as they are on the hayfield. Lambs and kids do not acquire the important GIN in a typical barn environment and will not acquire worms on pastures that have not been previously grazed.
  - Sericea lespedeza
    - Information about planting and using sericea lespedeza can be found at the web site for the American Consortium for Small Ruminant Parasite Control: http://www.scsrpc.org/SCSRPC/Sericea/sericea.htm
  - Summer annual
    - Summer annuals such as turnips, kale, millet, cowpeas, or sorghum/sudangrass hybrids can provide a worm larvae-free place to graze growing lambs. These forages are most effectively grazed using strip grazing with a back fence to prevent animals having access to previously grazed portions of the field. If the fences are moved across these clean pastures at 3-4 day intervals, and the back fence prevents the animals from grazing where eggs may have been deposited, growing lambs and kids will not acquire NEW infections as long as these larvae-free fields are available. If strip grazing is not possible, deworming the animals before moving to the clean field will provide them with some protection against infection. Avoid treating all the animals and immediately moving them to a worm larvae-free field as this will result in selection for dewormer resistant worms. This selection can be reduced by: 1) deworming the group but leaving the heaviest 10-25% of lambs untreated; 2) treating all the animals with a non-persistent dewormer while still on contaminated pasture and waiting 5-7 days before moving them to allow them to acquire a small infection with unselected worms; or 3) moving to the clean pasture and waiting 5-7 days before treating them. It is important when using summer annuals for growing lambs and kids to make sure their nutritional needs are met.
  - Permanent pasture
    - Permanent pastures grazed in summer with weaned lambs and kids can be very dangerous if they were grazed in the spring with lactating females shedding large numbers of parasite eggs. Consider TST of lactating females in spring to reduce egg shedding. If only permanent pastures previously grazed by sheep or goats are available, consider using the FAMACHA© scoring system every 7-14 days throughout the summer for weaned lambs and kids. If other options might exist, consider alternate species grazing, grazing summer annual forages, or hayfield grazing to create larvae-free places to graze for lambs.

# Replacement females older than 6 months – but not nursing lambs/kids

Will these animals be grazing?

- **No** → Replacement females kept indoors or on dry lot will get no exposure to GIN.
- **Yes** → Will they be grazed with lactating or dry ewes?
  - **Yes** → Manage parasitism for replacement females the same as lactating or dry ewes/does they graze with.
  - **No** → Season being grazed

## Spring

When was this permanent pasture last grazed by sheep or goats?

- **Previous Spring** → Pastures grazed in the spring that were last grazed the previous summer or spring should be relatively worm larvae-free. Worm larvae exposed to summer weather will use up their stored energy and be unlikely to survive winter.
- **Previous Summer** → Although these pastures will likely have overwintered parasite larvae, replacement females that have had one season of grazing will have acquired some immunity to parasitism, and they can withstand a worm challenge more effectively than lactating ewes and growing lambs. If they are in good body condition and pasture nutritive value is good, risk of severe internal parasitism is low. It would be a good idea to monitor body condition and eyelid score occasionally (FAMACHA© system). Consult OSUE Fact Sheet VME-28-12 for more information on managing springtime pastures for replacement females.
- **Previous Fall** → Worm eggs that may have been deposited on the pasture during winters where freezing temperatures are common do not survive well. The first two stages of larvae developing from eggs that do hatch during periods of warm weather in winter are very susceptible to drying. Third stage larvae are the infectious stage and survive winter much better. The risk of pastures grazed during winter will depend on average temperatures in your area, moisture, number of animals grazing, and their egg output.
- **Previous Winter** → In addition to exposure to overwintered larvae, these animals will be exposed to larvae developing from eggs shed in an earlier grazing this spring. If some strategy to minimize egg shedding during the earlier grazing is not employed, these pastures can have high levels of worm larvae. Deworming only thin ewes and ewes with twins and triplets can reduce pasture contamination while still providing a refugia of worms not exposed to dewormer. Non-lactating replacement females will be more resistant to clinical parasitism than lactating females or growing lambs.
- **Same Spring** → In addition to exposure to overwintered larvae, these animals will be exposed to larvae developing from eggs shed in an earlier grazing this spring. If some strategy to minimize egg shedding during the earlier grazing is not employed, these pastures can have high levels of worm larvae. Deworming only thin ewes and ewes with twins and triplets can reduce pasture contamination while still providing a refugia of worms not exposed to dewormer. Non-lactating replacement females will be more resistant to clinical parasitism than lactating females or growing lambs.

Spring options:

- **Permanent pasture**
- **Winter annual (cereal rye, wheat)** → Winter annuals are usually planted after tillage of the soil and are usually planted in the fall following harvest of a crop. If they were planted on fields where sheep or goats had grazed that season, tillage will destroy most worm larvae making these pastures safe. If a "no-till" cultivation was used to plant the winter annual, some larvae may survive. No data exists to predict how many but it is likely to be only small numbers.
- **Hayfield** → If hayfields can be grazed in the spring, thus effectively harvesting "the first cutting" with the sheep, they usually provide a worm larvae-free place to put the animals. If combined with strip grazing and back fencing, hayfield grazing can be even more useful for worm control and be more efficient in forage usage. It takes at least 3-4 days under the most ideal weather conditions for a worm egg to hatch and reach the infective larva stage. If the fences are moved across the clean hayfield at 3-4 day intervals, and the back fence prevents the animals from grazing where eggs may have been deposited, animals will not acquire new infections as long as these larvae-free fields are available. Given the difficulty of making good quality first cutting hay in our region because of typical weather conditions, this can be a very efficient way of utilizing the forage. If the hay is predominantly alfalfa or clover, a strategy to manage bloat will need to be developed. If the hayfield is not grazed again during the summer or fall, it should be larvae-free by the next spring because most infective larvae will use up their stored energy over the summer, and hay making will expose them to drying out.

## Summer

- **Sericea lespedeza** → Information about planting and using sericea lespedeza can be found at the web site for the *American Consortium for Small Ruminant Parasite Control*: http://www.scsrpc.org/SCSRPC/Sericea/sericea.htm
- **Summer annual** → Summer annuals such as turnips, kale, millet, cowpeas, or sorghum/sudangrass hybrids can provide a worm larvae-free place to graze replacement females although they are better able to withstand a parasite challenge than young growing lambs. These forages are most effectively grazed using strip grazing with a back fence to prevent animals having access to previously grazed portions of the field. If the fences are moved across these clean pastures at 3-4 day intervals, and the back fence prevents sheep from grazing where eggs may have been deposited, animals will not acquire NEW infections as long as these larvae-free fields are available. If strip grazing is not possible and you will be grazing replacement females that you suspect have a worm burden sufficient to retard their growth, deworming the animals before moving to the clean field will provide the them with protection against an increasingly serious infection. Avoid treating all the animals and immediately moving them to a worm larvae-free field as this will result in selection for dewormer resistant worms. This selection can be reduced by 1) deworming the group but leaving the heaviest 10-25% of animals untreated; 2) treating all the animals with a non-persistent dewormer while still on contaminated pasture and waiting 5-7 days before moving them to allow them to acquire a small infection with unselected worms; or 3) moving to the clean pasture and waiting 5-7 days before treating them. It is important when using summer annuals for growing animals to make sure their nutritional needs are met.
- **Permanent pasture** → Permanent pastures grazed in summer can have very high levels of parasite larvae on them if they were grazed in the spring with lactating ewes or growing lambs that were shedding large numbers of parasite eggs. Although non-lactating replacement females should have a higher level of ability to withstand a parasite challenge than lambs in their first grazing season, they should be monitored for signs of parasitism. If only permanent pastures previously grazed by sheep are available, consider using the FAMACHA© scoring system every 14 days throughout the summer to monitor. Alternatively, monitoring body condition and group level fecal egg counts may provide an alternative approach. If treatment is needed consider using the FAMACHA© system as a guide for which animals to be treated or consider using a TST approach where the group is dewormed but the heaviest 25% of animals remain untreated. If other options might exist, consider alternate species grazing, grazing summer annual forages, or hayfield grazing to create larvae-free, or reduced risk, places to graze because you will want these animals to reach breeding condition without setback.

## Fall

- **Permanent pasture** → Permanent pastures may have significant numbers of worm larvae on them if they were grazed during the spring and summer by lactating ewes or growing lambs and depending on the success of parasite control strategies. Replacement females grazing these pastures should be monitored, with FAMACHA©, body condition scoring, or fecal egg counts, until the weather gets cold enough to retard transmission (ground temps below 50°F).
- **Hayfield** → Hayfields not previously grazed this grazing season can provide a worm larvae-free place to graze in the fall and may provide excellent nutrition for flushing ewes. Strip grazing with backfencing is the preferred technique. If alfalfa or clover is used, a bloat prevention strategy will need to be used. Care must be taken to allow the forage to recover before winter if the field is to be used for hay the following year.

## Winter

Replacement females grazing in winter will be unlikely to acquire many worms if it is cold. Good options in some areas include standing corn, harvested corn fields, and stockpiled fescue.

# Dry ewes or does

Will these animals be grazing?

- Yes → Season being grazed
- No → Dry ewes kept indoors or on dry lot will get no exposure to GIN

## Spring

- Permanent pasture
- Winter annual (cereal rye, wheat)
- Hayfield

When was this permanent pasture last grazed by sheep or goats?

- Previous Spring → Pastures grazed in the spring that were last grazed the previous summer or spring should be relatively worm larvae-free. Worm larvae exposed to summer weather will use up their stored energy and be unlikely to survive winter.
- Previous Summer → Although these pastures will likely have overwintered parasite larvae, non-lactating females that have had one season of grazing will have acquired some immunity to parasitism, and they can withstand a worm challenge more effectively than lactating ewes and growing lambs. If they are in good body condition and pasture nutritive value is good, risk of severe internal parasitism is low. It would be a good idea to monitor body condition and eyelid score occasionally (FAMACHA© system). Consult OSUE Fact Sheet VME-28-12 for more information on managing springtime pastures for dry ewes/does.
- Previous Fall → Worm eggs that may have been deposited on the pasture during winters where freezing temperatures are common do not survive well. The first two stages of larvae developing from eggs that do hatch during periods of warm weather in winter are very susceptible to drying. Third stage larvae are the infectious stage and survive much better. The risk of pastures grazed during winter will depend on average temperatures in your area, moisture, number of animals grazing, and their egg output. However, non-lactating females can withstand some worm larval challenge without becoming severely parasitized. Use body condition score and/or the FAMACHA© system to monitor these animals.
- Previous Winter → These animals will be exposed to larvae developing from eggs shed in an earlier grazing this spring. If some strategy to minimize egg shedding during the earlier grazing was not employed, these pastures can have high levels of worm larvae. For example, if lactating females were the last to use this pasture, then deworming thin ewes and ewes with twins and triplets can reduce pasture contamination while still providing a refugia of worms not exposed to dewormer. However, non-lactating mature females will be more resistant to clinical parasitism than lactating females or growing lambs.
- Same Spring → Winter annuals are usually planted after tillage of the soil and are usually planted in the fall following harvest of a crop. If they were planted on fields where sheep or goats had grazed that season, tillage will destroy most worm larvae making these pastures safe. If a “no-till” cultivation was used to plant the winter annual, some larvae may survive. No data exists to predict how many will survive, but it is likely to be only small numbers.

Hayfield → If hayfields can be grazed in the spring, thus effectively harvesting “the first cutting” with the sheep, they usually provide a worm larvae-free place to put the animals. If combined with strip grazing and back fencing, hayfield grazing can be even more useful for worm control and be more efficient in forage usage. It takes at least 3-4 days under the most ideal weather conditions for a worm egg to hatch and reach the infective larva stage. If the fences are moved across the clean hayfield at 3-4 day intervals, and the back fence prevents the animals from grazing where eggs may have been deposited, animals will not acquire new infections as long as these larvae-free fields are available. Given the difficulty of making good quality first cutting hay in our region because of typical weather conditions, this can be a very efficient way of utilizing the forage. If the hay is predominantly alfalfa or clover, a strategy to manage bloat will need to be developed. If the hayfield is not grazed again during the summer or fall, it should be larvae-free by the next spring because most infective larvae will use up their stored energy over the summer, and hay making will expose them to drying out.

## Summer

- Sericea lespedeza → Information about planting and using sericea lespedeza can be found at the web site for the *American Consortium for Small Ruminant Parasite Control*: http://www.scsrpc.org/SCSRPC/Sericea/sericea.htm
- Summer annual → Summer annuals such as turnips, kale, millet, cowpeas, or sorghum/sudangrass hybrids can provide a worm larvae-free place to graze mature non-lactating females. However, they are much better able to withstand a parasite challenge than young growing lambs or lactating ewes. These forages are most effectively grazed using strip grazing with a back fence to prevent animals having access to previously grazed portions of the field. If the fences are moved across these clean pastures at 3-4 day intervals, and the back fence prevents sheep from grazing where eggs may have been deposited, animals will not acquire NEW infections as long as these larvae-free fields are available. Dry females may not need the high quality nutrition that some summer annuals provide. Sorghum Sudangrass hybrids may be ideally suited to non-lactating females. As with any other class of animals, avoid treating all the animals and immediately moving them to a worm larvae-free field as this will result in selection for dewormer resistant worms. Typically, after the lambs or kids are weaned, fecal worm egg counts fall to low levels unless the ewes/does have been stressed by poor quality nutrition and are in very thin body condition. They should be evaluated at weaning and treated selectively if needed. The forage quality should be sufficient for the ewes/does to regain body condition in preparation for breeding.
- Permanent pasture → Permanent pastures grazed in summer can have very high levels of parasite larvae on them if they were grazed in the spring with lactating females that were shedding large numbers of parasite eggs. Typically, after the lambs or kids are weaned, fecal worm egg counts fall to low levels unless the ewes/does have been stressed by poor quality nutrition and are in very thin body condition. They should be evaluated at weaning and treated selectively if needed. The forage quality should be sufficient for the ewes/does to regain body condition in preparation for breeding. Although mature non-lactating females are much better able to withstand a parasite challenge than young growing lambs, they should be monitored for signs of parasitism. If only permanent pastures previously grazed by sheep are available, consider using the FAMACHA© scoring system every 14 days throughout the summer to monitor. Alternatively, monitoring body condition and group level fecal egg counts may provide a different approach. If treatment is needed consider using the FAMACHA© system as a guide for which animals to be treated or consider using a TST approach where only animals in thin body condition are treated. If other options might exist, consider alternate species grazing, grazing summer annual forages, or hayfield grazing to create larvae-free, or reduced risk, places to graze because you will want these animals to reach breeding condition without setback.

## Fall

- Permanent pasture → Permanent pastures may have significant numbers of worm larvae on them if they were grazed during the spring and summer by lactating ewes or growing lambs and depending on the success of parasite control strategies. Dry ewes in good body condition are able to withstand a worm challenge that would create severe parasitism in lactating females or lambs. However, it is still a good idea to monitor the condition of these animals using the FAMACHA© system, body condition scoring, or fecal egg counts, until the weather gets cold enough to retard transmission (ground temps below 50°F).
- Hayfield → Hayfields not previously grazed this grazing season can provide a worm larvae-free place to graze in the fall and may provide excellent nutrition for flushing prior to breeding. Strip grazing with backfencing is the preferred technique. If alfalfa or clover is used, a bloat prevention strategy will need to be used. Care must be taken to allow the forage to recover before winter if the field is to be used for hay the following year.

## Winter

Non-lactating mature females grazing in winter will be unlikely to acquire many worms if it is cold. Good options in some areas include standing corn, harvested corn fields, and stockpiled fescue.

# Breeding Males

Breeding males are usually managed as a separate group, and their nutrient requirements are principally for maintenance until breeding season. There is evidence that breeding males are somewhat more susceptible to severe parasitism than non-lactating adult females. This should be taken into consideration when these animals are grazed on a worm larvae-contaminated pasture, and a monitoring plan using FAMACHA©, body condition scoring, or fecal egg counting should be implemented during the summer and fall grazing periods.

Will these animals be grazing?

Yes

Season being grazed

No

Mature rams and bucks kept indoors or in dry lot settings will get no exposure to GIN.

When was this permanent pasture last grazed by sheep or goats?

- Previous Spring
- Previous Summer
- Previous Fall
- Previous Winter
- Same Spring

Pastures grazed in the spring that were last grazed the previous summer or spring should be relatively worm larvae-free. Worm larvae exposed to summer weather will use up their stored energy and be unlikely to survive winter. Breeding males should be able to withstand some parasite larval challenge with safety.

Although these pastures will likely have overwintered parasite larvae, breeding males that have had at least one season of grazing will have acquired some immunity to parasitism. However, research suggests that intact adult males may be more susceptible to parasitism than similar females. If the animals are in good body condition and pasture nutritive value is good, risk of severe parasitism is low. It would be a good idea to monitor body condition and eyelid score occasionally (FAMACHA© system).

Worm eggs that may have been deposited on the pasture during winters where freezing temperatures are common do not survive well. The first two stages of larvae developing from eggs that do hatch during periods of warm weather in winter are very susceptible to drying. Third stage larvae are the infectious stage and survive much better. The risk of using pastures in spring that were last grazed during winter will depend on average temperatures, moisture, number of animals grazing, and their egg output. However, non-lactating animals can withstand some worm larval challenge without becoming severely parasitized. Use body condition score and/or use the FAMACHA© system to monitor these animals.

Breeding males will be exposed to larvae developing from eggs shed in an earlier grazing this spring. If some strategy to minimize egg shedding during the earlier grazing is not employed, these pastures can have high levels of worm larvae. For example, if lactating females were the last to use this pasture, then deworming only thin ewes and ewes with twins and triplets can reduce pasture contamination while still providing a refugia of worms not exposed to dewormer.

## Spring

- Permanent pasture
- Winter annual (cereal rye, wheat)
- Hayfield

Winter annuals are usually planted after tillage of the soil and are usually planted in the fall following harvest of a crop. If they were planted on fields where sheep or goats had grazed that season, tillage will destroy most worm larvae making these pastures safe. If a “no-till” cultivation was used to plant the winter annual, some larvae may survive. No data exists to predict how many will survive, but it is likely to be only small numbers.

If hayfields can be grazed in the spring, thus effectively harvesting “the first cutting” with the animals, they usually provide a worm larvae-free place to put them. Rams and bucks usually do not require a high level of nutrition at this time of year, and are usually not grazed on hayfields. If springtime hayfield grazing is anticipated, please see the information for dry ewes/does.

## Summer

- Sericea lespedeza
- Summer annual
- Permanent pasture

Information about planting and using sericea lespedeza can be found at the web site for the *American Consortium for Small Ruminant Parasite Control*: http://www.scsrpc.org/SCSRPC/Sericea/sericea.htm

Summer annuals such as turnips, kale, millet, cowpeas, or sorghum/sudangrass hybrids can provide a worm larvae-free place to graze mature breeding males. These forages are most effectively grazed using strip grazing with a back fence to prevent animals having access to previously grazed portions of the field. If the fences are moved across these clean pastures at 3-4 day intervals, and the back fence prevents animals from grazing where eggs may have been deposited, they will not acquire NEW infections as long as these larvae-free fields are available. Breeding males may not need the high quality nutrition that some summer annuals provide. Sorghum Sudangrass hybrids may be sufficient for breeding males. As with any other class of animals, avoid treating all the animals and immediately moving them to a worm larvae-free field as this will result in selection for dewormer resistant worms. If a leader-follower system is used where the males follow behind lactating females or weaned lambs/kids on these forages, the males may be exposed to high concentrations of parasite larvae unless the first animals to graze the forage have been managed to minimize their worm egg output.

## Fall

- Permanent pasture
- Hayfield

Permanent pastures may have very high levels of parasite larvae on them if they were grazed in the summer with lactating females or growing lambs/kids that were shedding large numbers of parasite eggs. If only permanent pastures previously grazed by sheep or goats are available, consider using the FAMACHA© scoring system every 14-21 days throughout the summer to monitor parasitism. Monitoring body condition and group level fecal egg counts may provide an alternative approach. If treatment is needed consider using the FAMACHA© system as a guide for deciding which animals to treat or consider using a TST approach where only animals in thin body condition are treated. If other options might exist, consider alternate species grazing, grazing summer annual forages, or hayfield grazing to create larvae-free, or reduced risk places to graze.

Hayfields not previously this grazing season grazed can provide a worm larvae-free place to graze in the fall and may provide excellent nutrition prior to breeding. Strip grazing with backfencing is the preferred technique. If alfalfa or clover is used, a bloat prevention strategy will need to be used. Care must be taken to allow the forage to recover before winter if the field is to be used for hay the following year.

Permanent pastures grazed in summer can have very high levels of parasite larvae on them if they were grazed in the spring with lactating ewes or growing lambs that were shedding large numbers of parasite eggs. If only permanent pastures previously grazed by sheep or goats are available, consider using the FAMACHA© scoring system every 14-21 days throughout the summer to monitor. Alternatively, monitoring body condition and group level fecal egg counts may provide an alternative approach. If treatment is needed consider using the FAMACHA© system as a guide for which animals to be treated or consider using a TST approach where only animals in thin body condition are treated. If other options might exist, consider alternate species grazing, grazing summer annual forages, or hayfield grazing to create larvae-free, or reduced risk, places to graze because you will want these animals to reach breeding condition without setback.

## Winter

Breeding rams grazing permanent pastures in winter will be unlikely to acquire many worms if it is cold. Good options in some areas include standing corn, harvested corn fields, and stockpiled fescue.