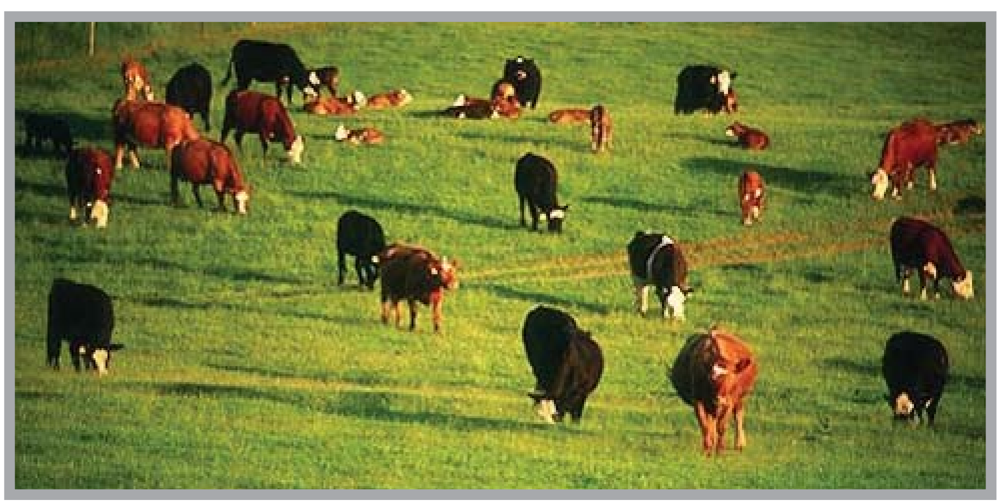
All Grazing Cattle are Economically Impacted by Gastro-Intestinal Parasites

Dewormng Beef Cattle Has Evolved to Standard Recommended Practice

Deworming beef cattle has evolved over the past 10 years to become a standard recommended practice on most progressive cow/calf and stocker operations throughout the U.S. The emphasis on the economic benefits of deworming has brought about this change. Beef producers recognize the value of deworming as a tool to greatly improve the efficiency and quality of their animals. Each year, more and more producers are deworming their cattle at strategic times of the year to prevent economic losses caused by parasitism rather than waiting until after the cattle are harboring high levels of parasites and parasitic damage to the animals has already occurred.

Progressive producers are concerned about deworming at the optimal time to achieve maximum benefit. These producers appreciate having highly efficacious formulations that are safe, easy to apply and trust that the advertised efficacies of the dewormers they use are accurate. Progressive producers have discovered that an aggressive strategic deworming program conducted on an annual basis will keep parasite burdens low throughout the year allowing their animals to look and perform better. Strategically dewormed animals have been shown to produce more milk, have improved feed efficiency, increased dry matter intake, improved reproductive efficiency, produce higher carcass quality, obtain higher body condition scores and have a stronger immune system to fight off other diseases. Gastro-intestinal parasites both directly and indirectly affect the animals in a number of ways. Animals are harmed by adult parasites living within the animals themselves but also through daily ingestion of infective larvae that begin attacking the animal's immune system as soon as the infection process begins. The key to parasite control involves preventing parasite build-up in the animals and their environment through strategical timed deworming programs. This is preferred rather than waiting until the animals are harboring high levels of parasites to treat. Often times waiting until the animals appear parasitized before deworming, means that parasite damage has already occurred before the deworming is instituted.

Research conducted on the benefits of strategic timed deworming programs has been shared with veterinarians, nutritionists, feed companies representatives, and producers.[4, 8, 9, 21, 33] A number of companies have created FDA approved formulations that facilitate the ease of deworming for the producer. These formulations include many non-handling forms such as medicated blocks, medicated free-choice minerals, medicated range cube or cake supplements, medicated complete feeds and top-dressed feed formulations as well as topically applied pour-ons.[3,10,12,19.]



Prevent Economic Loses With Strategic Deworming

Strategic Deworming Entails More Than Simply Applying a Dewormer:

The goal of strategically timed deworming application is to prevent economic loss and reduce environmental parasite contamination by eliminating worm egg shedding for a period of time at least equal to the life cycle of the parasites removed.[1, 5, 16, 17, 18, 26, 27] The timing of the deworming is very important in relation to the season of the year, type of grazing programs practiced and the overall management goals of the operation. The success or failure of these strategically timed programs depend upon a number of factors, of which, one of the most important is being the ability of the dewormer to effectively stop parasite eggs being shed back on the pastures, especially during the early part of the grazing season. If the dewormer fails and cattle continue to shed worm eggs back on the pasture following treatment, the benefit for pasture clean-up is greatly reduced or, in many cases, eliminated.

The Economics of an Aggressive Deworming Program:

In the study below, performance data of yearling cattle dewormed strategically on pasture and then re-dewormed upon arrival in a feed-yard were compared with non-treated cattle over the same period. This data demonstrated that parasites adversely affected all parameters measured including weight gain, feed conversion, carcass quality and health The strategically

Table 1: A recent "grazing through feedlot deworming performance trial[32]" demonstrated that Safe-Guard®/Panacur® (fenbendazole) given strategically had a significant production advantage compared with non-dewormed cattle as follows:

Parameters	Treatment Group		Deworming Advantage
	Non-dewormed cattle	Dewormed cattle*	
Weight gain on pasture	110.0 lbs.	158.0 lbs.	+ 48.0 lbs.
Avg. daily gain on pasture	0.93 lbs. / day	1.34 lbs. / day	+ 0.41 lbs. / day
Weight gained in feedyard	486.0 lbs.	536.0 lbs.	+ 50.0 lbs.
Avg. daily gain in feedyard	3.85 lbs. / day	4.46 lbs. / day	+ 0.61 lbs. / day
Feed-to-gain conversion	5.75 lbs. / lb. gain	5.42 lbs. / lb. gain	+ 0.33 lbs. / lb gain
Total weight gained	596.0 lbs.	694.0 lbs.	+ 98.0 lbs.
Percent choice	29.0 %	55.2 %	+ 26.2 %
No. of animals that died	4	0	100% improvement
No. of Animals pulled for Rx	22	4	Greater than 100% improvement

*Treated cattle were dewormed strategically on pasture (treatments at 0, 4 and 8 weeks) and again upon arrival into the feedyard with fenbendazole (Safe-Guard® / Panacur®).[32]

dewormed steers received a total of four treatments throughout the study using Safe-Guard®/Panacur® (fenbendazole) for an approximate cost of $1.25-$1.50 per head depending upon weight at the time of treatment or between $5.00 and $6.00 an animal for the entire trial period. At the start of the study and again upon arrival in the feedlot the treated cattle were dewormed orally with Safe-Guard® suspension. Since the cattle were already being worked for other management reasons no extra labor cost were required to administer these treatments. While the cattle were on pasture Safe-Guard®/Panacur® (fenbendazole) was administered twice via a medicated free-choice mineral so again no significant labor cost were involved in any of the deworming treatments.

The benefits of maintaining cattle relatively parasite-free throughout the trial began with an average advantage of 48.0 pounds per head at the end of a 118-day grazing period. Subsequently during the feeding period, the benefits were magnified with an average additional gain of 50.0 pounds resulting in a total weight of 98.0 pounds for the treated group versus the controls during the entire trial period. During the feeding period, the treated group averaged .33 pounds less feed for every pound of gain. None of the treated cattle died during the feeding period compared to four animals that died in the control group. The number of animals pulled during the feeding period for unrelated health problems was five times greater in the control than in the treated group (22 versus 4). Additional, 26.5% more of the treated cattle graded choice than the control cattle. Overall the return on a $6.00 per animal deworming investment netted a return greater than 10 fold just in the weight gain advantage alone. These data demonstrate that an aggressive deworming program applied strategically using a highly effective product such as Safe-Guard®/Panacur® (fenbendazole) can greatly improve the efficiency and profitability of an operation[30].

Deworming, applied strategically, is a valuable tool to prevent production loss and allow animals to reach their maximum genetic potential. A parasite-infected animal can also be fed past the parasitism if the cost of production is not a factor. The more efficient the animal is in terms of genetic potential and management; however, the higher the costs are to feed past the parasitism. Depending on production levels and physiological needs, at some point it becomes nearly impossible to feed past the problem. In a highly efficient animal, all it takes is a few parasites to cause an economic problem. An example of this is feedlot cattle gaining over 4.0 lb./head/day are more susceptible to parasite problems and the effects of parasitism than cattle gaining 2.0 lb./head/day. Achieving weaning weight in calves greater than 700 lb. requires a better deworming program that weaning calves at 500 lb. Also, cattle grazing extensive range conditions can be nutritional stressed due to a lack of available forage, and therefore, benefit greatly from deworming even though these cattle most often harbor fewer parasites than cattle raised on lush or adequate pasture situations.

Internal Parasites Attack Nutrition and Immune System

The Physiological Effect of Gastro-intestinal Parasites is Anti-nutrition.

The process whereby a 1,000 lb. Angus steer can be harmed by a few tiny parasites is complicated. Physical damage caused by parasites in the abomasum changes the physiology of the digestive system. One particular parasite specie, *Ostertagia*, for example, completes it life cycle by spending time as a developing larva in the gastric gland. This larva can live within the gland for months at a time. While this larva is in the gland it undergoes a molting process, growing and expanding within the gland. The parasite mechanically destroys the gland temporarily shutting down acid production and causing blood leakage back into the gut tract. When a large number of parasitic larvae are present in the gastric glands, acid production is reduced, the abomasal pH rises, digestion efficiency is reduced, appetite decreases and dry matter intake drops off. It only takes several hundred to several thousand parasites to cause economic loss. Internal parasites, in simple terms, are anti-nutrition. Producers spend millions of dollars to improve their animals' nutritional status; however, little is gained if the gastro-intestinal tract is riddled with internal parasites.

Internal parasites can also adversely affect the immune system.

Recent data indicate that gastro-intestinal parasites' have a strong affect on the animal's immune system.[20, 30, 32] One benefit to deworming, that is often overlooked, is its impact on the effectiveness of vaccinations. Cows that are infected by parasites have compromised immune systems caused by the negative nutritional impact gastro-intestinal parasites have on the immune system. In addition to this indirect impact, some parasites have a direct impact on the immune system though mechanical damage they cause to the animal itself.

Immuno-suppression occurs when parasites actively hinder one or more of the host's defense mechanism. For example, *Ostertagia* secrete substances that suppress the host's immune system. Because the *Ostertagia* larvae damage the glands of the abomasum during development they disrupt metabolism and are thought to affect development of immunity simply by reducing the necessary substances such as protein and trace minerals. It has been shown that some parasites can cause cows to create immune cells that shut down the production of antibodies and macrophages, key components in a functioning immune system. Such measures ensure that the parasite will survive and be able to reproduce in the cow. These immune suppressive tactics that protect the parasite leave the cow susceptible to other invaders such as bacteria and viruses. As noted previously immuno-suppression interferes with the host's ability to respond to a vaccination, our most effective tool for preventing infectious disease[30].

The Usage of Endectocide Pour-ons

Endectocide pour-ons have become popular among cattlemen because they are easy to apply and cause less stress to animals compared with injectable formulations of the same product. Some concerns have risen about the prolonged usage of pour-on products by a number of parasitologists. Several of these concerns are:

1. Production losses due to failure of pour-ons to adequately remove internal worm burden may occur in some cases.
2. Continued egg shedding in pastures and, therefore, continued contamination if not dosed properly.
3. Parasites left following treatment by pour-ons may recontaminate the pastures.

Lower absorption into the bloodstream of the active ingredient as compared to injectable formulations is shown below[39]. Blood level determination following treatment with doramectin in an injectable (90% absorbed) and pour-on formulation (15% absorbed) is described as follows:

1. 200 mg/kg injectable delivers a maximum plasma concentration of 32 µg/mL.
2. 500 mg/kg pour-on delivers a maximum plasma concentration of 12 µg/mL.

Nearly all endectocide manufacturers claim, "persistent efficacy" for these products, indicating long-lasting protection ranging from 14-28 days following treatment. A trial conducted at Louisiana State University by Dr. Williams indicates varied worm egg counts for ivermectin pour-on or doramectin pour-on formulations in those studies. (Table 2)

Questions about extended efficacy.

The persistent efficacy indicated on the label for some products claims protection from re-infection during the persistent period for some internal parasites. Once the animal is re-infected, the parasite undergoes a prepatent period during which time it develops into an adult stage. Another 4-6 weeks are required before worm eggs should appear in feces.

In the study below, neither pour-on product exceeded 85% reduction in fecal worm counts. The World Association for the Advancement of Veterinary Parasitology (WAAVP) has set a standard that if the efficacy of a product does not reduce worm egg counts greater than 90% following treatment, the product is designated as a "parasite resistant product."

Table 2: Fecal worm egg counts and percent reductions taken at weekly intervals from cattle following treatment with ivermectin and doramectin pour-on formulations.

Treatment Group	Post Treatment (worm eggs/3 g. samples)									
	0	7	14	21	28	35	42	49	56	70
Controls	193.7	96.8	93.0	100.7	73.1	53.0	77.0	111.3	98.3	55.5
Ivermectin	128.2	26.1	53.7	24.6	19.0	24.6	12.1	27.8	32.2	24.8
% Reductions		73%	43%	76%	74%	54%	85%	75%	68%	56%
Doramectin	217.8	36.7	42.5	41.5	37.2	27.3	18.1	33.6	21.1	20.0
% Reductions		62%	55%	59%	50%	49%	77%	70%	79%	64%

Source: Williams, et. al, 1999. Fecal worm counts were taken every seven days following treatment.

Strategic Deworming is Based on Seasonal Parasitic Contamination Patterns

Gastro-intestinal parasites have two basic functions in life; the first function is to completely live off the animals they invade while the second function is to reproduce into the environment by producing eggs that pass out of the animals with the feces.

The reproductive goal is to contaminate the environment of their host animals thus maintaining their life cycle keeping their species alive. Fortunately, in most parts of the country, parasitic larvae have a seasonal survival and infection pattern. When a parasite egg is shed on the pasture in the feces, this egg begins development, embryonating into a first stage larva (L_1), it then molting into a second stage larva (L_2) and finally molts again into a third and infective stage larva (L_3). During the first two larval stages in the fecal pat, the larva are fairly immobile feeding off the bacteria and other debris found in the feces. Egg development is greatly dependent upon temperature and moisture. Eggs which are passed in the middle of winter will not develop until warm weather returns in the spring. Eggs passed in the middle of a drought or other unfavorable conditions may develop into infective larvae in the feces but without moisture can not move away from the pat where they can be consumed by a host animal when it eats grass. Eggs that are shed during the summer grazing season, however, can develop into infective larvae in just a few days if temperatures are warm and moisture is plentiful. Also, the eggs shed on the pastures earlier in the year, but that have been dormant in the environment will develop at this time as well. Because of this, pasture contamination can build rapidly especially during rainy conditions or where moisture is sufficient to allow the larvae to move away from the fecal pats onto the vegetation.

During the final molt into an infective L_3 larva, this developing infective L_3 larva maintains an external sheath covering that provides extra protection from environmental conditions allowing L_3 larvae to survive severe winter or summer drought conditions. This sheath also prevents the L_3 larvae from feeding because the mouth parts are covered with the sheath forcing the L_3 larvae to live off internal stored food supply. Due to this feeding limitation, L_3 larvae have a limited life span especially after winter survival. In the spring when temperatures begin to warm and grass begins to grow, the infective L_3 larvae which have survived the winter become active moving with moisture trails away from the fecal pat onto the vegetation in order to be consumed by grazing cattle. When temperatures are sufficiently warm (greater than 65º-70º F) the larvae will move continuously using up internal body food supplies while trying to find a host animal. It appears that somewhere between two and threes months (60-90 days) into the grazing season the larvae surviving the winter will expire and die if no host is found.

Strategic deworming performed during this period of time works by preventing worm egg contamination and repopulation of the pastures during the first three months of the grazing season while the pasture are "naturally becoming de-contaminated." The specific goals of strategic deworming are to prevent parasite contamination in the environment by reducing the ability of the gastro-intestinal parasites to reproduce during the first three months of the grazing season. Strategic deworming is simply the use of dewormers to interrupt the life cycle of the parasites by allowing the cattle to consume infective larvae while grazing but timing treatment to kill these parasites before they have time to develop into an adult parasite producing eggs within the animals. Cattle work like vacuum cleaners picking up larvae while grazing but these larvae are killed by strategic treatment before they have a chance to re-contaminate the environment. If no parasite eggs are shed on the pastures for the first three months, the second three months of grazing will be relatively parasite free. Strategic deworming, therefore, provides approximately six months of "parasite-safe" pastures.

Strategic Deworming Recommendations for Cow/Calf Operations

This first goal of strategic deworming is to make sure cattle are parasite-free during the winter and at the beginning of the grazing season. If cattle are harboring adult worm population in late winter or early spring, these parasites will begin contaminating the pastures immediately as temperatures warm up. In most parts of the U.S, parasite challenge is minimal during the winter months. Cattle dewormed at the beginning of winter in late November or early December will most often remain relatively parasite-free until the following spring. The dewormer used must have a high degree of efficacy otherwise a second treatment given in early spring is required to remove all adult parasites before grazing begins.

Strategic deworming occurs after spring grazing begins. This spring deworming(s) needs to be given after the cattle have had a chance to graze but before the invading larvae have developed into adult parasites. Grazing cattle begin consuming the larvae as soon as they begin grazing. Within six weeks after ingestion, larvae will have time to reach maturation to an adult and begin laying worm eggs. This is the ideal time when the cattle should be dewormed strategically to prevent worm egg contamination back on the pastures. In adult cows, it takes approximately six weeks from the time of larval ingestion until an egg laying adult worm is present whereas with younger animals this time period is shorter. A treatment given six weeks after spring grazing in brood cows will remove all parasites ingested during the first six weeks of grazing. Even if cattle ingest larvae immediately following treatment, it will be another six weeks before adult parasites are present. This strategic spring treatment in adult cows prevents worm egg shedding for the first 12-weeks or three-months of the grazing season. Therefore, adult cows given a deworming in late November or early December and then again six weeks after spring grazing begins prevents parasite contamination of the environment for at least six months. These strategically treated animals would remain parasite-free throughout the winter and for at least three-months (12-weeks) into the grazing season, the spring parasite contamination cycle is broken. Research indicates that yearly parasite contamination levels can be reduced by 80% or greater for the entire season.[5, 19, 6, 21, 33, 36]

In southern US and parts of the country where grazing begins prior to April 1st, two spring dewormings given six weeks apart is often recommended.
Example:
If spring grazing starts the first week in March, the first strategic deworming would occur around the 15th of April with a second deworming during the last week in May or the first week in June. This is necessary whenever the length of the season is greater than 150-180 days.

Strategic Deworming Recommendations for Grazing Yearling Heifers and Stocker Operations

The deworming strategy is designed to be more aggressive for younger cattle than it is for older cattle. The larval development time within adult cattle is longer than it is in yearling cattle and young calves due to an increased level of immunity against larval infestation by the older animals. The time it takes from larval ingestion until a mature adult parasite is present in young animals can be as rapid as three weeks in young calves up to four weeks in yearling cattle or bred heifers. To achieve parasite free-status during the first 12-weeks of the grazing season, the strategic deworming recommendations for young calves or yearling cattle is for these animals to be free of parasites at the beginning of the grazing season and then to receive two additional deworming, the first given four weeks after grazing begins and the second given four weeks later. This program is called a "0-4-8 week" program. Since it will be another four weeks after the last deworming before worm eggs are shed, this program protects the young animals from shedding worm eggs back on the pasture for 12-weeks much like the strategic program for adult cows.

The timing of when dewormer use can have the greatest benefit and the number of deworming necessary to achieve this benefit varies from location to location in the country but the principles involved remain the same. The main reason the timing varies from location to location is due to the seasonal weather patterns. The intensity of a deworming program is also often dictated by the efficiency of the operation or goals of the operation where a purebred operation may use a more aggressive deworming strategy than a commercial operation. Some producers use different formulations of dewormers at different times of the year depending on whether the animals are on pasture or are being fed a supplement. Some producers alternate their deworming products depending upon the season. Over all, deworming given at the right time with the right product can add to the efficiency and economics of a deworming strategy.

Pour-on usage and Ivermectin/Milbemycin (Endectocide) Resistance:

Endectocides are compounds that demonstrate the ability to kill internal and external parasites in cattle. Although these endectocide compounds have showed efficacy against internal parasites, the failure of the endectocide pour-ons to eliminate worm egg shedding was identified soon after the endectocide pour-ons were first introduced on the U.S. market[7, 14, 23, 37]. This continual shedding predisposed the surviving parasites and their progeny to the development of potential parasite resistance to the Ivermectin and milbemycin family of compounds which are used in the pour-on formulations. Since parasite survival and continual egg shedding is occurring while these chemical compounds are still active in the animals and their feces, both the worms themselves and their eggs which are being shed on the pasture after exposure to the chemical compounds or residue of the compounds in the feces. This reduced efficacy and continual product exposure by the parasites over time creates the potential for parasite resistance to develop to these compounds.[11, 13, 24, 25, 31]

The reason for the potential of reduced efficacy with endectocide pour-ons has been identified as the lack of consistent and adequate level of absorption by the endectocide pour-ons into the bloodstream when compared to injectable formulations of the same products[14]. Blood level determinations following treatment with doramectin in an injectable formulation demonstrated 90% absorbed while the pour-on formulation was only 15% absorbed as described by Pfizer, Inc.[12, 28] is as follows:

- 200 mg/kg injectable will deliver maximum concentrate in plasma 32ng/ml (SD +/- 8ng)
- 500 mg/kg pour-on will deliver maximum concentrate in plasma 12 ng/ml (SD +/- 6 ng)

This reduced blood level (12 ng/ml versus 32 ng/ml) indicates that many animals may not be receiving a therapeutic dose following treatment with endectocide pour-on formulations and the parasites and their offspring are predisposed to parasite resistance. Also the adult parasites and newly developing adults that survive pour-on treatment continue to produce eggs that are shed back into the environment of the animals, therefore, rendering these pour-on products unsuitable for use in a strategic deworming program.

The problem with the reduced blood levels exhibited by the pour-ons is compounded by the "persistent efficacy" exhibited by most of the endectocide pour-on products[15]. Based on FDA approvals, these products exhibit persistent residues in the animals ranging from 14 to 42 days following treatment depending upon the product and species of parasite involved. The persistent residues indicate prolonged exposure of the surviving parasites and parasite offspring to endectocide thereby greatly increasing the chance for the development of parasite resistance to these compounds. Endectocide pour-ons that have poor efficacy against internal parasites, may promote resistance to these internal parasites. Recent data, in fact, indicate that parasite resistance is now a real threat in operations where the pour-ons have been used for several years or more.[7, 13, 29] Endectocide pour-ons have become popular among cattleman because of ease of application and reduced cattle stress compared to injectable formulations of the same product. However, recent field trials have indicated, in some cases, these pour-ons lack sufficient efficacy which may be due to application errors . Three fears result from this lack of efficacy:

1. **Production losses occurring due to failure of pour-ons to adequately remove internal worm burden**
2. **Continued egg shedding in pastures with continued parasite contamination in the environment.**
3. **Parasites and parasite eggs left following t treatment may cause resistance to develop.**

University trial measuring duration of protection with endectocide pour-ons demonstrates low level of efficacy with two popular endectocide pour-ons

Table 3: A trial conducted at Louisiana State University[37] by Dr. Williams indicates extended efficacy does not occur and parasite resistance is probable for ivermectin pour-on or doramectin pour-on formulations using the Fecal Egg Count Reduction Test: Ivermectin Pour-on (Ivomec® Pour-on – Merial) and doramectin pour-on (Dectomax® – Pfizer).

The persistent efficacy indicated on the label claims protection from re-infection during the persistent period. Once the animal is re-infected, the parasite undergoes a prepatent period during which time it develops into an adult stage. Another 4-6 weeks are required before worm eggs should appear in feces. In the study below, neither pour-on chemistry exceeded 85% reduction in fecal worm counts. The WAAVP (World Association for the Advancement of Veterinary Parasitology) has set a standard that if the efficacy of a product does not reduce worm egg counts greater than 90% following treatment, this product is designated as a "parasite resistant product.[38]"

Summary of pour-on failures to adequately control gastro-intestinal parasites:

- The control of gastro-intestinal and the efficacy of dewormers have become economically more important as the genetic potential of cattle improves.
- Incomplete parasite control by the endectocide pour-ons means cattle will continue shedding parasite eggs on pasture, leading to increased parasite burdens further into the grazing period, the potential for the development of parasite resistance, and failure of strategic deworming programs to be effective.
- Producers can ensure their animals are parasite-free by having fecal samples run for parasite eggs following treatment.

Table 3

Treatment* Group	Days Post Treatment (worm eggs/3 g samples)									
	0	7	14	21	28	35	42	49	56	70
Controls	193.7	96.8	93.0	100.7	73.1	53.0	77.0	111.3	98.3	55.5
Ivermectin	128.2	26.1	53.7	24.6	19.0	24.6	12.1	27.8	32.2	24.8
% Efficacy		73%	43%	76%	74%	54%	85%	75%	68%	56%
Doramectin	217.8	36.7	42.5	41.5	37.2	27.3	18.1	33.6	21.1	20.0
% Efficacy		62%	55%	59%	50%	49%	77%	70%	79%	64%

Fecal worm egg counts and the fecal egg reduction test (FECRT) are valuable tools to determine the parasite status within a herd.

The Wisconsin Modified Fecal Flotation Technique[6] is recommended. The most important part in determining parasite contamination level is the fecal examination technique used. Using the wrong fecal technique will lead to erroneous information, an incorrect diagnosis and a flawed recommendation. This is especially true for cattle harboring a subclinical level of parasites. Most commercial fecal exam kits sold to veterinary clinics such as the "Fecalyzer" or "McMasters" are unsuitable for determine worm egg counts in cattle. These techniques were developed for sheep or small animal parasite diagnosis where a low fecal output and high worm egg counts are common. Adult beef cows produce thirty to fifty pounds of manure a day so the technique used must be very sensitive. A sugar flotation test such as the Modified Wisconsin Cenrifugal Flotation technique is the only method sensitive enough to provide satisfactory results in brood cows. The necessary concentration of sugar to float worm eggs out of the fecal material is 1.0 lb white table sugar/12 ounce of hot water (454 g of sugar in 355 ml of water) (Appendix II).

Advantages of the "Modified Wisconsin Sugar Flotation Method"

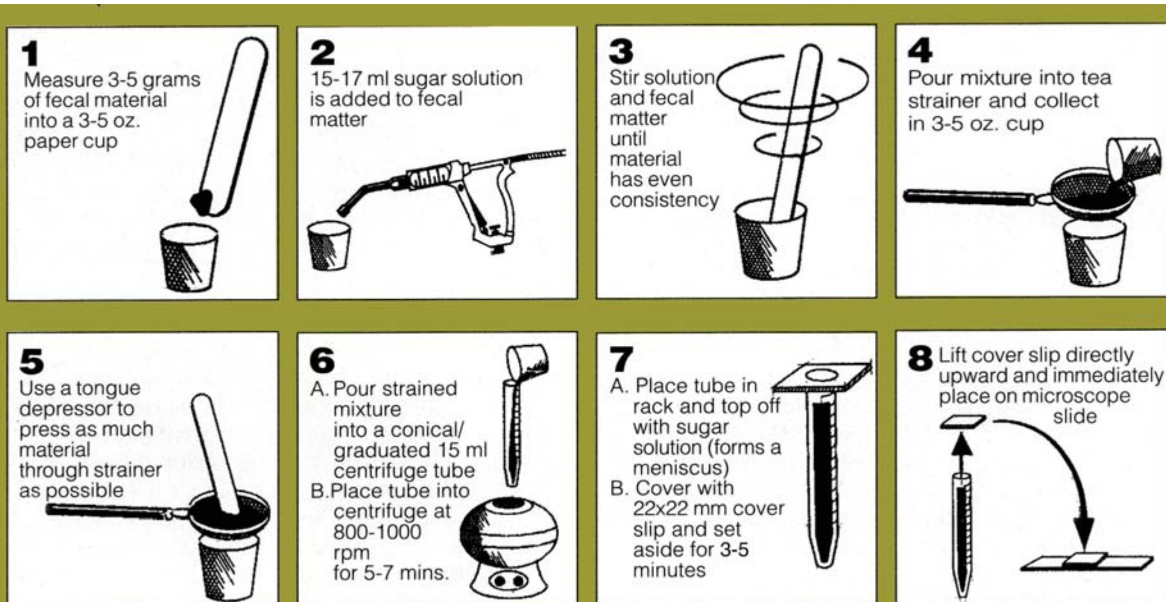
1. Requires no specialized equipment and can be conducted in a small area, even under field conditions.
2. Can be used to examine a large number of samples in a short period of time. One person can set up one 100 samples in a couple of hours.
3. This technique is sensitive enough to detect low egg counts in lactating dairy cows producing 80 to 100 lbs of manure a day.
4. This technique is sensitive enough to detect eggs from non prolific worm species such as whipworms (*Trichuris*) and threadneck worms (*Nematodirus*).
5. This technique breaks up tapeworm proglottids allowing tapeworms (*Moniezia, Anoplocephala* and *Taenia*) eggs for easy detection.
6. This technique is sensitive enough to float coccidia, cryptosporidium and giardia cysts and for species identification of coccidia oocysts.
7. This technique is sensitive enough to show the difference in egg shedding associated with various dewormers and is the recommended technique for the FECRT (fecal egg count reduction test).
8. Does not distort worm eggs thus allowing general parasite genus identification through egg morphology.
9. Can be used to float lungworm (*Dictocaulus*) and threadworm (*Strongyloides*) larvae form fresh rectal fecal samples.
10. Samples do not have to be read immediately. Prepared samples can be stored in a refrigerator for several days before reading if necessary.

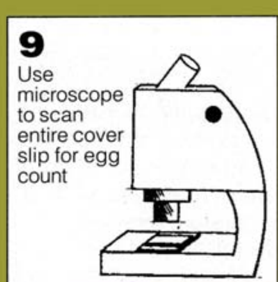
Fecal Egg Count Reduction Test (FECRT):

The World Association for the Advancement of Veterinary Parasitology (WAAVP) Guidelines for Anthelmintic Testing recommends the FECRT for parasite resistance testing[38]. This procedure simply involves taking a random fecal sampling of 5 to 10% of the herd at the time of deworming application followed by a second sampling taken 10 to 15 days later from a similar number of animals. If the worm egg counts taken after treatment are not reduced by 90% or greater, parasite resistance is suspected and an unrelated dewormer should be used. (See guidelines for taking and sending samples – Appendix III).

Modified Wisconsin Sugar Fecal Worm Egg Flotation Method

Determining whether a herd is exposed to parasites can be accomplished easily using a sensitive fecal worm egg flotation technique. The Modified Wisconsin Sugar Flotation Method is the recommended technique for dairy cattle.





1. Fecal samples can be stored for long periods if refrigerated (not frozen).
2. Sugar solution is prepared by adding 1 lb. of sugar into 12 fluid oz. (355 ml) of hot water; stir until all sugar is dissolved.
3. Slides can usually be placed in the refrigerator for several days prior to reading.
4. Materials needed
   - **a.** sugar solution plus dispensing bottle, gun, or syringe
   - **b.** tea strainer
   - **c.** 3 oz. and 5 oz. Dixie cups
   - **d.** tongue depressors
   - **e.** taper bottom test tubes
   - **f.** test tube rack
   - **g.** standard microscope slides and 22x22 mm cover slips
   - **h.** centrifuge
   - **i.** microscope

Diagram of method prepared by Dr. Bill Kvanisnicka, Extension Veterinarian, University of Nevada-Reno.

Product Profile of Safe-Guard® (Fenbendazole) / Panacur® (Fenbendazole) – (Intervet, Inc.)

Safe-Guard®/Panacur® (fenbendazole) was approved for equine in the U.S. in 1979, for cattle in 1984, for swine in 1986 and for lactating dairy cows in 1996. Safe-Guard®/Panacur® (fenbendazole) has been used in hundreds of thousands of animals over the past 25 years with a flawless safety record. For cattle, Safe-Guard®/Panacur® (fenbendazole) is approved as an oral suspension, oral paste, in a free-choice mineral to be fed over a three to six period, in a medicated block to be fed over three days, as a top-dress crumble, pellet, or meal or can mixed in the ration in a one-day feeding. Research data on the efficacy of fenbendazole given in a single dose versus a single dose spread multiple days was excellent either way.[12, 34] These data indicate that fenbendazole accumulates in the parasite and when sufficient product is ingested over time, the parasite is destroyed. Safe-Guard®/Panacur® (fenbendazole) high degree of efficacy in swine with an approved label recommendation to be fed over three to 12 days is proof of this particular valuable characteristic especially with non-handling formulations of fenbendazole.

Fenbendazole has a 100X margin of safety and can be used at any stage of gestation or lactation safely. Fenbendazole is also safe for the environment with no detrimental effects on fecal fauna such as dung beetles. The reason for Safe-Guard®/Panacur® (fenbendazole) high degree of safety is due to its mode of action and ability to kill parasites by destroying their ability to metabolize food stuff while nearly all other dewormers kill by destroying the nervous system of the parasite. By destroying the ability of the parasite to utilize food stuff, it kills the parasites rapidly removing them within the first 24-hours after product exposure.

Recent data following fecal worm egg counts following treatment with different formulations demonstrated equally high efficacy levels between the different formulations. No differences were observed in the efficacy levels achieved between different formulations of fenbendazole based on fecal egg counts (Table 4)[23]

Table 4: Fecal worm egg counts taken one to two weeks following treatment with fenbendazole (FBZ) using different formulations:

Formulation Containing FBZ	Oral Suspension	Blocks	Medicated Mineral	Medicated Feed
Number of Operations:	26	4	9	31
Number of Samples	173	30	57	200
Number Positive	4	5	7	7
Number Negative	169	25	56	193
Range:	0-6	0-33	0-9	0-6
Percent Negative	98%	83%	88%	97%
Average Post Rx Worm Egg Counts:	0.1	3.2	0.4	0.06

Wide Choice of Formulations

HANDLING & NON-HANDLING

IT PAYS TO HAVE A CHOICE OF FORMULATIONS.

FORMULATIONS	DESCRIPTION	SIZE	DOSE	APPLICATION RATE
CATTLE HANDLING FORMULATIONS – SAFE-GUARD®				
PASTE	• Low-dose volume paste • Apple-cinnamon flavor for improved palatability • Specially designed metal hook for convenient dosing	• 290-g paste cartridge • 92-g paste syringe	• Each 290-g paste cartridge deworms 29 head of 440-lb. cattle • Each 92-g paste syringe deworms eight head of 500-lb. cattle	• Single dose application
ORAL SUSPENSION	• Low-dose volume suspension offers stressless dewormer application • Easy-to-use applicator gun for accurate dose	• Gallons • 1-liter bottles	• Each gallon deworms 330 head of 500-lb. cattle • Each liter bottle deworms 86 head of 500-lb. cattle	• Single dose application
CATTLE NON-HANDLING FORMULATIONS – SAFE-GUARD®				
PELLETS	• Alfalfa-based pellet for improved palatability • For top-dress feeding	**Animal Health Distributor:** • 1 lb., 5 lb., 10 lb. bags	• ½ lb. per 500 lbs. body weight	• Feed for one day
Feed Manufacturer **PELLETS/ CRUMBLES**	• Palatable crumbles for use when adding to meal rations	• Packaging may vary by Feed Manufacturer	• Read and follow label directions from manufacturer	• Feed for one day
Feed Manufacturer **CUBES**	• High-quality range cubes for pasture top-dress			
Feed Manufacturer Daily Feeding and Free-choice **MINERAL**	• Formulations vary by company			
EN-PRO-AL® BLOCKS	• Soft-poured molasses block	• 25-lb. block	• 1 ½ lb. per 500 lb. body weight	• Feed over a three-day period
SWEETLIX® 20% PROTEIN BLOCKS	• Cold-pressed protein block	• 25-lb. block		
FREE-CHOICE MINERAL	• Two convenient, palatable formulations: 35% salt 20% salt	**Animal Health Distributor**: • 20-lb. plastic pail (35% salt) • 25-lb. plastic pail (20% salt)	• 10 oz. per 500 lb. body weight (35% salt) • 8 oz. per 500 lb. body weight (20% salt)	• Feed over a three-to-six-day period
1.96% SCOOP DEWORMER	• Two convenient formulations: Flaked meal and soft mini-pellets Unique, high-concentration, low-volume dose	**Animal Health Distributor**: • 25-lb. plastic pail	• 1 oz. per 240 lb. body weight	• Feed for one day

Spectrum of Activity

WORMS

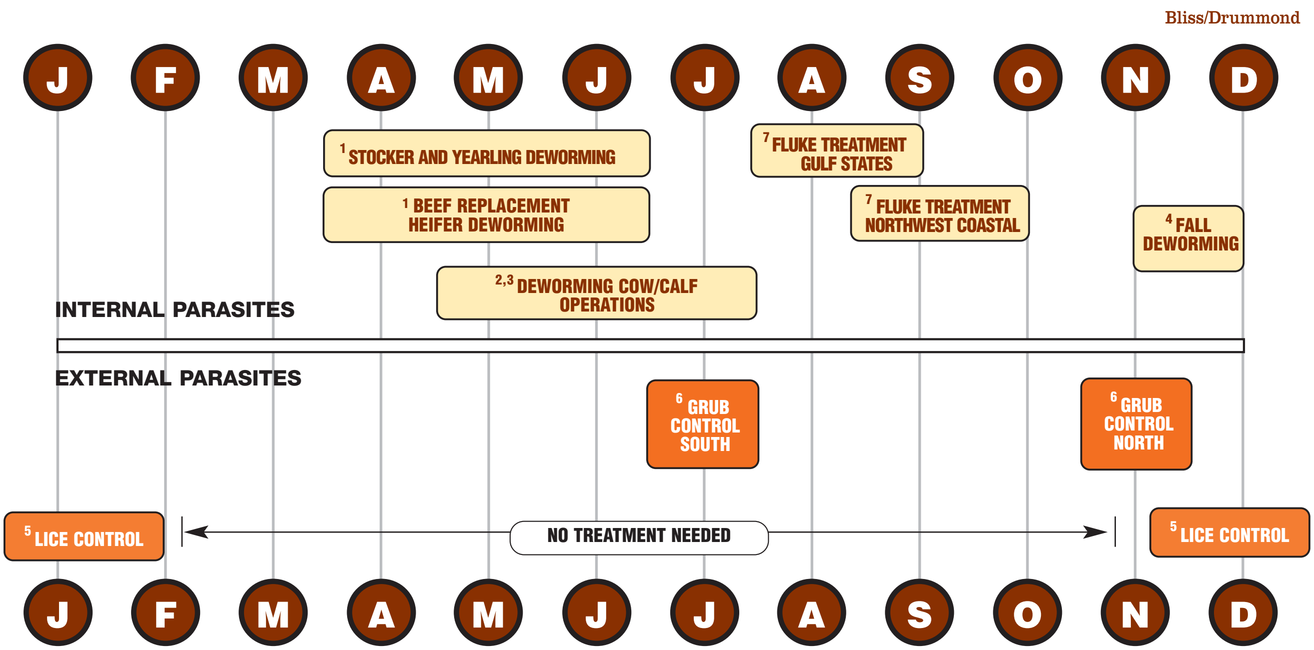
WORMS	Stage	PANACUR®/SAFE-GUARD® SUSPENSION (*Fenbendazole*)	DECTOMAX® POUR-ON[1,2] (*Doramectin*)	DECTOMAX® INJECTABLE[1] (*Doramectin*)	CYDECTIN® POUR-ON[1,2] (*Moxidectin*)	EPRINEX®[1,2] (*Eprinomectin*)	IVOMEC® INJECTABLE[1] (*Ivermectin*)	IVOMEC® POUR-ON[1,2] (*Ivermectin*)	VALBAZEN®[1,3] (*Albendazole*)	SYNANTHIC® (*Oxfendazole*)	RUMATEL® (*Morantel Tartrate*)	LEVASOLE®, TOTALON® & TRAMISOL® (*Levamisole*)
BROWN STOMACH *(O. ostertagi)*	ADULT	★	★	★	★	★	★	★	★	★	★	★
	INHIBITED L4	★[4]	★	★	★	★	★	★	★	23%-83.5%†	NO	NO
	TYPE II OSTERTAGIOSIS	★[4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
BARBERPOLE *(Haemonchus spp.)*	ADULT	★	★	★	★	★	★	★	★	★	★	★
	L4	★	★	★	NO	★	★	★	★	NO	NO	NO
SMALL STOMACH *(T. axei)*	ADULT	★	★	★	★	★	★	★	★	★	★	★
	L4	★	NO	★	★	★	★	★	★	NO	NO	NO
BANKRUPT *(T. colubriformis)*	ADULT	★	★	★	★	★	★	★	★	NO	★	★
	L4	★	★	★	★	★	★	★	NO	NO	NO	NO
SMALL INTESTINE *(Cooperia punctata, C. oncophora)*	ADULT	★	★	★	★	★	★	★	★	★	★	★
	L4	★	★	★	NO	★	★	★	★	★	NO	NO
THREADNECKED *(Nematodirus helvetianus)*	ADULT	★	NO	NO	★	★	84%	NO	★	NO	★	★
	L4	★	NO	NO	NO	★	NO	NO	★	NO	NO	NO
HOOKWORM *(B. phlebotomum)*	ADULT	★	★	★	★	★	★	NO	★	★	NO	★
	L4	★	NO	NO	NO	★	★	NO	NO	NO	NO	NO
NODULAR *(O. radiatum)*	ADULT	★	★	★	★	★	★	★	★	★	★	★
	L4	★	★	★	NO	★	★	★	★	NO	NO	NO
LUNGWORM *(D. viviparus)*	ADULT	★	★	★	★	★	★	★	★	★	NO	★
	L4	NO	★	★	★	★	★	★	★	★	NO	NO
TAPEWORM *(M. benedeni)*	ADULT	★[4]	NO	NO	NO	NO	NO	NO	★	★	NO	NO

[1] Also approved for external parasite control
[2] Also approved for horn-fly control
[3] Do not administer to female cattle during first 45 days of pregnancy or for 45 days following removal of bulls
[4] At 10 mg/kg dosage, Panacur label only. Do not use at the rate of 10 mg/kg in Dairy Cattle. Dose rate of 10 mg/kg in Dairy Cattle could result in violative residues in milk.
† FOI Summary of Pivotal Studies

Strategic Deworming

CONTROL THE RIGHT WORMS, AT THE RIGHT TIME.

When you need to deworm, Safe-Guard® is your best choice against the internal parasites that can cause the most economic damage.



1. Stocker, yearling and replacement heifers dewormed at turnout, four and eight weeks after onset of grazing (0-4-8).
2. Cow/Calf deworming six weeks after onset of grazing.
3. If cattle were not dewormed in the fall, adult cows should be dewormed at pasture turnout and again six weeks after onset of grazing.
4. All cattle retained over winter should be dewormed.
5. During lice season, two treatments two to three weeks apart may be necessary.
6. Grub treatment three to four months after the end of heel fly season, varies south to north. Requires systemic, annual control only.
7. Cattle grazed along the Gulf Coast and Northwest coast should be treated for adult and immature liver flukes.

(Horn-fly control as needed to keep populations below 200 flies per animal.)

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Appendix I: Gastro-intestinal and Lung Parasite Infections Found in Beef Cattle

Parasitism in dairy cattle can be broken into five main categories: Stomach worms, Intestinal worms, Liver Flukes, Lungworms, and Protozoa.

A. Stomach Worms:

• ***Haemonchus*** **(barber pole worm)** is a blood-sucking parasite that causes significant economic damage in cattle, but is especially damaging in sheep and goats. It is one of the most important causes of morbidity and mortality in these animals. Larval stages have been found in the rumen and abomasal tissues and are extremely hard to kill. Eggs are easily identified in a fecal exam.

• ***Ostertagia*** **(brown stomach worm)** is probably the most studied and prevalent parasite of cattle. Larval stages invade and temporarily destroy the gastric glands, so large numbers of parasites can significantly reduce acid production which in turn reduces digestion efficiency. *Ostertagia* has also been shown to adversely affect dry matter intake by reducing appetite. Larval stages can undergo inhibition and remain in the glands for months before emerging into lumen of the abomasum to develop into an adult worm. Eggs are easily identified in a fecal exam.

• ***Trichostrongylus*** **(bankrupt worm).** These parasites suck gastric fluids from mucosa and cause necrosis of the mucosa, so they can be very damaging in large numbers. Though this parasite has a distinctive kidney bean-shaped egg, most parasitology technicians don't separately distinguish their eggs from *Ostertagia* and *Haemonchus* but group them all together under the heading of "stomach worms."

B. Intestinal Nematode Parasites:

• ***Cooperia*** **(small intestinal worm)** disrupts digestive functions of the intestine. *Cooperia* is considered the second most prevalent parasite of cattle. Eggs are easily found in a fecal exam and are distinct because of elongated parallel sides. *Cooperia* is an underrated parasite in terms of damage caused by this worm.

• ***Nematodirus*** **(threadneck worm)** is most commonly found in young animals and is seldom found in adult cattle. Larvae survive well in cold weather and can live for two years on pasture. This parasite is a common cause of diarrhea and often causes death in young calves and yearling cattle. *Nematodirus* is very pathogenic and older animals acquire a strong immunity against this parasite. The egg is very large and is easily identified in a fecal exam.

• ***Trichuris*** **(whipworm)** is another very damaging parasite of young cattle. Symptoms are often confused with coccidiosis because of the bloody diarrhea associated with this parasite. Several hundred worms can kill a young calf. The egg is very characteristic and looks like a football with polar caps on each end. The female worm is not prolific and eggs are often missed in the fecal exam unless carefully conducted.

• ***Bunostomum*** **(hookworm)** adults suck blood feeding on a plug of mucosa in the intestine. The larvae penetrate the skin and migrate through the lungs, causing dermatitis and pneumonia. Calves on manure packs in the winter often become infected with hookworms. Their large eggs are easily identified with a fecal exam.

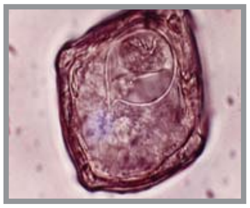
• ***Oesophagostomum*** **(nodular worm)** is becoming more important because intestines are often condemned at slaughter if nodules are found in large numbers. These parasites are associated with anorexia, depressed weight gain, and diarrhea. Nodular worms are most commonly found in adult cows and older yearling animals.

C. Intestinal Cestocide Parasites (Cattle Tapeworms)

- The tapeworm develops in the soil mite, which is ingested by cattle. The develop time to reach an adult after ingestion is reported to be from 6 to 8 weeks. The adult tapeworm lives in the small intestine and can grow to be 1 inch wide and 6 feet long. They absorb nutrients through their cuticle. In high numbers, tapeworms can completely block the intestine. Tapeworm eggs are distinct and easily found in a fecal exam.

D. Cattle lungworms *(Dictyocaulus viviparous)*

Lungworms are acquired almost exclusively through grazing. Lungworm larvae are not very mobile, and, therefore, often require a heavy rain to move out away from the manure pat. Cattle on rotational and intensive grazing systems are often exposed to lungworms. Does not pick up well in a fecal exam but rather the fecal must be subjective to a separate test called a "baermann test" to find lungworm larvae. Postmortem check for lungworms entails removing the lungs and trachea intact, filling them with warm water, and pouring the contents on a flat surface so the lungworms are easily visible with the naked eye.



E. Trematodes Parasites (Liver flukes)

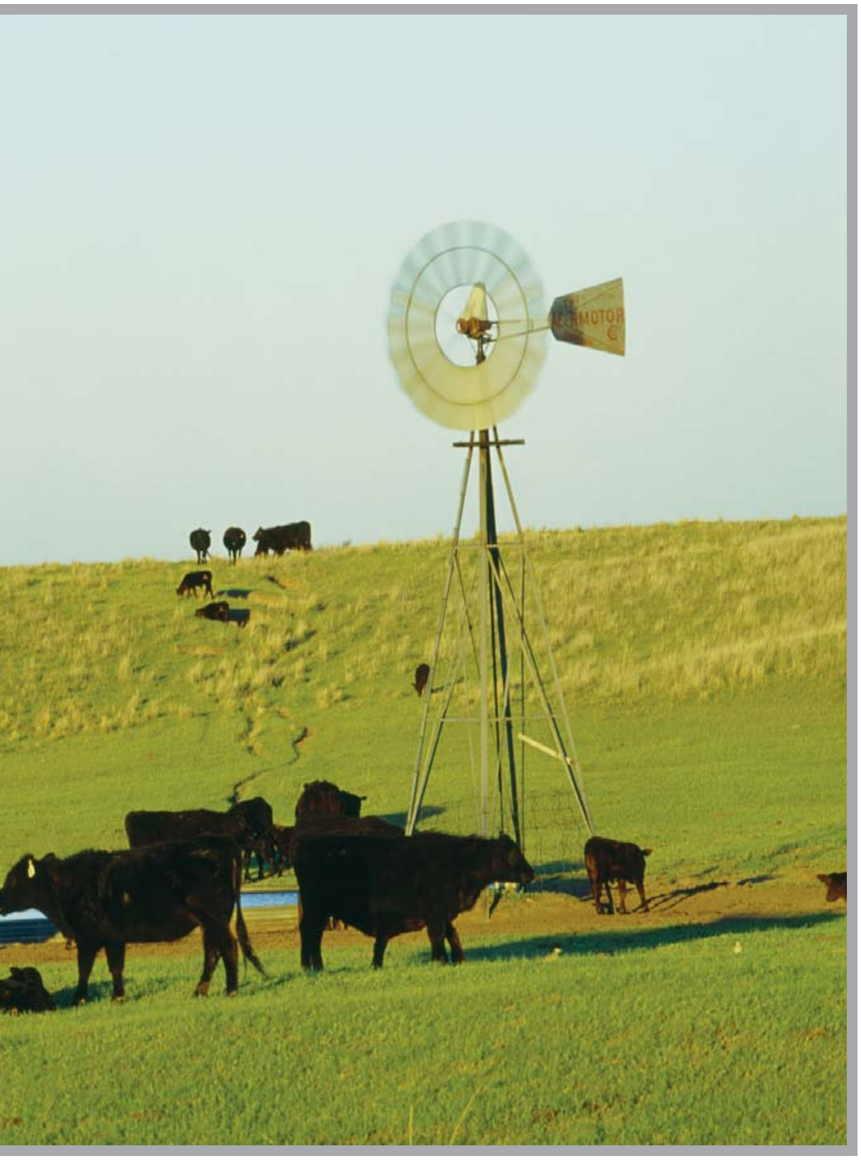
1. ***Fascioloides magna*** **(deer fluke)** found in the Great Lakes region is relatively untreatable in cattle. Diagnosis can be done accurately only upon necropsy since this fluke is encapsulated in the liver and cannot release its eggs. Infections can be spread with deer with an intermediate snail host. Keeping cattle away from wet areas and streams where deer congregate is currently the only method of control.
2. ***Fasciola hepatica*** **(common fluke)** is found in the Gulf coast from Florida to Texas and along the Pacific coast regions from California/Nevada to Washington and east to Colorado. Treatment in late summer or early fall is desirable to reduce contamination. Snails can carry the infection through the winter and cattle become re-infected in the spring in grazing wet areas where infected snail habitat are present.

F. Protozoan Parasites of Cattle:

1. ***Coccidia*** are single celled protozoan parasites that all cattle are believed to be exposed to sometime in their life. Coccidia are very host specific such that coccidia of swine, dogs, and chickens won't infect cattle. The reverse is also true. Coccidia are ingested through fecal contaminated feedstuff. Wet muddy conditions usually increase infection levels. Cattle become infected when they ingest oocysts (egg-like structure) containing sporozoites, which escape the oocysts and penetrate the intestinal wall. A disease condition called *coccidiosis* occurs when coccidia numbers become high and the immune system of the animals becomes low. Coccidiosis often occurs when an nimal becomes stressed. Cattle shedding high number of oocysts indicate cell damage is on-going. Coccidia oocysts can easily be found in a fecal exam.

2. *Giardia* is one of the most common protozoan parasite pathogens of humans and animals worldwide. Infections can occur with in the first week of life in calves and can persist for several months. A survey of 109 New York dairy farms indicated that 20% of the calves were infected. It is an important parasite in cattle because it can cause diarrhea and ill health in calves and is a zoonotic threat to man from pasture runoff that can contaminate drinking water.

Appendix II:
For Best Fecal Lab Results



- Collect fresh samples then keep cool. Heat can cause worm eggs to develop. Freezing can destroy worm eggs. Send small samples. Each sample should be no larger that a golf ball.

- Send samples in plastic bags enclosed in a small box or styrofoam container with freezer pack (or frozen water bottle) in over-night or second day air. Samples can be collected by inverting "zip loc" bag or baggie over hand. **Do not send ice**.

- Send sufficient number of samples to profile herd. Take samples from adult cows, yearling cattle, replacement heifers, calves and bulls.For dairies take samples from different stages of lactation. For other species such as sheep, goats and swine do the same taking from various age groups.

  For horses and dogs take individual sample.

- Label each sample with animal name or number, if samples are taken randomly; label age group of animals where samples were taken. Send address, e-mail and/or fax number of where results are to be sent or reported.

Lab Results:

The results are reported as the incidence of eggs from specific parasite genera, coccidian and tapeworms. The total number of eggs from all genera found is given at the end of each column.

PANACUR® (fenbendazole) BEEF AND DAIRY CATTLE DEWORMER

1 Gallon (3785 mL)
Suspension 10% (100 mg/mL)

▶ RESIDUE WARNINGS: ◀

- **Cattle must not be slaughtered for human consumption within 8 days following treatment.**
- **Do not use at 10 mg/kg in dairy cattle. Dose rate of 10 mg/kg is for beef cattle only. Dose rate of 10 mg/kg in dairy cattle could result in violative residues in milk.**
- **A withdrawal period has not been established for this product in pre-ruminating calves. Do not use in calves to be processed for veal.**

CAUTION:
Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Keep this and all medication out of the reach of children.

DOSAGE:
Beef and dairy Cattle - 5 mg/kg (2.3 mg/lb) for the removal and control of:
Lungworm: *(Dictyocaulus viviparus)*
Stomach worm (adults): *Ostertagia ostertagi* (brown stomach worm).
Stomach worm (adults & 4th stage larvae): *Haemonchus contortus/placei* (barberpole worm), *Trichostrongylus axei* (small stomach worm).
Intestinal worm (adults & 4th stage larvae): *Bunostomum phlebotomum* (hookworm), *Nematodirus helvetianus* (thread-necked intestinal worm), *Cooperia punctata* and *C. oncophora* (small intestinal worm), *Trichostrongylus colubriformis* (bankrupt worm), *Oesophagostomum radiatum* (nodular worm).

Beef Cattle Only - 10 mg/kg (4.6 mg/lb) for the removal and control of:
Stomach worm (4th stage inhibited larvae): *Ostertagia ostertagi* (Type II Ostertagiasis).
Tapeworm: *Moniezia benedeni*

▶ Do not use in dairy cattle at 10 mg/kg. ◀

DIRECTIONS:
Determine the proper dose according to estimated body weight. Administer orally. In beef and dairy cattle, the recommended dose of 5 mg/kg is achieved when 2.3 mL of the drug is given for each 100 lb. of body weight. In beef cattle only, the recommended dosage of 10 mg/kg for treatment of Ostertagiasis Type II (inhibited 4th stage larvae) or tapeworm is achieved when 4.6 mL of the drug is given for each 100 lb. of body weight.

EXAMPLES:

Dose (5 mg/kg)	Dose (10 mg/kg)	Cattle Weight
2.3 mL	4.6 mL	100 lb
4.6 mL	9.2 mL	200 lb
6.9 mL	13.8 mL	300 lb
9.2 mL	18.4 mL	400 lb
11.5 mL	23.0 mL	500 lb
23.0 mL	46.0 mL	1,000 lb
34.5 mL	69.0 mL	1,500 lb

Under conditions of continued exposure to parasites, retreatment may be needed after 4–6 weeks. There are no known contraindications to the use of the drug in cattle. For dairy cattle there is no milk withdrawal period at 5 mg/kg.

Distributed by:
Intervet Inc., Millsboro, DE 19966

Store at or below 25°C (77°F).
Protect from freezing.
Shake well before use.

NADA #128-260,
Approved by FDA