

INTERNAL PARASITES OF CATTLE IN LOUISIANA AND OTHER SOUTHERN STATES

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Introduction

Cattle of all ages, but particularly young cattle, are affected by a diversity of internal parasites. Among these are the roundworms (Nematodes), which are primarily parasites of the gastrointestinal tract (a lungworm is included), the liver fluke (Trematodes), tapeworms (Cestodes) in the small intestine, and single-celled protozoan parasites (Coccidia) in the lower intestinal tract. Climatic conditions through most of the southern region of the U.S., including Louisiana, provide for long grazing seasons; however, these same conditions provide an ideal setting for internal parasites. Periods of greatest infection risk occur from late winter through spring and again in the fall. Considerable infection may also occur during milder winters and during summers that are very wet and not overly hot. Under pasture conditions, it is the rule to encounter mixed infections with several types of roundworms as well as with other parasites indicated above. Because of their wide distribution throughout the southern region, the large numbers of cattle infected, and the damage caused by the worms, nematodes are considered to be the most economically important group of internal parasites in cattle.

The progressive cattle producer today generally has a high level of understanding of factors that can cut into efficiency and profits in production. In spite of this, there are many who still underestimate or ignore the effects of internal parasites on cattle productivity and health. Under certain conditions of management, such as with low stocking densities and high levels of nutrition, it is often difficult to demonstrate that control methods for internal parasites are warranted. However, under most circumstances, in which cattle

production in the South is highly intensified and internal parasites are present in an environment that is highly favorable to their propagation, it is likely that productivity can be enhanced or substantially improved by parasite control measures.

Determination of accurate estimates of production losses to cattle internal parasites is difficult to achieve. Illness and deaths are obvious, but effects on weight gain, feed conversion, reproductive performance, cost of drugs and other medications, and other factors are more complex to assess. At varied intervals, national estimates of loss to internal parasites, external parasites or other disease entities are issued by governmental and other agencies. For records of 1994-1995, there were 103.8 million cattle in the United States valued at \$66.5 billion (Agricultural Statistics, USDA, 1996). American pharmaceutical companies estimated that gas-

trointestinal parasites can cost the producer from \$25 to \$200 per animal (Smith Kline Beecham Animal Health, 1991). Even at the lower estimate, this translates into a \$2.5 billion loss to the cattle industry each year. Obviously, all 90 million to 100 million cattle in a given year are not treated, but the fact that some may be treated more than once per year likely balances out the estimated numbers.

Two examples of how anthelmintic treatments can favorably affect weight gains in stocker beef cattle in comparison with untreated control calves are shown in Table 1. In all cases, the effect of treatment by far exceeds the cost of treatments. Such results have been observed invariably with different anthelmintics in the two examples and in many other LSU Agricultural Center research studies. It should be remembered, however, that even though anthelmintics are indispen-

TABLE 1. Weight gains (lb.) of cattle treated with different anthelmintics compared to untreated control cattle

Example 1. Treatment least square means for body weight (lb.) of cattle treated on study days 0 (Jan 11) and 84 (Apr 5)

Treatment - All Groups n=18/gp	Study Day						
	0	28	56	84	112	140	160
Untreated controls	477 ^{ab}	486 ^a	508 ^a	539 ^a	592 ^a	638 ^a	689 ^a
Doramectin inject.	469 ^a	521 ^b	574 ^b	631 ^b	730 ^c	777 ^c	818 ^c
Ivermectin inject.	482 ^b	526 ^b	570 ^b	620 ^b	713 ^b	759 ^b	807 ^b
Ivermectin pour-on	466 ^a	515 ^b	563 ^b	623 ^b	702 ^b	757 ^b	796 ^b

Different superscript letters in columns indicate significant differences (P<0.05).

Example 2. Bodyweights (lb) of untreated control cattle and cattle treated with a pour-on endectocide on study day 0 (Jan 18)

Treatment - All Groups n=15/gp	Study Day					Total gain	Value @ \$.7135	Value/ control
	0	28	56	84	112			
Untreated controls	481 ^a	557 ^a	638 ^a	719 ^a	762 ^a	281	543.69	—
Doramectin	484 ^a	587 ^b	683 ^{bc}	764 ^{bc}	807 ^{bc}	323	575.79	32.10
Ivermectin	481 ^a	582 ^b	668 ^b	744 ^{ab}	788 ^{ab}	307	562.24	18.55
Eprinomectin	485 ^a	586 ^b	685 ^{bc}	765 ^{bc}	812 ^{bc}	327	579.36	35.67
Moxidectin	485 ^a	593 ^b	696 ^c	778 ^c	823 ^c	338	587.21	44.52

Different superscript letters in columns indicate significant differences (P<0.05).

able in parasite control, other factors, such as a good nutritional level and general management, are also indispensable. When control of gastrointestinal nematodes and lungworm is combined with a planned and systematic effort to simultaneously control the liver fluke (where applicable) and ectoparasites, (i.e., flies, lice, grubs, etc.), productivity will be increased. Good control of any of the parasite groups just indicated can result in increased productivity, depending on prevalence in a given geographic area; however, good control of all parasites along with good overall herd health is the best guarantee of increased productivity.

The Parasites

Several genera and species of nematodes are commonly found in cattle of all ages in the southern region. As pointed out earlier, the nematodes are the most common and numerous of the internal parasites of cattle in the southern region and, consequently, more of a threat for disease and production loss than other internal parasites. Largest infections are usually found in weanling and yearling cattle. The worms are parasitic in different portions of the gastrointestinal tract. The abomasum or true stomach is the site of *Ostertagia ostertagi*, the

brown or medium stomach worm, considered to be the most harmful and economically important parasite of cattle in temperate areas of the world (Figure 1). More will be said later about a seasonal variation in development of this parasite that can result in severe parasitic problems. Also present in the abomasum are *Trichostrongylus axei*, the stomach hairworm, and *Haemonchus* sp., the large stomach worm or barber pole worm.

Among worms in the intestinal tract are several species of *Cooperia*, *Strongyloides papillosus*, *Tricho-*

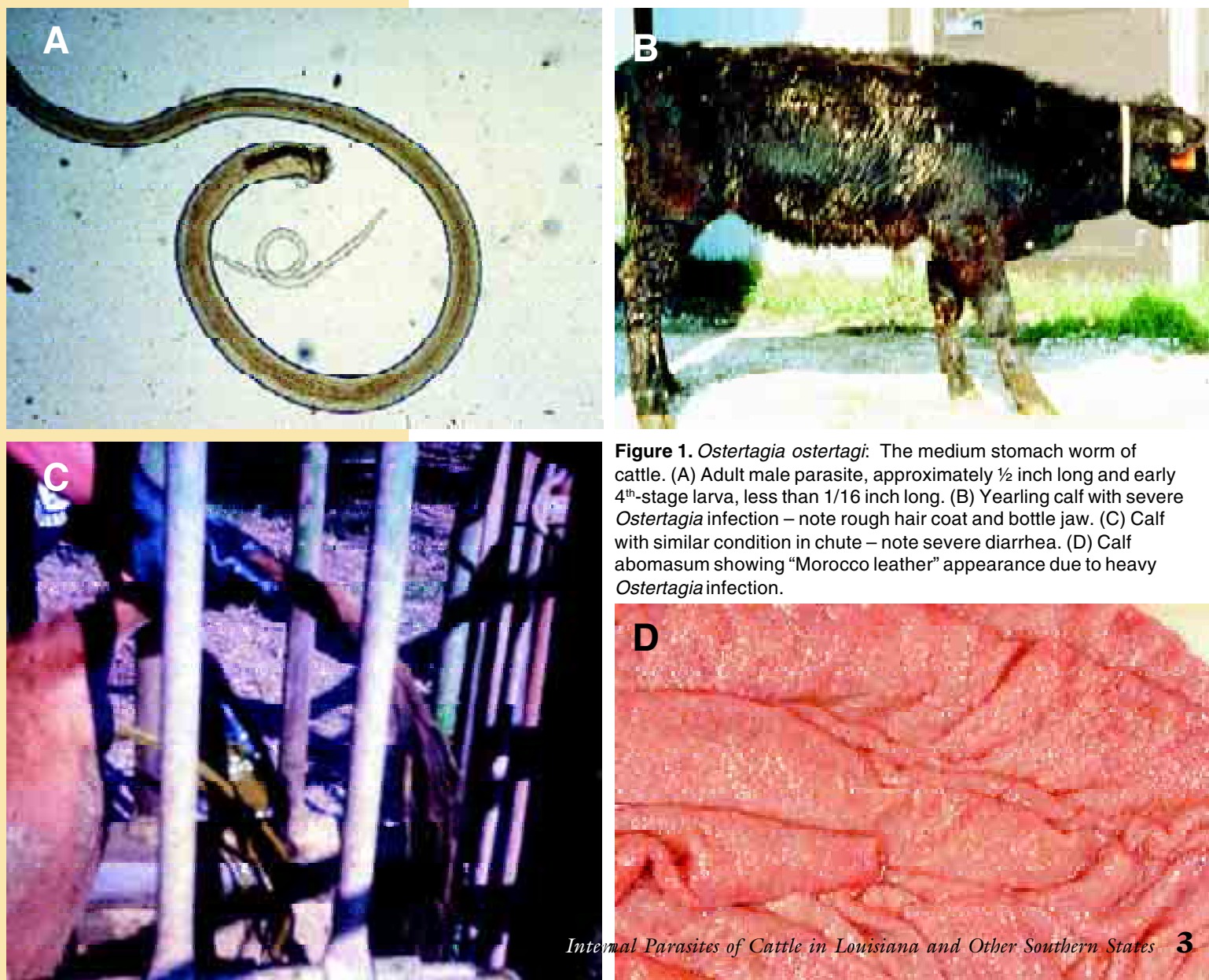


Figure 1. *Ostertagia ostertagi*: The medium stomach worm of cattle. (A) Adult male parasite, approximately 1/2 inch long and early 4th-stage larva, less than 1/16 inch long. (B) Yearling calf with severe *Ostertagia* infection – note rough hair coat and bottle jaw. (C) Calf with similar condition in chute – note severe diarrhea. (D) Calf abomasum showing “Morocco leather” appearance due to heavy *Ostertagia* infection.

trongylus colubriformis, *Nematodirus helvetianus*, *Bunostomum phlebotomum*, the hookworm, *Oesophagostomum radiatum*, the nodular worm, and *Trichuris* sp., the whipworm. The cattle lungworm, *Dictyocaulus viviparus*, is found in the large and small air passages of the lungs. It is the only lungworm commonly found in cattle. The liver fluke (*Fasciola hepatica*) occurs in the liver tissue (larvae) and bile ducts (adults). Nearly all of the worms are rather small and delicate, ranging from a fraction of an inch to more than an inch in length. In contrast, tapeworms of cattle (*Moniezia* spp.) can grow to very large size in the

small intestine but are not known to cause any ill effects.

The prevalence of nematode infections in cattle throughout the region is high. Surveys and other studies of apparently healthy cattle (beef and dairy cows, yearling steers, replacement heifers, and calves) generally reveal infection levels of 80% and greater as indicated by fecal egg counts and post-mortem examination. As mentioned earlier, level of parasitism is greatest in young cattle; adult beef and dairy cattle generally show little evidence of nematode infection or disease unless stressed by nutritional deficiency or other diseases.

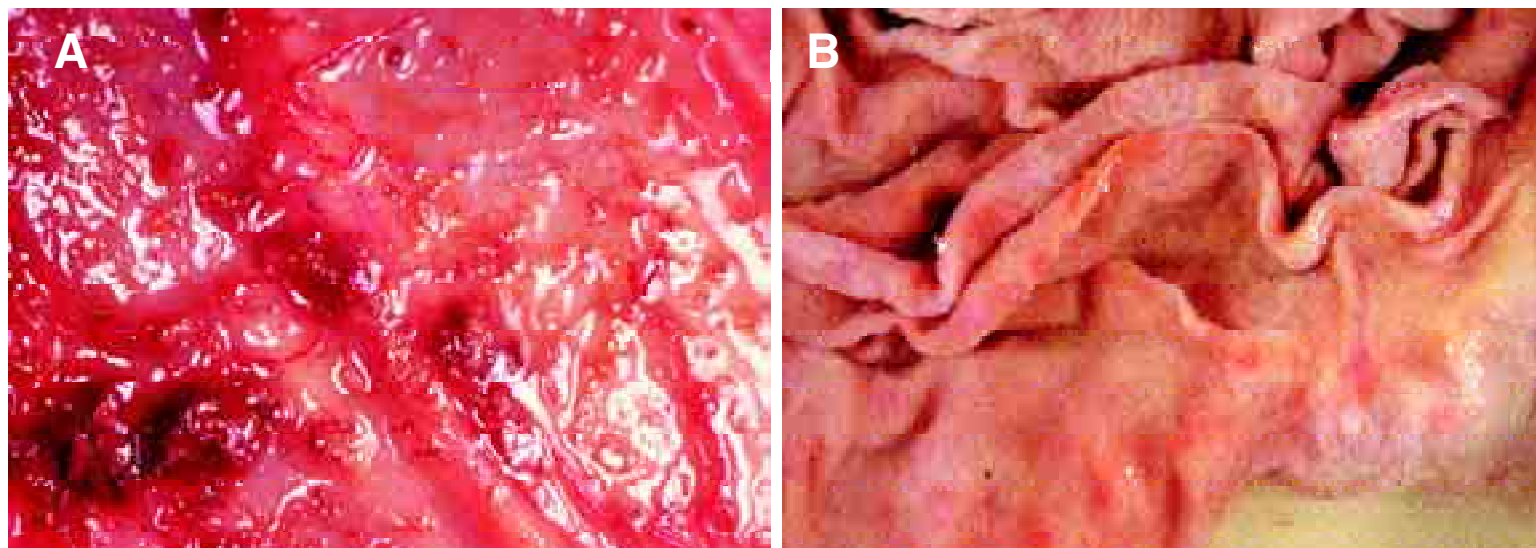
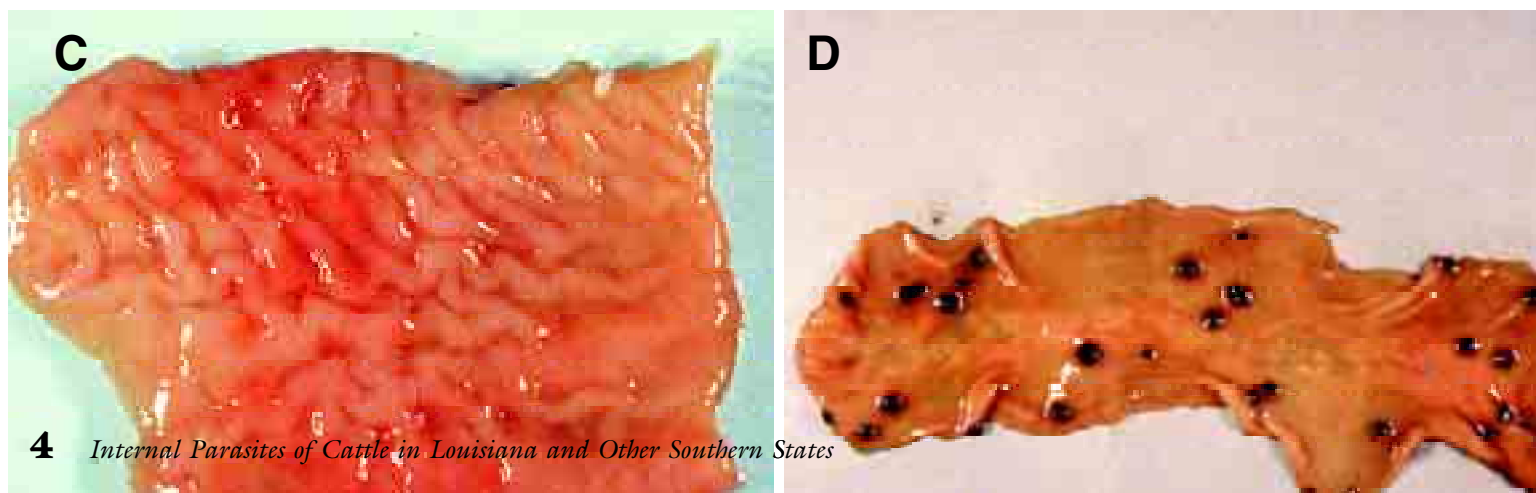


Figure 2. Damage caused by gastrointestinal nematodes in cattle: (A) Hemorrhage caused by large stomach worm *Haemonchus*. (B) Less obvious reddened areas due to smallest of the cattle stomach worms – *Trichostrongylus axei*. (C) Section of duodenal/upper

intestinal tissue showing some slight hemorrhagic condition and thickening of mucosa as caused by *Cooperia* spp. (D) Lower small intestine showing nodules caused by larvae of the nodular worm – *Oesophagostomum*.



Harmful Effects of Internal Parasites in a Cattle Herd

The means by which nematodes inflict damage on the host and consequently cause disease and reduced productivity are not well understood. Different nematodes may penetrate and migrate in tissue, suck blood, or otherwise cause small hemorrhages, cause erosion of surface layers of the gut lining, or incite formation of nodules. The medium stomach worm (*Ostertagia*) can extensively destroy vital digestive cells of the abomasum, resulting in

loss of serum albumin from the blood, reduced acidity, and severe diarrhea. The large stomach worm (*Haemonchus*) is an avid blood sucker as is the intestinal hookworm, *Bunostomum*. Worms in the intestinal tract (*Cooperia*, *Trichostrongylus*, *Nematodirus*) can all cause damage to the intestinal lining when present in large numbers. The lungworm can cause severe disease and deaths primarily from the effects of pneumonia and asphyxiation. Liver condemnation is a major loss caused by damage due to the liver fluke. Besides anemia, serious production losses can be attributed to the fluke

for reasons not clearly defined. Since many of the different types of worms may occur in cattle at the same time, their individual and collective damaging effects are not difficult to comprehend (Figure 2, Figure 3).

For a long time it was thought that the primary effect of nematode infection on the host was interference with digestion and malabsorption of nutrients. Considering the basic digestive and absorptive function of the gut and the mechanical and possible chemical damage inflicted by parasites, the association appeared to be appropriate. Recent evidence has shown that damage and

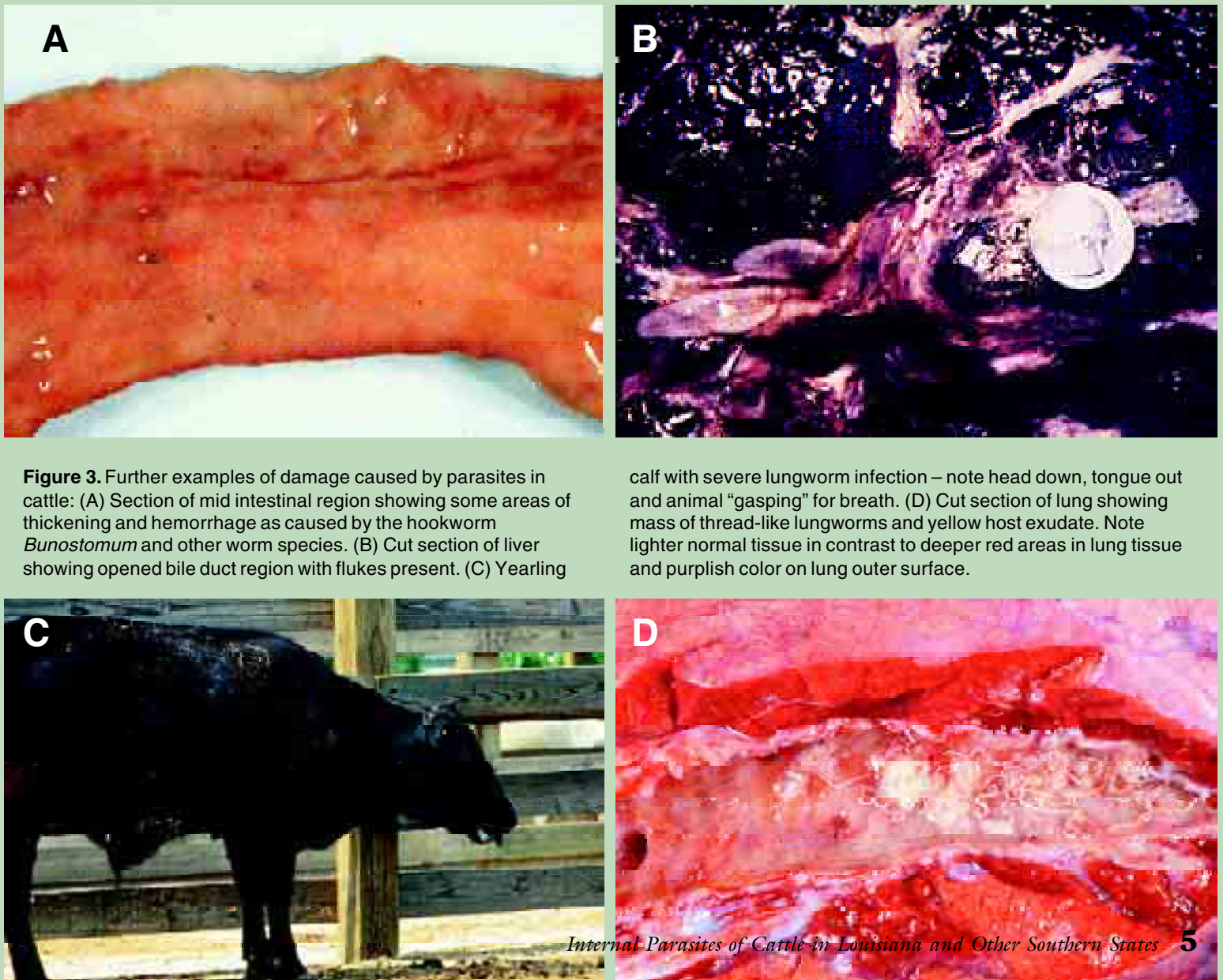


Figure 3. Further examples of damage caused by parasites in cattle: (A) Section of mid intestinal region showing some areas of thickening and hemorrhage as caused by the hookworm *Bunostomum* and other worm species. (B) Cut section of liver showing opened bile duct region with flukes present. (C) Yearling

calf with severe lungworm infection – note head down, tongue out and animal “gasping” for breath. (D) Cut section of lung showing mass of thread-like lungworms and yellow host exudate. Note lighter normal tissue in contrast to deeper red areas in lung tissue and purplish color on lung outer surface.

inflammation of the lining tissue of the gastrointestinal tract results in leakage and loss of blood protein into the gut. Such loss can drastically alter protein metabolism, including muscle growth. A major unexplained effect of infection is loss of appetite. The end result is failure to grow or weight loss (Figure 4). For a number of years in parasite control studies at the Dean Lee Research Station near Alexandria, it has been observed that cattle treated experimentally for parasites graze their pastures more

completely than untreated controls. The aerial photograph shown in Figure 5 demonstrates this difference in pastures. The differences in appearance are due to forage height and availability because of decreased appetite in untreated control cattle. At relatively high stocking rates, treated animals may graze pastures so close that they do not have sufficient forage for optimum weight gain. Animals not treated, on the other hand, may have significantly more available forage and, even

though they need less forage, they have all they want and can reach their performance potential. This can mask some of the differences between treated and non-treated animals. Nematode infections, as well as factors such as forage palatability and toxicity, can also bias forage evaluation studies by affecting forage availability and nutritive value. Replicates of different stocking rates may be necessary to accurately evaluate differences.

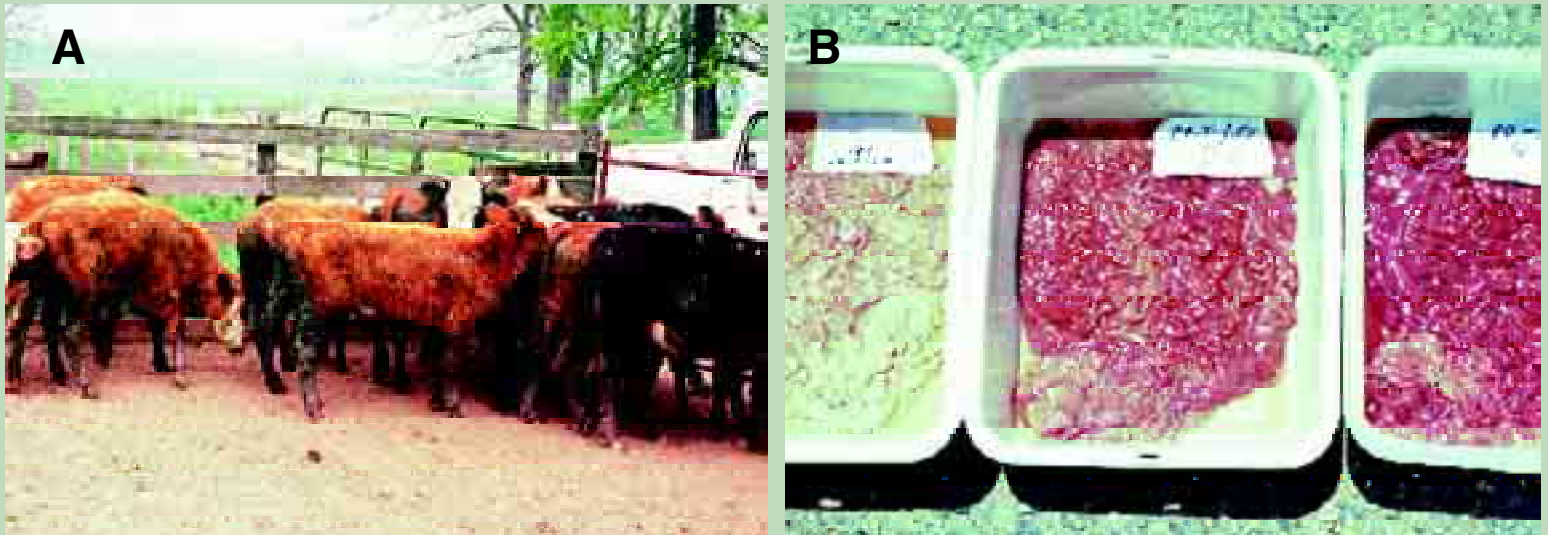
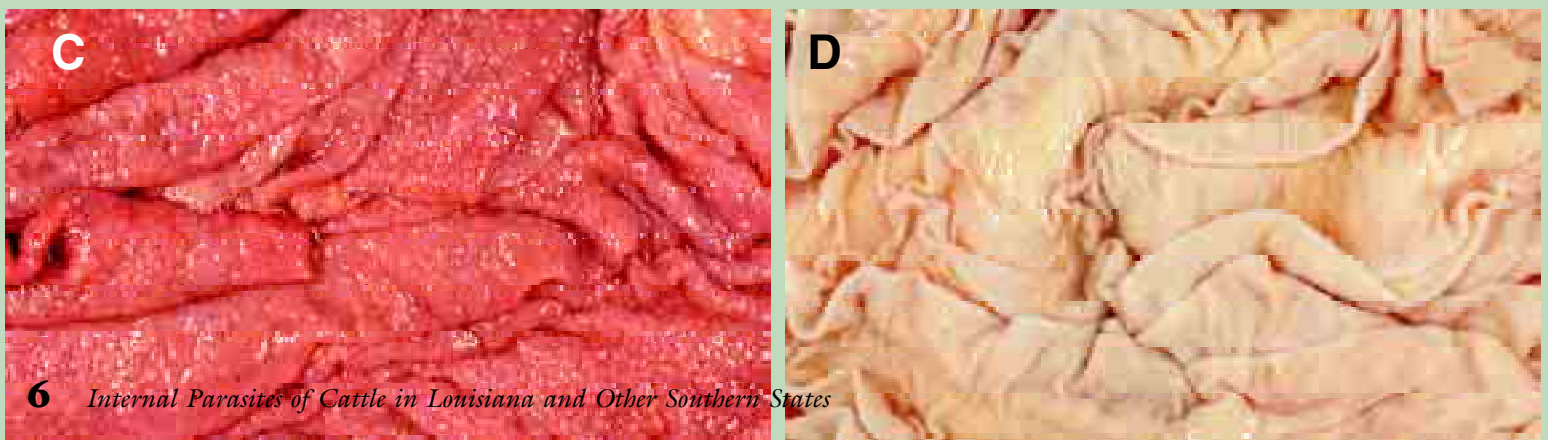


Figure 4. (A) Weaner/yearling cattle during a wet and cold Louisiana winter. Note poor condition, evidence of diarrhea due to parasitism. (B) Abomasum from calves of different treatments in a parasite control field study – abomasum at right end is from an untreated control; the abomasum at left end is from group that received maximal control and grazed on pasture with little infection; the abomasum in center is from a calf that received maximal

control but grazed on pasture with heavy infection risk. Levamisole and thiabendazole were drugs used in this 1982 study, but the major point is effect of pasture management in reducing infection risk. (C, D) Comparison of a severely parasitized abomasum (*Ostertagia*) on left and another from a calf on the right of similar age (early yearling) but not exposed to infection.



Recognition of Internal Parasites as a Problem in a Herd

While all cattle can be expected to have some nematodes in their gastrointestinal tract, it should not be assumed that all or most cattle are adversely affected by clinical parasitism. Clinical parasitic disease is usually obvious; minimal or not so minimal losses in day-to-day productivity caused by small worm burdens are not so obvious. Loss in productivity due to inapparent or subclinical parasitism has not been accurately assessed, but most evidence indicates that it results in greater losses industrywide than clinical disease outbreaks. It might be noted that widespread use of the avermectin/milbemycin compounds (ivermectin, doramectin, eprinomectin, and moxidectin), with their highly efficient anthelmintic activity and persistence, has generally reduced the occurrence of acute parasitic disease outbreaks.

Recognition of nematode parasitism, whether it be a clinical disease outbreak or subclinical inapparent parasitism and reduced productivity in a herd, is a key factor in any approach to prevention and control (Figure 6). The classical signs of severe parasitism such as progressive weight loss, diarrhea, rough hair coat, bottle jaw, and anemia are all too familiar. In many cases, however, it is necessary to rule out the possibility of diseases other than parasitism or deficient nutrition. Effects of roundworm parasites in a herd may go largely unnoticed except with careful observation. Such effects may include inefficient feed utilization, delay in attainment of breeding age (puberty), poor conception rates/pregnancy, depressed milk production, and lighter calves with greater susceptibility to parasitism and other



Figure 5. Aerial photograph of pasture at the Dean Lee Research Station showing effect of treatment for parasite control on appetite in cattle. The four pastures (5 cattle on each 4-acre plot) separated by vertical lines are those of note; pasture on far left is wedge-shaped. Differences in appearance are due to forage height and availability because of decreased appetite of untreated and parasitized control animals. Pastures occupied by treated animals are lighter in color, while the control pastures are darker green, indicating a greater amount and density of forage.

diseases. The producer who sees his cattle regularly can often judge whether such problems exist.

Besides early recognition of parasitism, which can help in reducing further loss and preventing continued contamination of pasture with worm eggs, an evaluation of general management, grazing history, and weather factors is important in determining risk of parasitic infection. Nematode parasitism is closely associated with certain grazing practices, and avoiding or altering these practices can reduce risk. Temperature and rainfall are also clearly related to the danger of parasitic infection under certain grazing practices. Services of a veterinarian are often required to fully understand the nature of a given problem and to achieve a solution. An experienced herd health practitioner can aid producers by

evaluating all factors involved, including clinical signs of parasitism, differentiation of parasitism from other disorders/diseases, deficient nutrition, and the relationship of management and weather factors.

Two techniques that a veterinarian may use to help in diagnosis are fecal examination for parasite eggs and post-mortem examination. Microscopic examination of cattle feces for parasite eggs can indicate what worms are present and may at least suggest levels of parasitism. The post-mortem examination of an animal or animals in a herd that die is the most direct method of determining the kinds of worms present and the amount of damage caused. Observations of the producer and veterinarian in many herds will indicate that worms are a significant burden even though a post-mortem examination is not feasible or incon-

clusive and worm egg counts are low. “Diagnostic treatment” in such cases with an efficient de-wormer or anthelmintic can help to understand and alleviate the problem and ultimately improve overall herd performance.



Figure 6. Cattle nematode parasite eggs and infective larvae. (A) Microscope illustration of a gastrointestinal nematode egg from fecal sample (large object at right center) and to the lower left is a protozoan oocyst (*coccidia*). (B) The picture is “staged” but shows a large number of cattle nematode infective larvae in a droplet of water on a blade of grass – this happens in nature.



Transmission of Parasite Infections to Cattle

Adult male and female worms of the various nematode genera inhabit different parts of the gastrointestinal tract. After mating, female worms produce eggs that are passed out in feces onto the pasture. In the case of the lungworm, eggs hatch in the gut, and first-stage larvae are passed in the feces. Hatching of eggs and development and survival of infective larvae are highly dependent on temperature and moisture. All processes are rapid in warm weather and slowed during cooler weather. High temperature and desiccation in summer and subfreezing temperature in winter can effectively kill off eggs and larvae on pasture, and this often results in reduced parasite transmission during these periods. In addition, hot and alternating wet and dry periods of summer in the region are more adverse to nematode free-living stages on pasture than winter conditions. The basic life cycle of the nematode parasites from the time that eggs are deposited in feces on pasture until infective larvae are available for infection and the parasitic stage in cattle is shown in Figure 7.

Infective larvae of most nematode species on pasture grass are swallowed with forage by grazing cattle. In the case of the hookworm, *Bunostomum*, and the intestinal threadworm, *Strongyloides*, infection occurs when infective larvae penetrate the skin of cattle. This occurs on the lower portion of the legs while animals stand in muddy, fecal-contaminated areas or anywhere on the body surface when animals lie down in such areas. Larvae of the latter two worms travel by the blood to the heart and lungs and then to the intestinal tract where they mature. In the case of the cattle lungworm, eggs hatch in the cattle

intestine and early or first stage larvae are passed in the feces. Development of gastrointestinal nematode larvae to the third or infective stage can occur as quickly as 7 to 14 days on pasture during optimal conditions (warm weather) but may be delayed for several weeks in colder weather. Once larvae reach the infective stage they can survive for several months from fall and winter to spring. This fact clearly emphasizes how large levels of pasture contamination accumulate under poor and sometimes generally good management conditions. Survival is generally shortest during summer.

After infection of cattle, most of the nematode parasites develop to the adult stage in 2 to 4 weeks. Major damage in the abomasum and intestinal tract occurs during the period of larval development to the adult stage. Therefore, with a total life cycle, from egg to egg, requiring about 6 to 8 weeks (2 to 3 weeks on pasture and 2 to 5 weeks in the cow) during much of the year, it is possible for infections to recycle several times during a long grazing season. With constant daily infection occurring in grazing cattle during a grazing season, considerable worm burdens can develop.

The life cycle of the liver fluke is far more complicated than the direct cycle of nematodes. Development of the liver fluke in the free-living environment requires an intermediate host (snail), and the free-living phase requires 10 to 12 weeks before infection can occur. The parasitic phase also requires about 10 to 12 weeks, from time of infection to development of mature parasites (Figure 8). In Louisiana, Texas, and Florida, most fluke transmission occurs between the months of February and July. Moisture surplus and temperatures during this period are most suitable for expansion of snail populations and development of immature fluke stages on pasture. Fluke transmission effectively ceases during the drier months of summer and early fall. By fall, fluke infections in cattle consist almost entirely of mature adults and, consequently, treatment is most effective at this time.

Figure 7(A). Life cycle of gastrointestinal nematodes in cattle. General cycle of nematodes of the stomach and intestinal tract. Developmental time in cattle ranges from 2-5 weeks for most, but up to 8-9 weeks for the hookworm.

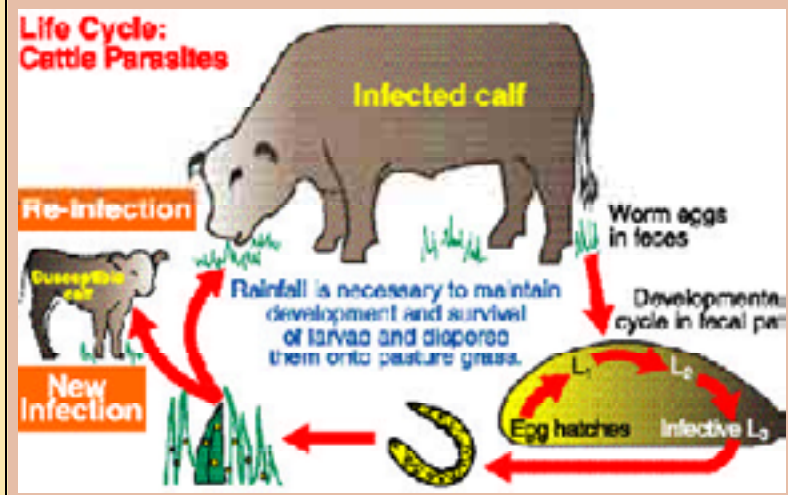


Figure 7(B). Life cycle of gastrointestinal nematodes in cattle. Life cycle of *Ostertagia ostertagi*, including notes on the inhibited larval phase that occurs in spring and summer in Louisiana.

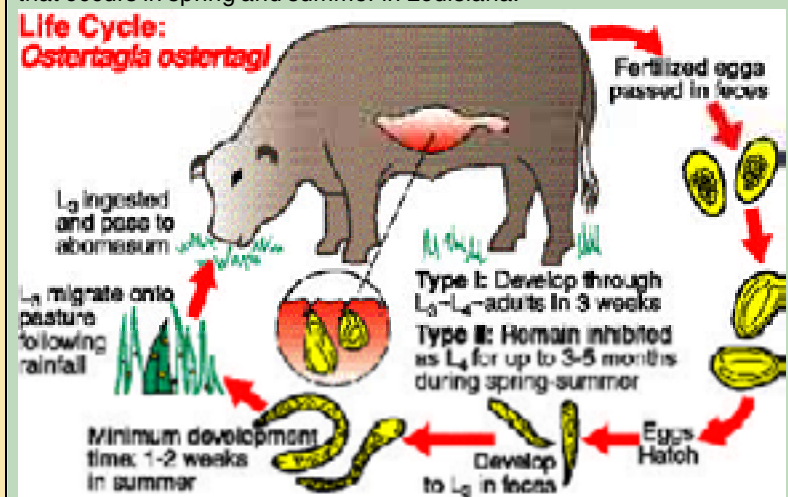
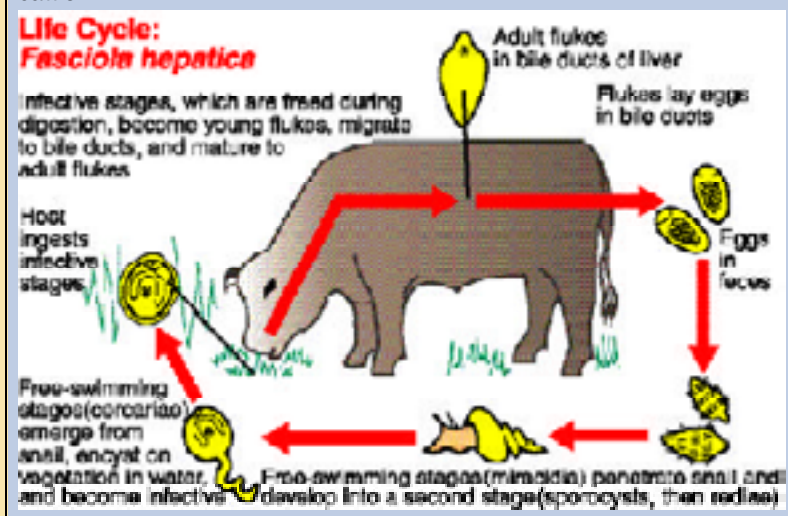


Figure 8. Life cycle of *Fasciola hepatica*, the common liver fluke in cattle.



Inhibition of Larval Development - *Ostertagia Ostertagi*

Throughout the southern region, including Louisiana, the medium stomach worm presents an additional problem, making it unique from the other gastrointestinal nematodes because of a seasonal variation in its life cycle pattern. Weather conditions from late spring through early fall are adverse to survival of infective larvae of this parasite on pasture and, consequently, little or no infection with this parasite occurs during the period. However, the parasite population does not die off but spends the period of adverse weather in an inhibited or arrested early (L_4) larval stage in tissues of the cow's stomach (Figures 7B and 9). The *Ostertagia* infection and disease pattern is closely tied in with age classes of cattle and different seasons.

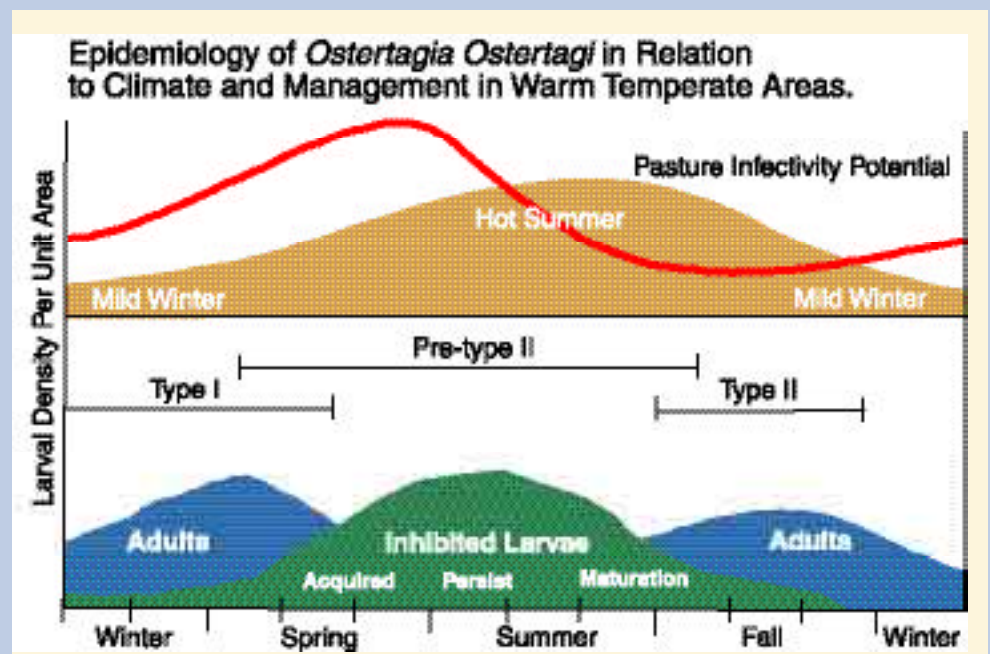
During late fall through winter and particularly in early spring, cattle near weaning age and up to 14 to 16 months of age can be affected by Type I *Ostertagia* disease. This is a time of year that is basically optimal for development and survival of infective larvae on pasture. When infection occurs, the worms develop promptly to the adult stage in the normal time span of about 3 weeks. With heavy infection, the young cattle can be severely affected, showing substantial weight loss. It is also during spring that most of the *Ostertagia* larvae on pasture become conditioned by weather factors to undergo inhibition of development once swallowed by the cow. This process presumably occurs in the several weeks preceding the onset of hot and dry or wet weather of summer that kills off larvae on pasture. During the inhibited state (Pre-type II *Ostertagia*), the larval

worms cause no problems. However, the inhibited worms will begin to mature to adults usually in late August and September, a time when summer temperatures begin to decrease. In the maturation process, the worms increase in size about **tenfold** in a relatively short time, causing massive destruction of digestive tissue of the stomach. This form of *Ostertagia* disease is called Type II *Ostertagia* disease; its harmful effect is similar to but far more serious than Type I disease. Type II disease is seen most commonly from August to October, and usually only a small portion of a herd is severely affected. Yearling steers older than 16 months of age and replacement heifers of similar age are commonly involved. It is not un-

usual to see the condition in older cows and bulls as well. Large numbers of inhibited larvae, accumulated in stomach tissue during spring, can mature at intervals in the fall, causing a long and drawn out disease process that may result in death.

In northern portions of the United States, the inhibition pattern of *Ostertagia ostertagi* is different. Larvae become inhibited in development during late fall grazing and remain in the stomach tissue through winter (Figure 10). As a result, Type II disease occurs from late winter into spring, and Type I disease in younger cattle occurs during summer and fall. In the absence of documented research, the type of *Ostertagia* pattern that exists in various parts of the country

Figure 9. Seasonal pattern of infection risk for gastrointestinal nematodes and lungworm in Louisiana and other warm temperate regions. Major infection risk occurs from late winter into spring, having remained lower or even increased during winter, following lowest levels during summer and early fall. In the case of the stomach worm, *Ostertagia ostertagi*, adult worms predominate in winter and again in the fall, but numbers of inhibited early 4th-stage larvae increase in numbers during spring and remain in glands of the abomasum until they mature to adults in the fall.



remains unknown. In areas such as the central plains and in states across the center of the country from the Mississippi River to the Atlantic, the time and duration of larval inhibition and disease types have not been defined.

A problem in the past has been that older anthelmintics such as thiabendazole and levamisole were effective against adult worms but not against inhibited larvae of the medium stomach worm. These drugs were effective in controlling Type I *Ostertagia* in winter and spring but ineffective in killing inhibited larvae and controlling Type II *Ostertagia*. New and improved anthelmintics are effective against inhibited larvae and will be discussed in a later section.

Prevention and Control of Internal Parasites

Eradication of worms is virtually impossible, but control of worms must be a major component of cattle herd health programs, particularly in the South. The major aim of effective parasite control is to keep infections as low as possible to minimize any interference with production.

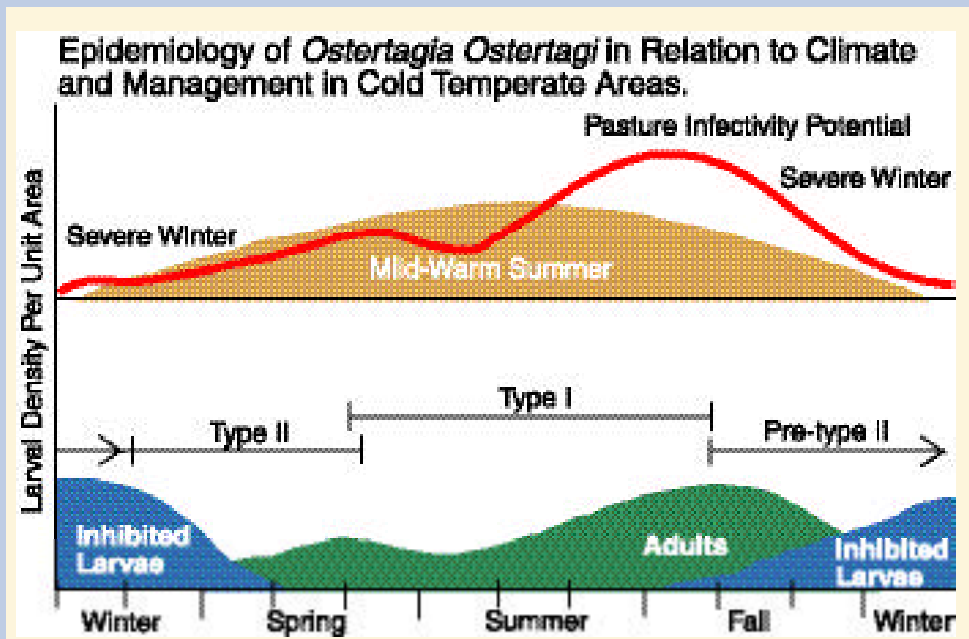
Effective control must be looked upon not as a single approach but as an integration of different complementary components. In broad outline, these components in control systems are grazing management, use of efficient de-wormers, and enhancing the capability of cattle to resist infection.

Grazing Management

Prevention of parasitism is seldom planned into grazing management; however, grazing practices can affect pasture contamination levels and risk of infection. Pastures considered to have lowest levels of parasite contamination should be reserved for younger, most susceptible stock (weaners, stockers, replacement heifers). Reduced pasture contamination (**safe pasture**) can result from the following practices: pasture vacated for several weeks in summer for hay production, pasture grazed exclusively by older dry cows (they produce far less contamination than younger cattle) for several weeks, harvested cropland or rested pasture planted in annual forages, and frequent, but expensive, treatment with de-wormers. The last mentioned means could never be recommended because of inefficiency, expense, and the potential of inducing drug resistance. Since younger stock generally have highest levels of infection and produce heavy pasture contamination, one group of young stock should not follow another such group on the same pasture.

A frequently asked question concerns the use of pasture rotation in parasite control. The truth of the matter is that regular rotation practice in no way reduces infection risk but may increase the risk. A 3- to 4-week rotation allows time for eggs deposited on the pasture during the previous rotation to hatch and develop into infective larvae at about the same time that cattle are reintroduced to the pasture. Abundant, growing forage provides protection for the larvae from weather factors. Cattle in short-duration, rotational grazing programs (2- to 4-day pasture rotation) may consume a high percentage of the available larvae.

Figure 10. Seasonal pattern of infection risk for gastrointestinal nematodes and lungworm in cool temperate regions of the United States. In contrast to Louisiana and similar climatic regions, the seasonal pattern of infection risk is different. Reflecting the effects of winter/snow cover in cool temperate regions, parasite infection is of no significance. However, at the time that cattle are initially turned out to pasture in spring, a small initial rise in infection may be due to infective larvae that have overwintered on pasture. Major time of infection risk begins in mid- to late summer and extends into fall. In the case of *Ostertagia ostertagi*, inhibited early 4th-stage larvae are acquired during late fall and mature to adults in the following spring.



Use of De-wormers in Control

Development of highly efficient, broad-spectrum de-wormers since the early 1960s has been of untold benefit in reducing losses to nematode parasitism in cattle. General characteristics of all major products available to producers since that time are given below:

Early Modern Anthelmintics

Thiabendazole – Merial no longer makes the product

Levamisole, Tramisol – still available, various formulations

Morantel tartrate, Rumatel – in-feed formulations

Benzimidazole Anthelmintics

Fenbendazole, Safeguard, Panacur, (Intervet) oral, block, and in-feed formulations

Albendazole, Valbazen (Pfizer) oral, in-feed formulations

Oxfendazole, Synanthic (Fort Dodge) intra-ruminal injection, oral

Besides efficacy against nematodes, all the benzimidazole drugs have some effect against tapeworms; albendazole provides “aids in control” for liver fluke. Fenbendazole is also available for use in lactating dairy cattle of breeding age. Slaughter withdrawal times for fenbendazole, albendazole, and oxfendazole are: 8 days (oral) and 11 to 13 days (in feed), 27 days and 7 days, respectively. The effective worm killing duration of these drugs is 2 to 3 days. The only drug available for fluke control is clorsulon, Curatrem (Merial).

Endectocidal Products for Endo- and Ectoparasites

Ivermectin, Ivomec (Merial) from 1984, injectable, pour-on, 35- and 48-day slaughter withdrawal, respectively

Ivomec-F or Plus (+Curatrem), efficacy against nematodes, adult liver flukes, and external parasites. Slaughter withdrawal time of 49 days and not for use in dairy animals of breeding age

Ivermectin Sustained-Release (SR) Bolus (Merial), from 1997, prevents infection up to 5 months after single treatment; 180-day slaughter withdrawal time; not for use in dairy animals of breeding age

Eprinomectin, Eprinex (Merial), from 1997, pour-on only, no meat or milk withdrawal

Doramectin, Dectomax (Pfizer), from 1996, injectable and pour-on, not for use in dairy animals of breeding age and slaughter withdrawal time of 35 days for injectable and 45 days for pour-on

Moxidectin, Cydectin (Fort Dodge), from 1998, pour-on only, no meat or milk withdrawal

Persistence of effective drug activity of single doses of ivermectin, eprinomectin, doramectin, moxidectin will range from approximately 3 to 6 weeks.

Prior to 1960, drugs available for parasite treatment were generally not

very effective and, in some cases, were as harmful to the host animal as to the parasites. Some of the compounds introduced from the early 1960s were highly useful and effective in their time, but either they are no longer manufactured (thiabendazole-Merck/Merial) or have fallen

into only sparing use: morantel tartrate-(Pfizer), levamisole (Fort Dodge). Decline of these products cannot be definitively attributed to drug resistance in cattle nematodes, although activity against specific parasites (*Ostertagia*) decreased over time. These compounds were essentially replaced by benzimidazole drugs (related to thiabendazole), released for use in the United States from the late 1970s into the 1980s, namely Safeguard, fenbendazole (Intervet); Valbazen, albendazole (Pfizer); and Synanthic, oxfendazole (Fort Dodge). These products were used extensively for a decade or two and were highly active against gastrointestinal nematodes and lungworm. There was some activity against the tapeworm (*Moniezia*), and albendazole offers some aid in control of the liver fluke (*Fasciola*). All three of the benzimidazole compounds just mentioned are still widely used by cattlemen, all retain good activity against a broad spectrum of parasites, but all three have a common fault of variable efficacy against inhibited larvae of *Ostertagia*.

Beginning in 1984, a new chemical class of de-wormers was introduced beginning with ivermectin. While de-worming products were always termed **anthelmintics**, meaning they killed worms, the new generation compounds were termed **endectocides**, meaning they had powerful activity against both “endo” (internal parasites) and “ecto” or external parasites (lice, flies, ticks, mites, grubs). These products **do not** have activity against liver flukes or tapeworms. Since the development and release of ivermectin (Ivomec) by Merial in 1984, two other similar products were made available for use in 1996 (Dectomax, Pfizer) and 1998 (Cydectin, Ford Dodge), respectively. Additionally, in 1997, Merial introduced an exclusively

pour-on product called Eprinex (eprinomectin), which is related to ivermectin but has no meat or milk withdrawal period and is approved for dairy cattle. Merial also in 1997 introduced its ivermectin sustained-release bolus (SRB), which can prevent infection with nematodes for up to 5 months. While the older products were purely synthesized chemicals, the new generation, endectocidal compounds have been derived from bacterial/fungal organisms by fermentation and further manipulated chemically. A major characteristic and advantage of the new generation products over older ones is persistence of anti-parasitic activity. While killing action of the benzimidazoles (fenbendazole, etc.) extends maximally for about 3 days, activity of the most current products may extend from 3 to 6 weeks, and as noted for the ivermectin SRB, up to 5 months. This is a major advance in efficiency of a single treatment, that is in preventing pasture contamination, particularly when coupled with some grazing management procedure to further limit reinfection.

The modern de-wormer products, especially the newer generation of endectocidal compounds, are well suited for timely strategic treatments based on their overall high efficacy and killing activity, which lasts for 3 to 6 weeks. In some instances, a single treatment with these products is fine. In most cases, however, at least two treatments, spaced approximately 8 to 12 weeks apart, for example for stocker calves grazing on winter pasture, is recommended. The ivermectin SRB, which costs approximately three times as much as a single treatment with ivermectin injectable or pour-on, is capable of protecting cattle from infection completely during the southern winter-spring grazing season.

Systematic or Strategic Use of De-wormers

In spite of all of the advances in evolution of anthelmintic technology, there has remained a large tendency among producers to consider de-wormers as the sole or major means of control, sometimes to the exclusion of overall good management and constant provision of good nutrition. To some extent this policy has been fueled by those selling de-wormer products, with little concern being given to timing of treatments and other means of reducing infection risk in specific geographic regions. The primary purpose of de-wormers is **not to cure sick animals**, whether mildly or severely ill, but to reduce levels of pasture contamination and consequently prevent such episodes of illness or reduced productivity. Reducing pasture contamination with eggs/larvae is most effectively accomplished by some **systematic** timing or strategic use of de-wormers, tied in with management, such

as a comprehensive herd health program. It is essential when information is available that treatment timing be meshed in with seasonal prevalence of infection risk. With irregular treatment, or at times when the herd or individuals in the herd look like they need treatment, it is already too late. This essentially is a waste of time, labor, and cost of the drug and only serves to prevent deaths or further deterioration of cattle condition.

The advantage of systemic use of de-wormers or strategic treatment is that it can be timed to mesh with some management procedure such as change of pasture. Also, de-worming might be done at the beginning of a period such as summer, when hot and dry weather is most destructive to eggs/larvae on pasture. The de-wormer, along with management and weather, can be very efficient in cutting down losses to parasitism. The widely used spring and fall treatment has much merit in that it removes the large worm loads that can be acquired at these times and



Parasite control study with cow/calf herd on rolling pastures at the Hill Farm Research Station, Homer, Louisiana.

delays and reduces pasture contamination. Treatment of all cattle a day or two before going to pasture of low infection risk is a must. Treatment at any time of year is most effective when the cattle do not return to heavily contaminated pasture and rapid reinfection. It should be remembered that although the newer endectocides have extended or persistent activity, they are not like vaccines with unlimited protection time.

One can make decisions as to priorities on what product to use under different circumstances, that is routine use of the best possible product for calves at the most critical times such as at weaning time or use of a less expensive and active product in adult stock for primarily preventive or prophylactic purposes. Producers who do treat cattle for internal and external parasites have traditionally done so in spring and fall. This practice is associated with those times when the herd was worked for processing new calves in spring and weaning, pregnancy checking, and other procedures in the fall. There is a great deal of merit in de-worming on these occasions, and deviations from the pattern are rare except in cases where emergency treatments may be warranted. Even though these treatment times are convenient and apparently most practical, they are **not** necessarily the most efficient and cost effective times to prevent and control parasitism.

A key word in parasite control is prevention, preventing the dangerous buildup of larval contamination on pastures that can lead to subclinical parasitism (the unseen variety in which productivity is lost) and clinical parasitism, which can cause great productivity losses and deaths. It has long been considered that most effective and rational prevention and control of parasitism must be based on epidemiology of the

parasites or the seasonal population dynamics of the worms in cattle and on pasture in relation to weather factors and management conditions. Such information must be known for specific regions; it is known and available for Louisiana and other south-central and southeastern portions of the United States. On this basis the most appropriate or strategic times for de-worming treatment of cattle in different age classes can be selected. Knowledge of the epidemiology of nematode parasites is also important in being able to judge what pastures are of high or low levels of pasture contamination in different seasons.

Strategic de-worming means that cattle are treated at specific times in which maximal effects can be derived. Some particular dates for treatment may appear to the producer to be inconvenient, impractical, or impossible. However, most epidemiologically correct treatment times should coincide with periods in which de-worming is provided with other management procedures.

Cattle of all ages are exposed to the same nematode infectivity potential during the course of a year. The actual numbers of larvae involved in such seasonal changes, however, will vary from high, under poor management conditions, to low under conditions of good management and parasite control. Basically, under poor or good parasite control measures, highest rate of infection begins during late fall and increases to peak levels in spring. Keep in mind, however, that with good parasite control, numbers of larvae and effects of parasitism are reduced. As indicated earlier, young cattle up to a few months post-weaning are susceptible to Type I *Ostertagia* disease, and yearlings, replacement heifers, and older stock are affected by Type II disease. Infection with the medium stomach worm does not

always result in outright disease, but with heavy infections, disease problems may be severe.

Regardless of the susceptibility of the young or resistance of older cattle to infection, all age classes of cattle are subject to the same yearly patterns of infection risk. In essence, considering late summer/early fall as a starting point, when infection risk is lowest, the prime or first step is to administer de-worming treatment for preventing the expected increase of infection risk from late winter through spring. Waiting for the traditional spring treatment time, mid-March to mid-May, can be a little late in achieving most efficient prevention of the spring pasture infectivity peak. Consequently, a second treatment at 8 to 12 weeks after the fall treatment, in January or February, would be recommended.

Improved Cattle Resistance to Parasites Through Management and De-wormers

Up to a year of age cattle develop little resistance to worm infections, but after this they can develop resistance to several worms and their effects. The best possible level of nutrition is a key factor in providing for development of resistance. Fertilization, weed control, use of best adapted forages, and maintenance of stocking rates to keep forages maximally harvested, provide excellent nutrition. Use of de-wormers at strategic times which reduce pasture contamination can substantially reduce infection rates and enhance cattle resistance to infection.

Drug Resistance in Cattle Nematodes

Drug resistance in nematode parasites of sheep and goats, including resistance even to new endectocidal compounds, has become a major worldwide problem, most notably in Australia and New Zealand, but also in South America, Europe, Africa, and the United States. Increasing evidence for its existence for some nematode parasites of horses has been reported, and drug resistance for some worms of swine has been observed in Europe. **There is little evidence to support drug resistance in cattle nematodes, but experts in this field warn of the potential for it to occur.** In the last decade or two, there has been only the occasional report about one species of worm or another being resistant to effects of a particular drug. In recent years, there have been several reports of cattle nematodes being resistant to benzimidazole drugs as well as to endectocides in New Zealand. This is a very localized situation and may relate to management and treatment frequency.

Cattle, for the most part, are not managed as closely and intensively as sheep. Most notably, cattle have never been treated for parasites at the frequency sheep are treated. It is generally agreed that cattle nematodes have a genetic makeup similar to those of sheep for drug resistance selection. However, there are a number of complex factors involved besides treatment frequency, such as general differences in management of cattle and sheep, differences in grazing behavior, and differences between rapidly disintegrating sheep fecal pellets and the larger, more compact, mass of cattle feces.

A large percentage of cattle on farms or ranges, especially very small herds, may never be treated for

parasites. In some instances treatment may be given once a year. In such cases, conditions for resistance selection would be essentially nil. However, in some cases, where multiple treatments may be given in the same year to cattle in a closed herd, conditions for drug resistance could be increased. Recommendations for strategic treatments call for two or three treatments per year, particularly for cattle from weaning through 16 to 18 months of age. This level of treatment, if deemed affordable, feasible, and profitable, should not enhance development of drug resistance. Availability of the newer endectocidal products with persistent anthelmintic activity could allow for only one or two treatments per year in young cattle. In the case of the ivermectin SRB only one treatment should be given to young cattle. Drug resistance in cattle nematodes is not a problem, per-

ceived or real, but the potential exists with overuse and indiscriminate use of de-wormer compounds. There is a general tendency today that increased numbers of cattle are being treated more frequently than before because of ease and convenience of modern drug formulations, for example injectables and pour-on products. If two or three treatments are given to the same cattle in a year, it would be appropriate for one of the treatments to be with a drug of a different chemical class from that of the other two treatments, for example fenbendazole for one and an endectocide for the other two.

Costs to industry to develop new drugs, chemicals, or other parasite control agents and bring them to marketing are astronomical. It is therefore imperative that the high efficacy of today's excellent de-wormers be protected as much as possible through judicious use.



Yearling cattle on 5-acre pastures in worm control experiment at the Red River Research Station, Bossier City, Louisiana.

Treatment Recommendations

The question of treatment recommendations for prevention and control of gastrointestinal nematodes of cattle is one that requires consideration of many factors. Under the climatic conditions of Louisiana and other states along the Gulf of Mexico, which are highly favorable to parasite propagation through most of the year, it is not a question of whether to treat, but when are the best and most economically beneficial times for treating cattle. Some of the factors that must be considered are type and level of management of forage and cattle, history of problems with parasite infections, the large variety of available anthelmintics or dewormer products that vary in formulation or means by which they are administered (drenches, injectables, pour-ons, boluses, in-feed medication), spectrum of efficacy against internal and external parasites, cost, and overall herd health objectives of the producer.

There are probably a few producers who never treat their cattle for internal parasites, while a few others may treat on a salvage basis only when parasite problems are obvious or suspected. A majority of producers probably treat for internal parasite control at least once a year. Many may follow the traditional practice of herd treatment during spring and fall. Information about treatment for internal parasites may be obtained by producers from several sources, including veterinarians, university extension personnel, drug company representatives, agricultural consultants, friends, television, magazines, and other media. More often than not, specific or general times of treatment are not included with recommendations for a given product.

Research on nematode parasites of cattle over many years in the Louisiana Agricultural Experiment Station at northern, central, and southern locations in the state has indicated that weather conditions of October through May provide optimal circumstances for development and survival of nematode free-living stages or high infection risk on pasture. Therefore, it is this period that must be the focus of prevention and control programs. The period is very long and coincides with best forage production on pasture, that is winter annuals and spring growth of perennial forages such as bahiagrass and bermudagrasses. Under these conditions, a single treatment of cattle in the fall is generally not sufficient to protect them from increasing reinfection for the entire winter-spring grazing season. The exception to this would be treatment in fall with the ivermectin SRB.

Among the different cattle age classes, stocker calves and replacement heifers require the most attention regarding parasite control programs. From the time of weaning, these cattle are expected to make maximal gains. Recommendations were, and remain, that such cattle require two or possibly three treatments with benzimidazole drugs, fenbendazole, albendazole, or oxfendazole, to adequately protect them from the time of weaning in the fall through spring of the following year. Such treatments are warranted at weaning in September-November and again in the spring (April-June). A third and possibly optimal treatment time is late winter (February-March). With the short-term killing action of the benzimidazole drugs, length of the winter-spring grazing season and general favorability of weather conditions for parasite propagation, the multiple treatments are necessary to achieve an adequate level of parasite control

in stockers and replacement heifers and to reduce pasture contamination. Three treatments with benzimidazole drugs at 4- to 5- week intervals from the time of weaning might be substituted for, and achieve the same level of control as, the treatment levels spaced at two to three months apart. With the newer endectocide products and their persistence of anthelmintic activity, frequency of treatments is reduced. As indicated earlier, the worm-killing activity of the endectocides extends for 3 to 6 weeks, rather than the 2 to 3 days for benzimidazoles. Endectocides for winter-spring control could thus be given to stockers and replacement heifers at weaning and 10 to 12 weeks later for effective protection and control through spring (Figure 11).

The following treatment recommendations should be appropriate for most cattle enterprises in Louisiana and south-central and southeastern sections of the United States.

Mature Cows

July-August: Most effective time for removal of parasites and reducing rate of infection. During the heat of summer, treatment can remove adults and larval stages of nematodes including *Ostertagia*-inhibited larvae. Thus, parasites in the cattle are removed at a time when hot and dry or alternating wet and dry conditions act to kill parasite eggs and larvae on pasture. Potential reinfection is greatly reduced after the summer treatment and can have lasting effect well into fall, if the cattle are not placed on a contaminated pasture. If mature cows are to be treated only once a year, this is the best time to do it.

In areas of liver fluke prevalence (bottomlands of Mississippi and Red rivers and coastal marsh areas), treatment may be moved forward to late August to allow flukes acquired

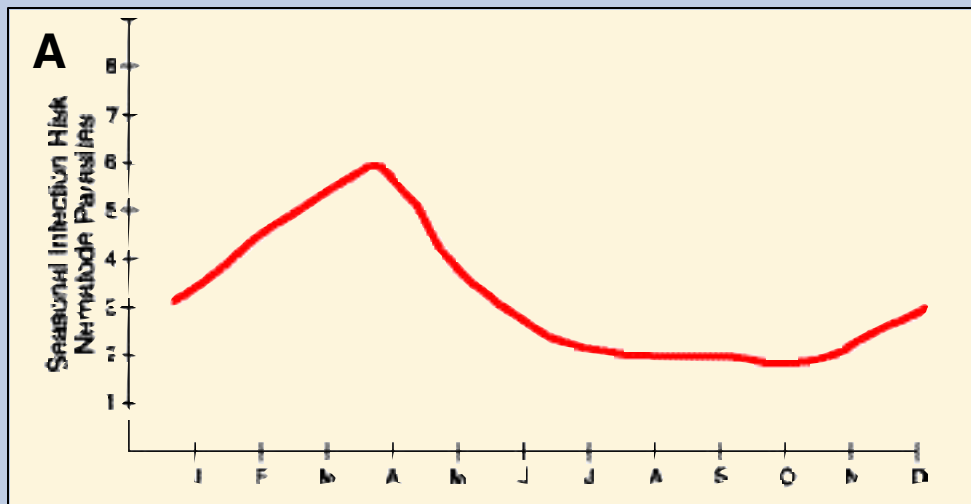
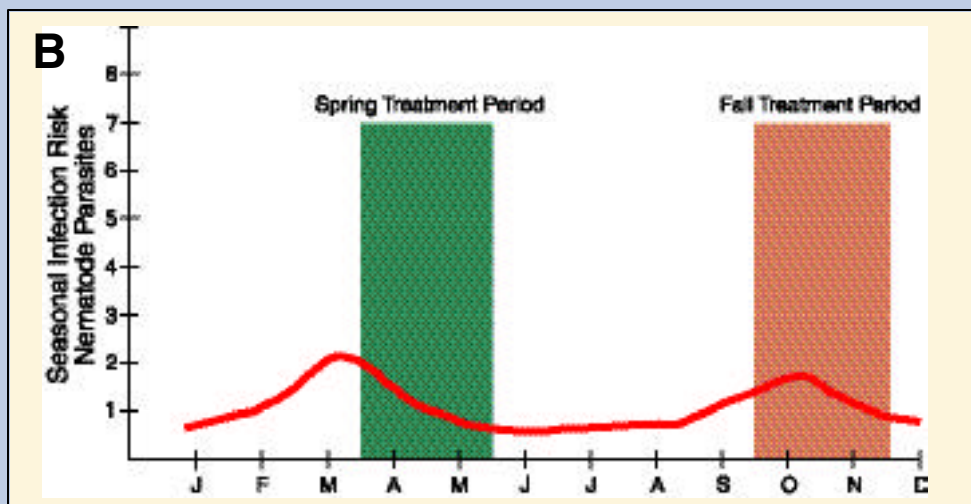


Figure 11. Seasonal pattern of infection risk with gastrointestinal nematodes and lungworm of cattle. (A) The natural seasonal infection risk pattern with nematode parasites in Louisiana. Peak levels occur from late winter into spring, decrease in the warmer months, and begin to increase again in the fall. (B) Effect of anthelmintic/de-wormer treatment as commonly used in the spring and fall. Parasite infection is not eliminated totally, but it is greatly reduced, and profit should be realized rather than economic loss.



in the previous spring to reach a maturity level that will ensure effective treatment. Treatment with any of the pour-on endectocides at this time would control cattle grubs and lice and provide some short-term reduction in horn fly populations. Spring-born calves, of which the producer plans to retain ownership, can be treated for nematode parasites at this time also and given routine calfhoo d vaccinations. The calves would be treated for parasites again at weaning and given booster vaccinations. Calves, generally, would not require treatment for flukes at this time.

January-February 15: Elimination of parasites when cattle are most likely to be stressed. Treatment at this time removes parasites and should help in reducing susceptibility to infection when animals are already under nutritional, environmental, and gestational stress. This treatment would also reduce pasture contamination levels, which otherwise would be available to infect fall-born calves with mother cows or spring calves that would soon be born. Fluke and external parasite control could also be affected as indicated for the July-August treatment.

September 15-November 15: Traditional fall treatment. This treatment time is usually more convenient than the two indicated earlier because it usually coincides with weaning for spring born-calves. Nematodes, flukes, and ectoparasites can all be controlled by treatment at this time. However, *Ostertagia*-inhibited larvae (from accumulation in cattle during spring-summer) would have largely matured to egg-laying adult worms in August-September, and fluke infections may have been transmitted with mild and wet fall weather. Thus, before this treatment, there would be some interval of time in which these parasites could have some ill effect on the cows and also produce more pasture contamination and increased infection risk for new calves.

February 15-April 1: Traditional spring treatment. This treatment is usually given prior to the breeding season. Again, this is a more convenient time for many producers who may have to schedule work around row-crop farming or other non-livestock enterprises, but it is not the best time for parasite control. Treating at this time will remove parasites from the cattle, but the parasites have had all fall and winter to adversely affect the cows and contaminate pastures with eggs/larvae. If this is the only annual treatment to be given, very high parasite populations can have accumulated in animals and on pasture, the latter posing a significant infection potential for new spring calves or fall-born calves. Treatment at this time, in combination with a late summer or fall treatment, can be a very effective parasite control program. However, if the only annual treatment is given early in the year, it is not the time to get the most benefit from dollars spent on parasite control.

Calves

All calves that will be retained by the producer should be treated for parasites and given regular calthood vaccinations at 2 to 4 weeks prior to weaning. They should be re-treated for parasites and given booster shots of appropriate vaccines at weaning.

Whether calves are sold at weaning or retained for herd replacement, most producers probably do not treat nursing calves (3 to 6 months old) for parasites prior to weaning. Spring-born calves would generally not begin to acquire nematode parasites in any substantial numbers until they are 2 to 3 months old. Older calves likely pick up more infection than calves born later in the calving season. Infections in the spring-born calf can build up to sizeable numbers by June or July and would usually be highest near time of weaning. With calves to be sold or retained after weaning, treatment for nematodes in June or July can result in substantially better and cost-effective weaning weights than without treatment.

Replacement Heifers

Spring-born heifers treated at weaning in October or November with an endectocide and flukicide and put on a relatively clean pasture or one of low infection risk should be sufficiently protected from nematode and fluke infections until after the first of the year. Treatment again with an endectocide and flukicide in late February or March should ensure that the heifers enter the breeding season with low levels of parasitism. Treatment when bulls are removed from the breeding herd in July should effectively remove mature and immature worms, including inhibited larvae of *Ostertagia*, and also reduce ectoparasite populations. One treatment with the long-acting ivermectin SRB could be substituted for the last two sug-

gested treatments, in February-March and July. Following a treatment shortly before the calving season, the heifers should be ready to go on the regular herd treatment schedule.

Whether spring-born or fall-born, both first- and second-calf heifers remain highly susceptible to nematode and fluke infections and their effects. This may be more obvious in first-calf heifers, but in many instances, it may be considered that the second-calf heifer is mature enough to have developed resistance to infection. On the contrary, while still nursing her first calf and being in gestation with the second calf, this young cow is highly susceptible to nematode infection and should be protected from effects of parasitism just as done for the first-calf replacement.

Fall-born heifers, which should be treated for parasites at weaning in June or July and put on clean pasture, may not require treatment again until just before the breeding season in December or January. Treatment again at the end of the breeding season in March or April would probably be cost effective because this is during the peak transmission period. Treatment with the ivermectin SRB in November could effectively be substituted for the latter two treatments. A treatment with one of the endectocides in July would allow the heifers to enter the calving season with relatively few internal and external parasites. After these heifers have calved, the regular cow-herd treatment schedule should be appropriate for them, subject to the caution indicated above for the second-calf heifer.

Stocker Calves

All newly acquired stocker calves should be given all appropriate vaccinations and treated with an endectocide as soon as possible after

they are received to prevent introduction and spread of infectious disease and contamination of pastures with nematode parasites. Home-raised calves should receive these treatments prior to weaning as mentioned earlier. Since the primary objective of a stocker program is to convert forage to pounds of calf weight, as economically as possible, a comprehensive plan for parasite control should be a major part of the program.

Spring-born, fall-weaned calves that will be grazed on winter-spring annual pastures can be allowed to carry low levels of parasitism prior to going on the fresh forage. They should be treated with an endectocide 2 or 3 days before going on the winter pasture. Thus, the calves will have potential to make excellent gains when the forage is available for them to reach that potential. A second endectocide treatment at 60 to 80 days into a 120- to 150-day grazing season would in most cases be economically feasible. Treatment with the ivermectin SRB when the calves go on winter pasture could be substituted for the two treatments just indicated. If grazing is to be continued on summer forages after the winter pasture is depleted, another treatment with an endectocide would be beneficial when the transition is made, in May or June.

Fall- or spring-born calves that are overwintered on hay and stubble and then grazed on warm-season perennial pasture in spring can be allowed to carry low levels of parasitism during winter. A great deal of risk, however, is involved in this. Nutritional deficiency and adverse weather conditions could exaggerate effects of existing nematode infection, help to propagate new infection risk, and possibly result in clinical parasitism. If this type of management is the only option, treatment at



This is not Wisconsin or Nebraska, but yearling cattle in a worm control experiment feeding on a rolled out round bale of Bermudagrass hay at the Red River Research Station, Bossier City, Louisiana.

the beginning of the wintering period with a lower cost, short-duration anthelmintic could be economically beneficial, especially if the cattle can be provided with pasture not heavily contaminated with parasite eggs/larvae. Use of a longer acting endectocide would obviously offer more benefit. Depending on the supply and quality of hay and winter weather, such cattle may require another treatment in late winter. When summer perennial pasture is ready for grazing in spring, the cattle should be treated with an endectocide.

Regular or fixed treatment programs or schedules should be developed and followed for adult cows. Schedules for young grazing cattle are more difficult to develop. Weather conditions, forage availability, levels of infection risk, and other factors vary from year to year. Therefore, control programs for stocker and replacement heifer calves

have to be more flexible. The objective is to have the cattle ready to make the most use of forage that is available. When available forage can provide enough nutrients to produce rapid calf gains, the calves need to be as free of parasites as possible to take full advantage of the forage.

Dairy Cattle

These recommendations have been written primarily with the beef producer in mind. All general principles in this publication, however, have direct application to dairy cattle. All of the internal parasites in dairy cattle are the same as those in beef cattle, and the life cycles and seasonal dynamics of the parasites in relation to climate are the same. Some of the differences in management of beef and dairy cattle have to be considered, but essentially the treatment recommendations already discussed would be applicable, especially for calves and replacement

heifers. Treatment restrictions for dairy cattle of breeding age, regarding withdrawal time for milking, are indicated on product labels. Safe-guard, Eprinex, Cydectin, and Rumatel are approved for use in lactating dairy cattle.

Anthelmintics and endectocides indicated for use in parasite control have efficacy against the full spectrum of nematode parasites including the cattle lungworm and *Ostertagia*-inhibited larvae. In the United States, we are limited to only two products (albendazole and clorsulon) with efficacy against the liver fluke; the activity of these products is largely limited to adult flukes. Although the tapeworm (*Moniezia*) of cattle is not known to cause any significant adverse effects, some producers may wish to treat for this parasite. The newer endectocides have no activity against the tapeworm, but the benzimidazole anthelmintics do have some level of activity in removing tapeworms.



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