Circular 770

Raising Dairy Replacement Heifers

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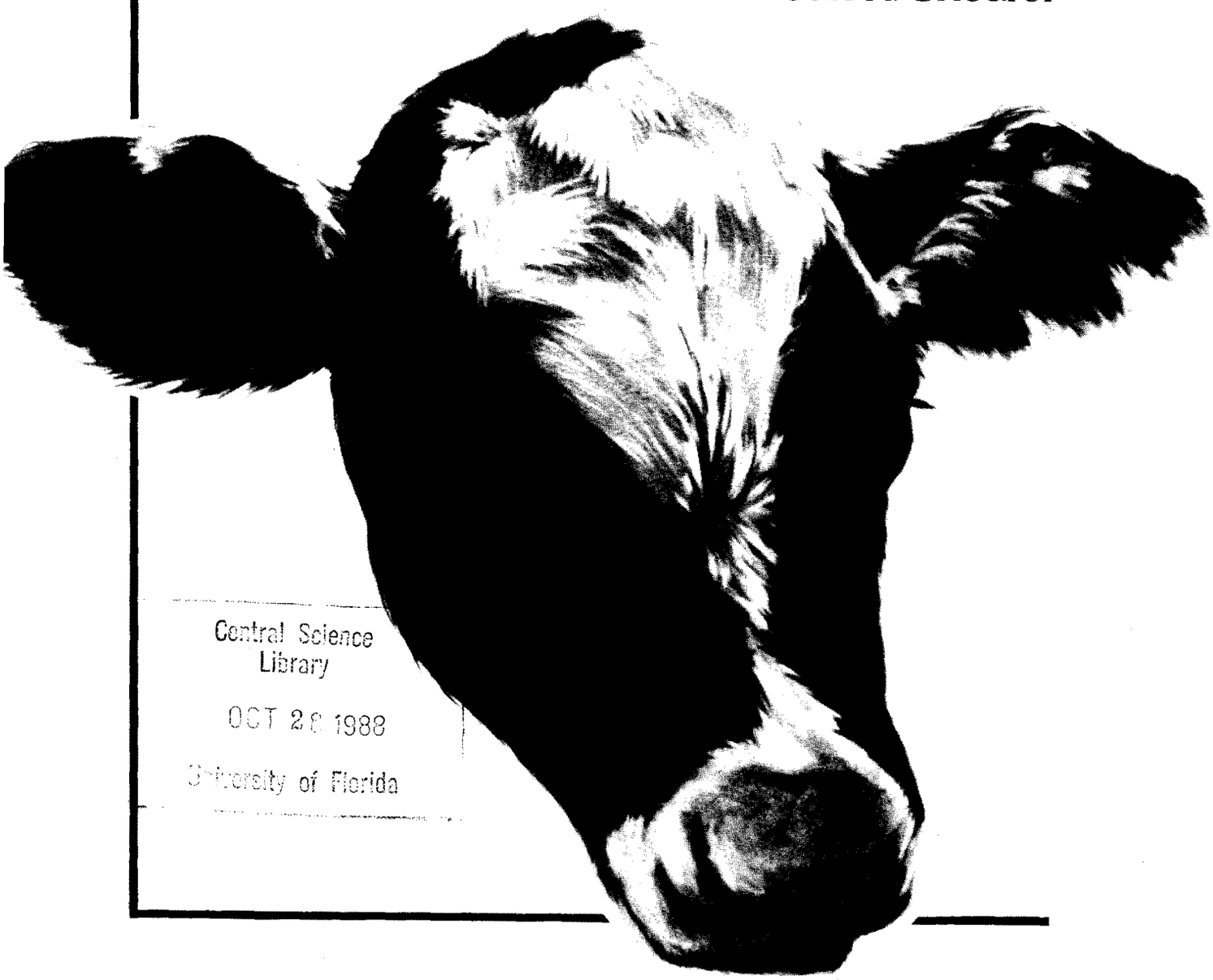

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Introduction

Raising replacement dairy heifers provides excellent opportunities and challenges in building for the future. Records show that about 25-35% of the milking herd must be replaced annually. Therefore, to maintain herd size and improve genetic potential for high milk production, quality replacements must be continuously available.

Good management is essential to raising healthy calves. Reducing death losses of newborn calves to less than 5% and raising strong, healthy heifers large enough to breed at 14 to 16 months of age are sound management objectives. Calves stunted from underfeeding or diseases may not develop into healthy and profitable cows.

Estimates are that some herds lose 15 to 25% of live-born calves consistently. This is excessive and costly to the dairy industry. Some dairy farmers consistently lose less than 2 to 3% of live-born calves. Careful attention to feeding, housing, and health management practices are key elements in successful raising of replacements.

In general, the younger the calf, the greater its risk of dying from disease. Most deaths occur in calves less than one month old. Therefore, sanitation during the pre-calving, calving and early post-calving periods is crucial.

Caring for the Cow and Calf at Calving

A good calving environment reduces the exposure of cows and newborn calves to infectious disease organisms. Well-drained grass lots or pastures visible from the barn are ideal calving areas. In cooler climates maternity stalls are used, particularly during periods of unfavorable weather. In either situation, a clean and comfortable area that provides cows with good footing minimizes the potential for injuries. Calving areas should be selected or landscaped to allow for adequate drainage. Shade structures are recommended. University of Florida studies have shown a detrimental effect on fetal growth rate and milk production in subsequent lactations when cows are not sheltered from heat stress.

Calf mortality is closely related to the dam's health during gestation, and fewer problems arise if dietary intake is monitored (see IFAS Circular 623-*Dry Cow Feeding and Management*). Studies indicate that 4 to 5% of calves are born dead or die within 24 hours of birth, and losses can be as high as 15% or more in herds where calving management practices are poor. Table 1 shows the causes of death in calves less than 24 hours old for one Florida study.

Table 1. Cause of death in calves less than 24 hours old in a Florida dairy (939 calvings).

	Number of calves	% of total deaths	% of total calvings
Premature deliveries and near-term abortions	10	18	1.6
Dystocia (assisted births)	23	40	2.4
Stillbirth or calf found dead	24	42	2.5

Cows at or near calving should be separated and observed frequently. Heifers will normally deliver their calves within 12 hours after the onset of labor. The interval from onset of labor to birth in cows is usually six to eight hours. Difficulties occur in slightly more than 3% of calvings among dairy cattle. If the labor and delivery process is prolonged or an abnormal presentation is detected (such as the appearance first of a tail, head or one leg) corrective procedures may be needed. Common causes for calving difficulties are excessive calf size and abnormal calf posture or position. Beginning with the cow's third calf, milk fever (also called parturient hypocalcemia) should be suspected anytime the labor process seems particularly slow or appears to have stopped. A cow with milk fever will often be wobbly or unable to rise. Milk fever can be treated rapidly and effectively by administering calcium-containing preparations.

Experience is an important prerequisite for the identification of problems or potential problems in managing calving. The calf has a better chance for survival if stress during the birth process is minimized.

Care of Navels at Birth

Calves' navels should be dipped in disinfectant at birth using a product such as two percent tincture of iodine. Failure to do so increases the opportunity for the development of potential fatal septicemia (invasion of the bloodstream by bacterial organisms). Further, bacteria associated with navel infections in calves may lead to serious arthritis that is difficult to treat and may result in the need for premature culling of affected calves.

Feeding Colostrum

The calf should receive colostrum as soon as possible after birth. The gut of the newborn calf is

able to absorb maternally-derived immunoglobulins (antibodies) contained in colostrum and transport them into the bloodstream. Antibodies transferred from the dam to the calf in this way are referred to as "passive" antibodies. The ability of the calf to absorb these colostral antibodies is greatest within the first hour following birth and remains fairly good for up to six hours. After this, there is progressive loss in the calf's ability to absorb colostral antibodies. After 24 hours a calf may be able to absorb little or none at all.

Colostrum's chief importance is providing antibodies which give the newborn calf resistance to disease. In addition, colostrum acts as a mild laxative which aids in removing digestive residue from the gut of the newborn calf. Colostrum is also high in nutrient value, especially vitamin A or its precursor carotene, B vitamins, proteins and minerals. The total solids and protein content of colostrum is about 23.9% and 14% as compared to 12.9% and 3.6% for normal milk.

Evaluating Colostrum Quality: Several factors affect the passive transfer of colostral antibodies to the calf: The immunoglobulin mass ingested, time delay after birth of ingestion of colostrum, the method of feeding and genetic, physiological, and environmental influences. Of these, the most important are **mass of colostral antibody consumed** and the **length of time after birth before ingestion.**

In the late 1970s researchers at the University of Arizona developed a method to estimate the antibody content of colostrum. The device used, known as a colostrometer, was designed for on-farm use and has become particularly valuable to dairies that store colostrum for hand-feeding newborn calves. The colostrometer is simply a hydrometer specially calibrated to provide a measure of colostrum specific gravity which is directly related to antibody concentration (Figure 1). Using this tool, dairy farmers can estimate the protective quality of the colostrum they collect from cows and thus selectively feed or store that which is of an acceptable value.

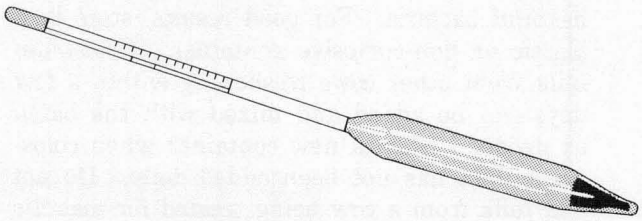

Figure 1. The colostrometer is a specially calibrated hydrometer.

Florida field trial results demonstrate the importance of monitoring colostrum quality (Figure 2). A

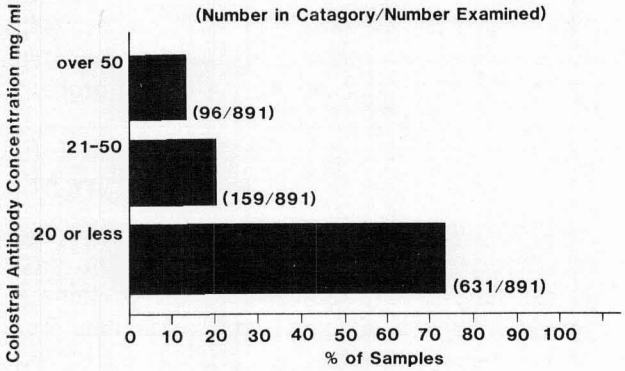

Figure 2. Colostrum scores at first milking from field trial at a Florida dairy.

total of 891 first-milking colostrum samples were scored with the colostrometer in a Florida dairy over a one-year period. As shown in Figure 2 only 96 (10.8%) of the colostrum samples examined at first milking contained 50 mg/ml or more of colostral antibody. This suggests that indiscriminate collection of first milking colostrum and pooling with other sources may result in storage of inferior quality colostrum. When possible, at least two liters of colostrum scoring in the zone over 50mg/ml should be preserved for each newborn calf. Colostrum may be fed by nipple bottle, but most dairies find it more convenient and expedient to feed colostrum by esophageal feeder or stomach tube (Figure 3). Colostrum with lower than optimal

Figure 3. Feeding a calf with a stomach tube.

antibody levels may be fed as is or diluted for feeding to older calves.

Detecting the Colostrum-Deprived Calf: Several methods can be used to determine if a calf has absorbed adequate levels of protective antibodies from colostrum. A popular procedure for large dairies is measurement of serum total proteins. This is by far the most efficient and practical method for routine screening of large numbers of calves and can easily be performed on the dairy by a veterinarian or dairy personnel.

Previous studies demonstrate that blood antibody levels correlate well with serum total proteins in calves at 2-10 days of age. Serum fractions from calves containing less than 5.0 gm/100 ml indicate insufficient colostral antibody absorption (Table 2).

Table 2. Interpretation of serum total proteins.

Less than 5.0 mg/dl	colostrum deprived
5.0 - 5.5 mg/dl	"suspect" deprived
5.5 - 7.5 mg/dl	colostrum satisfied
greater than 7.5 mg/dl	"suspect" (dehydration)

* Clinical signs of septicemia, diarrhea or other problems should be noted at the time of sampling.

Total protein values in excess of 7.5 gm/100 ml are suggestive of dehydration and may be cause for concern. Herds experiencing severe losses in calves under two weeks of age should evaluate calves to determine if colostrum deprivation is a problem. In very large herds we can oftentimes determine how successful the neonatal calf management program is by monitoring a sample of the calves between 2-10 days as opposed to checking all calves.

Starting the Nutrition Program

The milk feeding period in most calf operations is 4 to 5 weeks for large breed calves and 5 to 6 weeks for small breed calves. Liquid feeds commonly used are whole milk, milk replacers and colostrum. The choice of which to use depends on availability, practicability and cost.

Regularity in calf feeding is important. Too much milk at one feeding is likely to cause loose bowels which may develop into scours. For best results, weigh or measure the milk at each feeding.

Most dairy farmers prefer to feed milk to calves at about body temperature (90° to 100°F). However, research has shown that temperature may vary from slightly warm to about 100°F. Apparently, the temperature of the milk is relatively unimportant so long as a similar pattern is followed each day.

a) **Whole Milk** - This is the most common liquid for calves. It is usually fed twice a day but in recent years has been fed once a day with success. Calves should receive from 6 to 10 lbs per day depending on the size of animal (about 8-10% of body weight at birth).

b) **Milk Replacer** - Some of the primary concerns in the selection of a milk replacer is cost, physical properties and the nutritional value of the product. Milk replacers should mix easily, not settle out to any objectionable degree on standing and have milk-like appearance in dry and liquid form. The major difference between brands of milk replacers is usually the source of protein - casein, soy flour, etc. Select a good quality milk replacer.

c) **Fresh Colostrum** - In many dairy operations, more colostrum is available than can be fully utilized by newborn calves. Rather than discard a valuable product, it can be preserved by freezing and fed as needed. Colostrum's laxative properties, coupled with its extra total solids may increase the incidence of scours in calves unless diluted with water.

d) **Mastitic Milk** - Milk from cows with mastitis, which cannot be marketed, may be fed to calves with good success. Such milk should be fed to calves in individual pens to prevent the possible spreading of organisms since calves in community pens tend to nurse each other after drinking milk.

e) **Fermented Colostrum** - In recent years some dairy farmers have used fermented colostrum (sometimes called pickled milk or sour colostrum) to feed dairy calves. Research shows that colostrum can be successfully stored as a fermented product for a month or longer and remain readily acceptable to calves. The acidity of sour colostrum is reduced from 6.5 to a pH of about 4.0 which preserves the material. The increased acidity prevents the growth of harmful bacteria. For good results, store in a plastic or non-corrosive container. Colostrum milk from other cows freshening within a few days can be added and mixed with the batch as needed. Start a new container when colostrum milk has not been added daily. Do not add milk from a cow being treated for mastitis because the antibiotics stop fermentation and the milk will not sour properly. Mix the sto-

red colostrum before feeding. Feed a minimum of one quart (two pounds) and preferably three pounds of fermented colostrum diluted with about one-third water twice a day. Fermented colostrum appears to be a satisfactory nutrient source for calves when 4 to 6 pounds of colostrum is fed daily. Weight gains have been equal to calves receiving whole milk or milk replacer.

Once- Versus Twice-Daily Milk Feeding

During the past few years several studies have shown that milk may be fed to calves once instead of the usual twice per day. The once-daily feeding has not increased the number of digestive and health problems as compared to twice daily feeding. Calves receiving milk once daily remain active and consume their portion of liquid feed. Amounts up to 10% of body weight (8 to 12 lbs per calf) are consumed readily by larger calves.

An important question, particularly in Florida, is whether calves fed once daily during hot weather can perform as well as calves fed twice daily without supplemental water. An Ohio study showed that once daily fed calves provided with supplemental water gained an average of 4.5 pounds more than calves not given water. Consumption of calf starter averaged 7.0 pounds more at 30 days of age for the water-supplemented calves and resulted in greater efficiency of growth and increased body weight gain.

Once daily feeding reduces the time required for milk or milk replacer preparation and feeding pail washing. Food management makes the program work. Even though calves may be fed milk once daily, they should be observed at least twice daily for health and general management problems. Early detection of problems is an important aspect of any young animal management system.

Early Weaning Calves

Calves may be successfully weaned from milk or milk replacers at 3 to 6 weeks of age depending on breed and appetite. Smaller breed calves should receive milk a little longer than Holsteins and all calves should have been eating a minimum of 1 to 2 lbs of calf starter (grain mix) daily for the 7 to 10 days prior to weaning. Those consuming less may lose weight and do poorly for several days after weaning. To encourage starter consumption, reduce milk fed by about one-half a few days prior to weaning. (Table 3).

Table 3. Suggested pounds of milk to feed daily.[a]

Age of calf	Large breed (lb per day)	Small breed (lb per day)
1 day (first 24 hours)	Suckles cow or is fed colostrum	
2 - 7 days	8-10[b]	5-8
2nd week	10-12	6-9
3rd week	10-12	6-9
4th week	5-6	3-4

[a] If scours occur during milk feeding, the amount of milk may be withheld or reduced to one-half. Provide an equal amount of water to replace the milk withheld.

[b] One gallon of milk weighs 8.6 lb.

A special feed termed prestarter is commercially available and has been used by some dairy farmers to aid in early weaning. Experiments with the program have shown that calves can be weaned as early as two weeks and although growth is slower for a few weeks it is non-significant at three months of age. Calves respond differently to such an early weaning program. Advantages in such a program are reduction of labor and costs. Disadvantages are slower growth and possible increased death losses.

Calves Need Fresh Water

Growing dairy calves should have access to clean, fresh water at all times after they are weaned. Most dairy farmers offer water during the milk feeding period. Pail feeding fresh water is best. Avoid feeding water just before feeding milk. Young dairy calves have a higher requirement for water than older animals per unit of body weight. As calves get older, provide about one foot of water space for each 10 heifers.

The Calf Starter Ration

The calf's appetite increases as it grows. Offering a small amount of good starter ration to the calf at 2 to 3 days of age is an excellent way to meet this increasing need (Figure 4). Also, unlike milk, a starter ration will stimulate early rumen function and the establishment of the rumen microbial population and growth of the rumen papillae. The grain starter is more effective than hay in encouraging rumen development. Early rumen development allows early weaning and helps the calf

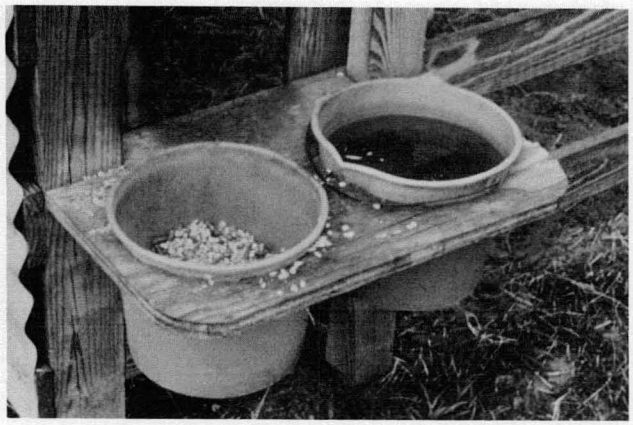

Figure 4. Bucket for feeding a palatable starter ration with water available.

overcome stresses associated with the milk feeding period.

A calf starter should be palatable and chewy. Some of the grain should be in the cracked, rolled or whole form. Variety is more important in a calf starter than in rations for the milking herd or older heifers. Pelleting is another method of increasing palatability when the ingredients are finely ground.

The calf starter ration should contain about 16 to 17% crude protein with added minerals and vitamins. University of Florida studies show an advantage in adding 10 to 15% cottonseed hulls to calf starter rations. Such rations need only contain 15 to 16% crude protein.

The calf starter should be supplied in a very small amount during the first week of life and then gradually increased. Feed only the amount that the calf will consume that day to help keep the feed fresh. Some calves will be consuming 3 to 5 lbs of calf starter daily at one month of age. Continue feeding the calf starter until the calf is about two months of age.

The Growing Ration

As calves increase in age and size, larger calves may be limited to about 4 to 6 pounds of grain per day and the smaller calves about 4 to 5 pounds per day in order to encourage consumption of roughage, especially hay (Table 4). When calves are older (8 to 10 weeks of age) and are consuming 4 to 5 pounds of calf starter daily, a more simple and economical grain mixture may be used (Table 5).

Table 4. Dairy calves receiving hay and a concentrate as the total ration.

	lb	DM	CP	TDN	CA	P
	----------	----------	lb	----------	----------	----------
Bermuda hay	2.00	1.76	0.14	0.80	0.00	0.00
Concentrate mix	4.50	1.35	0.63	3.12	0.03	0.02
Mineral	0.00	0.00	0.00	0.00	0.00	0.00
Totals	6.50	3.11	0.77	3.92	0.04	0.03
Requirements (150 lb body weight)			0.79	3.92	0.04	0.02

Table 5. Five simple 14-15% protein grain mixtures for supplementing growing heifers on pasture or other forages.

Ingredients*	1	2	3	4	5
	----------	----------	lb	----------	----------
Wheat, rolled	-	-	-	-	400
Soy hulls	300	300	-	-	300
Oats or barley, rolled	-	500	-	600	-
Citrus pulp	400	-	400	-	-
Molasses	100	150	-	100	-
Corn gluten feed	-	400	-	600	-
Wheat middlings	-	-	300	-	300
Soybean meal (49%) or peanut meal (50%)	290	130	260	40	180
Corn, cracked	870	470	1000	600	765
Urea	-	-	-	10	-
Defluorinated phosphate	20	10	5	0	10
Calcium carbonate	-	20	15	30	25
Salt, trace	20	20	20	20	20

* Add 6 - 8 million USP units of Vitamin A per ton.

Table 6 shows the amount of crude protein, total digestible nutrients, calcium and phosphorus needed for young growing heifers to make acceptable weight gains. A calf pasture should contain a good supply of clean water and some shade. Clip the mature plants and weeds occasionally. Mature plants are less palatable and less nourishing than younger growing plants.

Table 6. A feeding program for growing heifers weighing 800 pounds.

	lb	DM	CP	TDN	CA	P
	----------	----------	----------	lb	----------	----------
Bermuda hay	5.00	4.40	0.40	2.00	0.01	0.01
Grass pasture	50.00	7.50	0.90	6.00	0.03	0.02
Grain mixture(20%)	5.00	4.50	1.00	3.50	0.04	0.03
Mineral*	0.10	0.09	0.00	0.00	0.02	0.01
Totals	60.10	16.49	2.30	11.50	0.10	0.07
Requirements (800 lb heifers)			2.22	11.49	0.06	0.05

* Mineral contains 16% calcium, 8% phosphorus and 20% salt.

Calves on pasture should be supplemented with some grain and minerals. A complete mineral mixture containing about 20-30% salt, 8-10% phosphorus and 14-18% calcium may be used. Also, one part trace mineral salt mixed with one part defluorinated phosphate provides extra minerals. The minerals should be provided in a container or trough that provides heifers free access.

A feeding program should give the dairy heifer every opportunity to develop a healthy and strong body. A well-developed heifer has a far better chance of becoming a good producer than one poorly fed and cared for. Varying amounts of roughage and grain may be fed during the growing period, with the amount of grain based on the desired growth rates. A great deal of flexibility is possible during this period and similar results can be obtained by following one of several feeding plans.

There is no one best grain mixture for young dairy calves and growing heifers. A 14% grain mixture for dairy cows is satisfactory as a growing ration for older calves. This is true even though the grain mixture may contain some cottonseed hulls and urea. The level of urea (0.5% of DM intake) as recommended for mature cows also applies to growing heifers.

Hay Feeding

There have been a number of recommendations on the age when hay should be offered to young dairy calves. Some prefer to start feeding hay when calves are as early as one week old, while others recommend waiting until the calves are two months old.

Most calves will eat very little hay before they are two months old. A few, however, seem to have a strong appetite for roughage and may need to be fed some hay at an earlier age. For this reason, we recommend some hay when the calf is one to two months of age. Calves that select hay over grain should have hay restricted until they are consuming from one to two pounds of grain per day. Calf starter rations containing 10 to 15% cottonseed hulls provide adequate roughage during the first one to two months of life.

Hay is important for normal rumen function and should be made available to all calves over 1 to 2 months of age. More hay will be eaten if fresh hay is provided each day. Do not let hay get packed in hay racks for several days. Feed about the amount the calf will eat each day. An exception is where calves have free access to hay in round bales.

Minerals and Vitamins

Minerals and vitamins are important to all livestock, especially growing heifers. A free-choice commercial mineral containing calcium and phosphorus in about a 2:1 ratio with 20 to 25% salt and added trace minerals and vitamins should be adequate. Calves and heifers will consume less free-choice mineral if they are receiving a grain mixture containing a good balance of minerals. However, as heifers get older and pasture becomes more available, a free-choice mineral should be provided.

Antibiotics Used as Feed Additives

Antibiotics may be useful in starter rations in helping to reduce digestive disorders, increase feed consumption and improve daily weight gain in baby calves raised in some areas of Florida. In general, though, healthy dairy calves do not benefit from antibiotic supplementation.

Chlortetracycline (aureomycin) and oxytetracycline (terramycin) are of greatest value for calves when the untreated animals have had diarrhea or digestive disturbances.

Housing

Calves need clean, well lighted, properly ventilated quarters. Damp stalls, drafts, and wet bedding may lower the calf's resistance to certain diseases, especially pneumonia. Poorly ventilated quarters usually lead to strong undesirable odors. Individual, portable pens work very well in Florida.

Young calves should be placed in individual pens until 6 to 12 weeks of age, depending on facilities. The two most common types are portable and permanent pens. Permanent pens usually have wood-slatted or expanded metal floors that require no bedding and are easy to clean (Figure 5). Portable pens are popular in Florida (Figure 6). In addition to providing plenty of fresh air and shelter, they are inexpensive to make. Structures known as calf hutches are used in colder climates but are usually not needed in Florida.

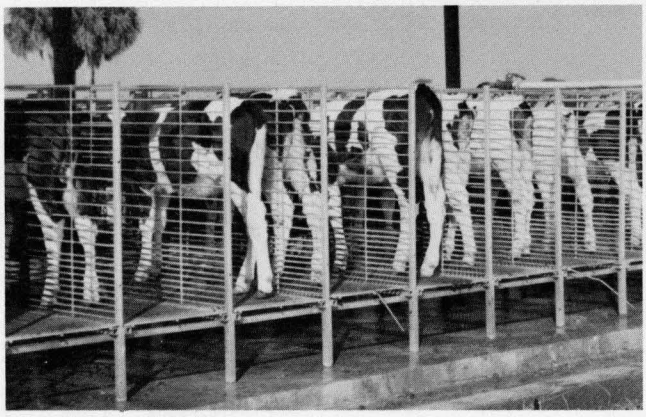

Figure 5. Calves in individual pens with easy-to-clean floors.

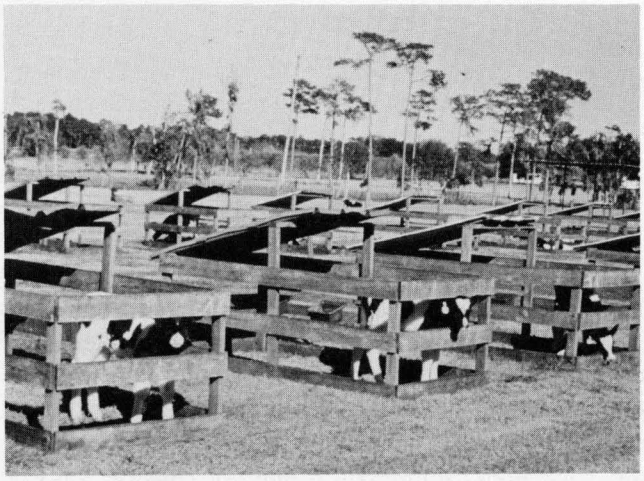

Figure 6. Portable pens can be moved to clean, dry ground as needed and are well-suited for use in Florida's mild climate.

There is less danger in spreading disease when calves are kept in individual pens. Portable pens are usually placed on clean permanent pasture with good drainage and a thick sod that serves as bedding for the calves. It is best to move the pens on a rotational basis every one to two weeks or as often as needed.

Grouping Heifers

Ideally, heifers should be placed in groups of 10 to 12 heifers per lot as soon as they are removed from individual pens. In most operations, this occurs at two to three months of age and provides ease in observing the heifers and detecting problems. Also, heifers tend to be more competitive at the feed bunk and, as a result, grow faster (Figure 7). As heifers become ready to be put on pasture at 5 to 6 months of age, larger groups are more desirable.

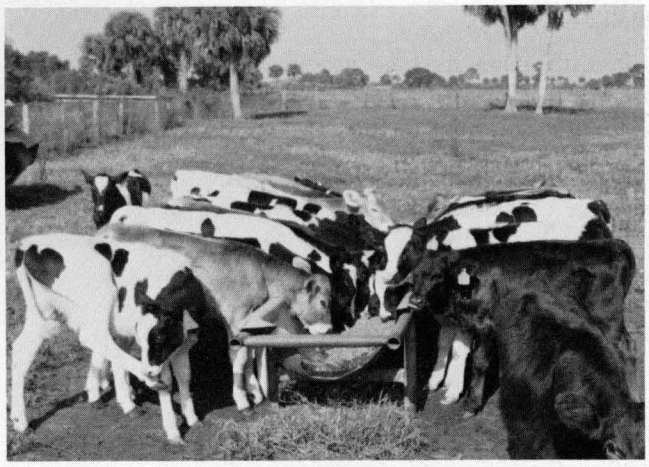

Figure 7. Weaned calves at feed bunk -- competition for feed can speed growth.

Things to Do Before Grouping

Before calves leave the individual pens, they should be dehorned, identified and extra teats should be removed.

Dehorning is a necessary surgical procedure in dairy calves. When performed early (at less than one month of age) setback is minimal, however, if the calf is near weaning age or beyond, dehorning can be particularly stressful. The preferred methods are burning the horn buds with an electric dehorner, or surgically removing them with specially designed dehorning gouges. Both of these instruments can be bought from most livestock supply companies. An alternate method of horn removal is chemical cautery. This must be performed with

great care in order to confine the caustic material to the horn bud area. Not uncommonly, calves will rub their heads on surrounding structures and inadvertently spread the caustic beyond the horn bud area, causing severe chemical burns to the head and face. When using caustics, calves should be isolated to eliminate contact with other calves.

The method chosen will determine the age at which dehorning is performed. Burning of horn buds can be done as early as one to two weeks of age on some calves. On others, horn buds may not be distinct until three to four weeks of age or older. Surgical removal requires a discernible horn bud. With either method, failure to burn or remove an adequate amount of the underlying horn bud tissue may result in the development of horn scurs. Aside from being unesthetic they can be troublesome and later require surgical removal. The best time to remove horns is when the calves are about one to two weeks old or as soon as the buttons can be distinctly felt.

Identification may be accomplished with commercially available numbered plastic ear tags as well as tattooing a number in the ear.

Removing extra teats is sometimes necessary because occasionally heifer calves are born with one or more extra teats. Later, these detract from the appearance of the udder and may interfere with milking. Removal of these extra teats is conveniently performed at the same time as dehorning or at least before the calf reaches six months of age. Disinfect the cut area with tincture of iodine or another antiseptic. If the extra teats cannot be readily distinguished or are attached to one of the regular teats, consult a veterinarian about removal.

Age-Based Grouping System

The following suggests a possible grouping system for replacement heifers:

a) **Weaning age to six months.** This group requires special attention and feeding to grow well (Figure 7). Vaccination programs for bangs and blackleg may be needed.

b) **Six months to nine months.** These calves need grain supplementation and good pasture.

c) **Nine months to breeding age.** This group may do well for short periods on quality forages and a mineral supplement. However, some grain may be needed for good growth.

d) **Breeding age to springing heifers.** Heifers in this group require special attention for breeding and mammary development (Figure 8).

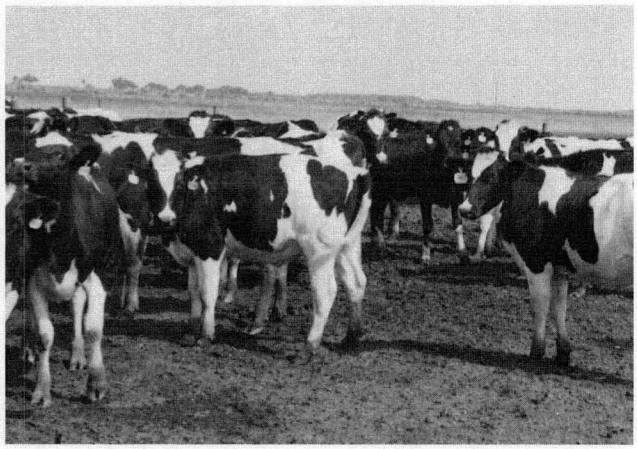

Figure 8. Breeding age heifers can be pastured in larger groups.

Provide adequate eating space for all heifers. Usually, 12 inches of manger space is needed for young calves and 18 inches for older heifers.

The Growing Dairy Heifer

Heifers are usually turned to pasture at five to six months of age and should receive grain supplements, the amount depending on the condition of the heifers (Table 4). Generally, two to five pounds of grain per day is needed for good growth. If the pasture contains some legumes, such as clover, a grain mixture containing 12 to 14% protein is adequate. If the pasture consists of grasses, millets, etc. the grain supplement should contain from 15 to 16% protein.

The desirable growth rate for large breed heifers (Table 7) from birth to 14 months is about 1.7 lb/day. At 14 months these heifers should weigh about 700 lbs.

Avoid Underfeeding and Overfeeding

Retardation of growth below recommended levels as shown in Table 7 tends to shorten the productive portion of the heifer's life. In some herds heifers frequently reach three years of age before first calving. The boarding bill for such heifers may become quite large.

Acceleration of growth above two pounds per day is also undesirable since lifetime milk production and longevity decrease. Tennessee studies show increased fatty infiltration of the mammary gland

Table 7. Daily nutrient requirements for growing heifers.[a]

Body Wt. (lb)	Daily Gain (lb)	Est. Age (wk)	NE g+m[b] (Mcal)	TDN (lb)	Crude Protein (lb)	Minerals Ca (lb)	Phos (lb)
			(Large breeds)				
90	0.90	1	2.00	2.15	0.40	.032	.012
100	1.00	3	2.14	2.24	0.45	.035	.013
150	1.40	8	3.33	3.92	0.79	.037	.018
200	1.50	13	3.90	4.06	0.94	.040	.020
300	1.70	21	5.24	5.56	1.29	.043	.024
400	1.70	29	6.31	6.75	1.60	.046	.028
500	1.70	37	7.33	7.92	1.82	.050	.032
600	1.70	45	8.28	9.10	1.87	.053	.036
700	1.70	54	9.21	10.27	1.94	.056	.040
800	1.70	63	10.10	11.49	2.22	.058	.043
900	1.70	71	10.96	12.75	2.52	.060	.044
1000	1.70	80	11.79	14.07	2.84	.062	.045
1100	1.70	90	12.62	15.48	3.20	.064	.046
1200	1.50	100	12.93	16.09	3.41	.064	.046
1300	1.30	110	13.20	16.65	3.61	.064	.046
			(Small breeds)				
60	0.70	1	1.25	1.03	0.40	.020	.010
75	0.80	2	1.60	1.55	0.50	.020	.010
100	0.80	10	2.60	2.80	0.60	.036	.018
150	1.00	19	3.20	3.45	0.75	.038	.019
200	1.10	26	3.64	3.76	0.93	.040	.020
300	1.30	37	5.04	5.32	1.26	.043	.023
400	1.30	48	6.06	6.56	1.54	.046	.026
500	1.30	59	7.08	7.80	1.60	.049	.029
600	1.30	70	8.07	9.07	1.75	.052	.032
700	1.30	81	8.93	10.41	2.07	.055	.035
800	1.10	92	9.37	11.06	2.43	.058	.038
900	1.10	105	10.19	12.52	2.84	.060	.042

[a] NRC requirements - 1988.
[b] Net energy for maintenance and growth.

and reduced number of alveolar cells available for milk synthesis. Greatest harm apparently occurs during pre-puberty (prior to first heat) with little to no detrimental effect on mammary growth post-puberty (from about 11 months on). Michigan State studies suggest that feeding high levels of energy to accelerate growth from breeding to calving does not inhibit formation of mammary secretory tissue, and would probably allow maximum lifetime milk yields.

When to Breed

Optimum time for first breeding depends on the feeding program and management system. Size is more important than age in determining when heifers should be bred. Often heifers are bred to freshen at a particular time of the year to increase milk sales when supply is low and price favorable.

Well-fed heifers can be bred at 14 to 15 months of age and should weigh about 750 pounds (Holstein and Brown Swiss). At this size, conception should be good with little to no increase in calving difficulties. During the nine month gestation period, heifers should gain from 400 to 500 pounds, 130 pounds of which is calf weight and associated tissue. Until three months of age the average rate of gain is seldom over one lb per day, so an average daily gain of 1.8 lb per day is recommended from 3 to 14 months in order to obtain the desired breeding size of 750 to 800 lb at 14 to 15 months of age. The suggested sizes and ages at which heifers are usually bred are given in Table 8.

Table 8. Age and weight to breed heifers and gestation periods.

Breed	Approximate Weight	Approximate Age (months)	Gestation Period
Ayrshire	600-700	14-15	278
Brown Swiss	750-850	14-15	288
Guernsey	556-650	14-15	283
Holstein	750-850	14-15	278
Jersey	500-600	14-15	278

A recent Iowa study compared age at calving on milk production of all first-lactation (305-2x-ME) heifers from 2124 herds (DHI records). The results are shown in Table 9.

Table 9. Holstein herds by average age at first calving, showing level of production.

Age Yr-Mo	No. Herds	-----1st Lactation----- Milk (lb)	Fat (lb)	Rolling Herd Avg.(lb) Actual
1 - 09	26	14,251	523	12,605
2 - 00	110	15,952	587	14,589
3 - 03	369	15,354	560	14,355
4 - 06	157	15,041	559	14,322
5 - 02	68	14,158	528	13,769

There is considerable cost in both time and money in rearing replacement heifers to first calving. Calving of replacement heifers at 23-24 months minimizes the cost of raising replacements and allows dairy farmers to begin receiving a return on investments without affecting lifetime production.

Diseases of Dairy Replacements

The diseases that account for most calf illnesses and deaths are septicemia, diarrhea, pneumonia and parasitism. Their frequency and distribution in and among herds reflects a complex interaction between the calf's immune defense mechanisms, environmental influences, and the capacity of various infectious agents to produce disease. The best solutions for herds experiencing excessive calf loss lie in differentiating those management practices which are beneficial from those which are detrimental or of little value in promoting health and preventing disease. For example, treatment of all newborn calves with hyperimmune serums or antibiotics is costly and of questionable value. While these may be advised for short-term problems, they are by no means a good substitute for environmental sanitation and early colostrum intake. Antibody-rich colostrum coupled with the highly absorptive gut of the newborn calf provides an unparalleled level of immunity to neonatal disease. Today's progressive calf programs are founded upon health management practices which augment this natural system and not on systems which rely primarily on treatment or vaccination schemes to control disease.

The following are some of the more common infectious diseases of calves from birth to weaning.

Septicemic Colibacillosis

Septicemia is the presence of bacteria and their toxins (poisons) in the bloodstream. It is caused by a wide variety of agents but when it occurs in calves under five days of age the most probable causes are invasive strains of *E. coli.*

The normal gut of calves and other animals is populated with millions of *E. coli* which live harmoniously with their host. Under certain conditions, however, this delicate balance is upset and the disease-producing strains increase. These organisms and their toxins multiply, cross through the intestinal wall and move into the bloodstream where they are distributed throughout the body. In unsanitary calving pens, invasive strains of *E. coli* can also cause systemic infection by entering through the navel of newborn calves.

Calves affected with septicemic colibacillosis become rapidly depressed and weak. Diarrhea may occur but is not a consistent feature of this disease. Mortality is usually high due to a severe endotoxic shock induced by circulating bacteria and toxins and calves may die within 12 hours of the onset of clinical symptoms. Death is often so sudden that it may be the only sign of disease observed.

Calves which survive the initial septicemic episodes may subsequently develop joint infections; hence, the syndrome of swollen inflamed joints caused by non-fatal cases of this disease are known as joint ill. The infected joints are painful and become arthritic. Severely affected calves may not make profitable herd replacements. In herds with a high incidence of septicemia, early culling of severely affected young calves may be necessary.

Septicemic colibacillosis should be suspected when there is excessive mortality in calves under five to seven days of age. Successful treatment depends upon prompt diagnosis. However, therapy is the least effective way to deal with this disease.

Calves deficient in colostral antibodies are most susceptible; dairy farmers who do not emphasize colostrum management often lose many calves to the disease. Calves born in a clean, dry calving area and given an adequate amount of colostrum soon after birth are less likely to suffer septicemia. Properly disinfecting the navel and moving the calf to a clean, dry individual pen will help ward off septicemia.

Diarrhea (Scours)

Diarrhea is common, if not universal, in calves under one month of age, and certainly not all cases demand aggressive treatment. However, diarrheic calves should be observed closely until stools return to normal consistency. Diarrhea can be caused by a variety of bacteria, viruses, and protozoa or may also result from improper feeding practices as discussed under "Starting the Nutrition Program." The following discussion will be limited to the infectious causes of diarrhea in young calves.

Enterotoxic Colibacillosis

While septicemia and rapid death are the distinguishing features of septicemic colibacillosis, enterotoxic colibacillosis is characterized by diarrhea, dehydration, and toxemia of varying severity. It is caused by enterotoxigenic (intestinal toxin producing) strains of *E. coli* (ETEC). These organisms do not enter the bloodstream but attach themselves to the wall of the upper small intestine where they multiply and produce large amounts of enterotoxin (poison produced in the intestine). These toxins drain fluid and electrolytes from the blood and other body tissues. This results in severe dehydration and a metabolic imbalance that will lead to death if not corrected. Enterotoxic colibacillosis is one of the most common forms of colibacillosis in calves under one week old. Death can occur suddenly before the development of diarrhea. Most infected calves develop a watery diarrhea. The tail, buttocks, and legs of an infected calf will usually be stained or soiled with diarrheic manure. These calves may refuse to suck, depending on the degree of toxemia and dehydration, and may lie down and refuse to rise as they grow weaker.

Whenever outbreaks of diarrheic diseases occur every attempt should be made to isolate the affected from the unaffected susceptible calves. As new calves are born they should be housed as far away as possible from sick calves. If possible, assign separate work crews to feed and care for each group so that the cross contamination potential can be minimized. Separate buckets or bottles should be used for feeding rather than using the same for all calves. Sanitation is a must in the control of diarrheal diseases. Provisions to insure that newborn calves receive colostrum are particularly important for resistance to these diseases. Promising results have been obtained from research trials on immunization of the pregnant dry cow against colibacillosis in calves. Vaccination of the cow within 2-4 weeks of calving with vaccines produced from strains of ETEC stimulates the production of a greater concentration of specific antibodies that, when given in colostrum at birth, provides an extra margin of protection against ETEC. More recently, with the development of a vaccine containing monoclonal antibody to the pilus antigen of ETEC, problem herds can get immediate protection for calves in the face of colibacillosis outbreaks. This must be administered as soon as possible following birth (within the first 8-12 hours at least) and is not effective as a treatment for calves which are already infected. It can only prevent the disease.

Rota and Coronavirus

Rotavirus is a frequent cause of diarrhea in calves under 2 weeks of age; coronavirus more often affects calves aged 2-4 weeks. As primary pathogens these viruses generally induce only a mild diarrhea, but when combined with secondary bacterial infections they may become major contributors to mortality in calves one month old and younger. Both viruses occur throughout the United States and in many foreign countries. Recent studies in the U.S. indicate that these viruses are present in most, if not all, herds and that the majority of calves eventually become infected by them. These viruses survive in feces for long periods. After ingestion they attack the epithelial cells lining the small intestine. The loss of this cellular barrier increases susceptibility to invasion by other infectious agents. A vaccine against these viruses is available for pregnant cows and newborn calves and should be used where the viruses are particularly troublesome. Some dairy managers have found that feeding colostrum continually for a week after birth reduces the incidence of serious diarrhea caused by these viruses.

Salmonella

Salmonellosis causes at least three clinical syndromes in cattle: septicemia, enteritis, and abortion. Septicemic salmonellosis is most common in calves,

and typically occurs at 3-4 weeks of age. (septicemic colibacillosis is more common in calves under 2 weeks of age.) Infected calves become weak and occasionally show signs of incoordination, suggesting involvement of the nervous system. The disease may end in death within 24-48 hours of the onset of illness. The typical mortality rate is 25%, but it may approach 100%.

Methods of treatment are controversial, but regardless of the therapeutic regimen chosen, treatment must begin early in the course of the disease. Control during outbreaks requires strict environmental sanitation and isolation of affected calves. Calves should be kept in individual pens, and feeding utensils should be routinely disinfected. Prevention using vaccines for salmonella have yielded mixed results and cannot be universally recommended at present.

Sudden Death Syndrome (Enterotoxemia)

The sudden death of an apparently healthy calf is frequently due to enterotoxemia caused by *Clostridium perfringens*. These organisms occur naturally in the soil and may be found in the gut of normal calves. Under certain conditions, clostridial organisms multiply while in the intestinal tract and produce a potent enterotoxin that damages blood vessels in the brain as well as other tissues. Death usually occurs suddenly.

Overfeeding of grain and/or milk is one cause for the rapid proliferation of *Clostridia*. Calves consuming considerable amounts of grain while still receiving a full feeding of milk are most likely to develop this disease, thus the incidence of sudden death is generally highest for calves 3-8 weeks of age. Since most calves are fed free choice and feeding errors are sometimes made, dry cows and calves should be routinely vaccinated with Clostridium C and D toxoid. For dry cows being vaccinated for the first time, two injections should be made 2-3 weeks apart. For calves, vaccinations should be made at 1-2 weeks of age and repeated in 2-3 weeks.

Pneumonia in Calves

In cool climates, calf pneumonia is usually associated with poor ventilation. In Florida, however, calf pneumonia often occurs around weaning time when calves are moved from individual to group pens. The co-mingling of calves into group pens increases the potential for their exposure to disease organisms. Problems are compounded by stress associated with pecking order establishment rituals. Consequently, calves should be grouped according to breed and body size and groups should contain no more than 10-12 calves.

Some dairy farmers make the stress to calves worse without meaning to by scheduling vaccination, dehorning, and deworming procedures too close to weaning for the sake of convenience or because it may seem like the most appropriate time. It is preferable to perform these procedures at least 1-2 weeks before or after weaning.

The infectious agents which most usually cause respiratory disease in calves are the bacteria *Pasteurella* spp., *Corynebacterium pyogenes*, and *Mycoplasma* spp.; and several viruses including infectious bovine rhinotracheitis (IBR), parainfluenza-3 (PI3), bovine virus diarrhea (BVD), and bovine respiratory syncitial virus (BRSV). Calves are exposed to these pathogens as they are put into group pens where they share feed and watering facilities. Calves are more likely to resist infection if weaning stress is minimized. Vaccinating cows with IBR/PI3 and BVD protects newborn calves who are fed colostrum of from vaccinated cows (CAUTION: do not use modified live vaccines for IBR and BVD in pregnant cows). The intranasal IBR/PI3 vaccine may provide calves additional immunity to disease. Several respiratory disease complex vaccines are now being developed. *Pasteurella hemolytica* vaccine, which has been developed recently, may also be helpful in preventing infection where this organism is a major cause of pneumonia.

Parasite Problems of Dairy Replacements

Protozoal Parasites of Cattle

Coccidiosis: The acute form of coccidiosis, caused by a protozoan, is characterized by bloody diarrhea and anemia. Calves 3 weeks to 6 months old are most susceptible to infection. The disease usually strikes at weaning time when calves are moved to overcrowded, dirty and wet pens. Feeding hay fed from the ground or grain from low troughs which are easily contaminated by fecal material increases the likelihood of infection.

Once ingested, coccidia invade and destroy the epithelial cells lining the intestine. Diarrhea, sometimes bloody, and anemia are often observed in clinically affected calves. Calves that survive coccidiosis develop long-lasting immunity. Pens should be maintained in dry areas with a sufficient drainage system. Overcrowding should be avoided and waterers and feeders should be constructed or

located so that fecal contamination can be averted. Medicating feed and water supplies usually controls the disease without interfering with the development of immunity.

Cryptosporidiosis: These organisms are protozoans like coccidia, and are capable of infecting a variety of animals, including man. The disease is reported to be common in calves up to one month old; however, in Florida, it most frequently is observed around 7-10 days of age. Recent surveys on several Florida dairies have found a high incidence of cryptosporidial infection in calves between 5 and 15 days of age.

Cryptosporidia damage epithelial cells of the small intestine. This decreases the absorptive ability and surface area of the gastrointestinal tract and causes watery diarrhea. Because the infected calf cannot digest and absorb nutrients, it loses weight.

The importance of cryptosporidia as a cause of calf diarrhea is unclear, however it has increasingly been reported as a finding in calves with diarrheal disease. Less severe experimental infections often clear up in 1-2 weeks, whereas naturally acquired infections are often complicated by *E. coli* or rotavirus and may lead to death. Like aforementioned pathogens, cryptosporidia are found in the gut of healthy calves. One study showed that neonatal calves deficient in colostral antibody are at increased risk of developing cryptosporidial-associated diarrhea. The best current treatment is good nursing care. The best prevention is to feed calves colostrum at birth. Continued feeding of colostrum through the first week of life may provide additional protection against cryptosporidia as well as other pathogens likely to infect calves during this period.

Nematode Parasites of Cattle

Nematode or worm infections in cattle usually begin with first exposure to grass. Most young animals have only a limited immunity to parasites, and will develop overwhelming infections if not carefully monitored. However, calves who recover from these infections develop a long-lasting immunity that protects them into adulthood. In the southeast, low immunity is often a result of malnutrition or conditions conducive to extreme parasite exposure.

General Life Cycle of Nematodes: The life cycles of gastrointestinal parasites are similar in that none needs an intermediate host (Figure 9). Mature worms produce eggs that are passed in the feces. After variable lengths of time these eggs hatch,

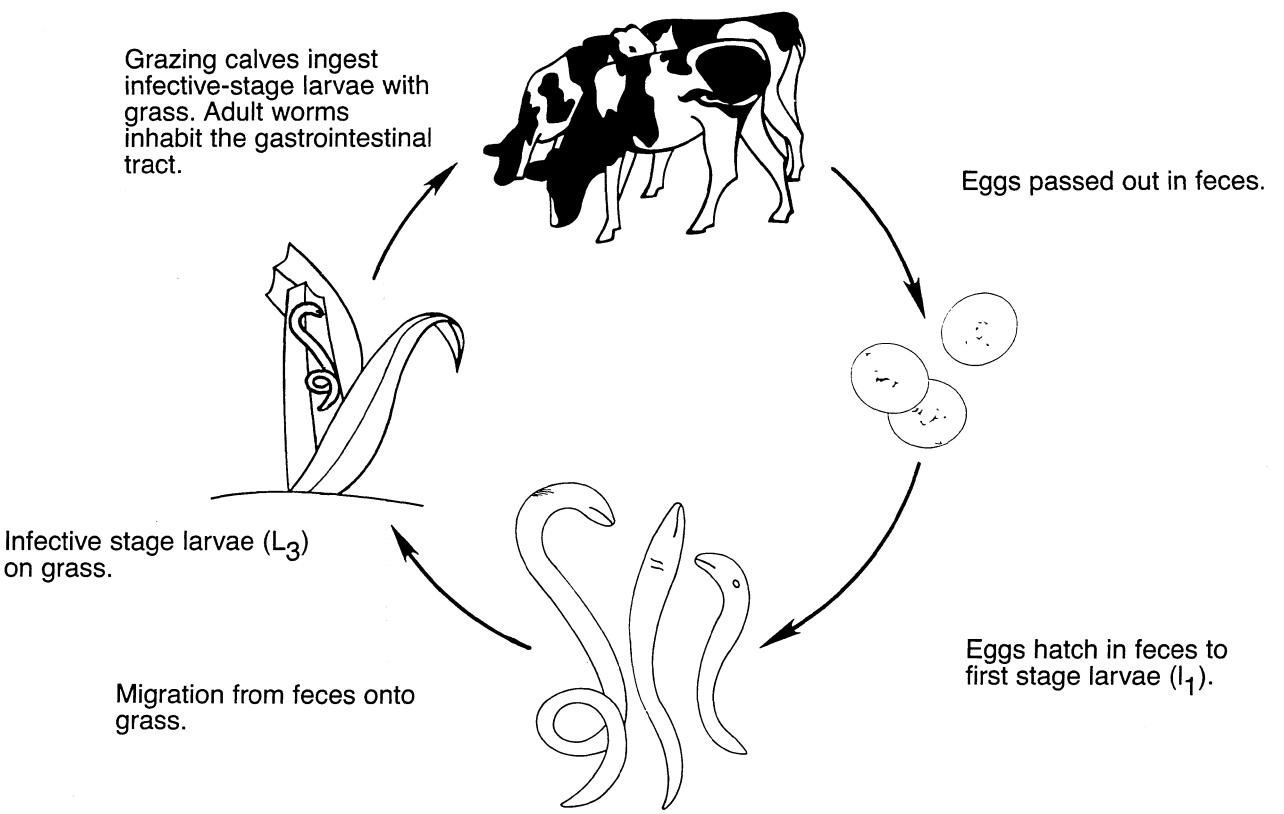

Figure 9. Life cycle of the common gastrointestinal nematode parasites of cattle.

liberating the first of two free-living larval stages, commonly known as L_1 larvae. These larvae grow and molt twice, giving rise to third stage "infective" larvae (L_3). This infective L_3 remains in the manure pat until it moves onto surrounding vegetation following periods of rainfall or heavy dew. Cattle become infected while grazing infected pasture and ingesting infective L_3. In general, survivability of the infective L_3 is most favorable during cooler seasons in Florida, whereas survival is less certain during the hotter and dryer times of the year. In the gut, L_3 undergo further development to an L_4, L_5 , and an adult stage. Once mature, they reproduce and the cycle repeats itself.

An understanding of this basic life cycle is fundamental to the development of rational control strategies. The most effective control schemes are based upon appropriate use of anthelmintics in a deworming program designed to prevent contamination of pastures with infective stages of parasites. This can be accomplished by deworming immediately prior to movement to new grazing areas and again three to four weeks later.

In the sections that follow are descriptions of the disease syndromes resulting from common nematode infections in cattle. These descriptions are organized under general headings according to the organ or organ system in which they occur.

Stomach (Abomasum) Worms: The stomach worms of major significance in cattle, *Ostertagia ostertagi, Trichostrongylus axei,* and *Haemonchus spp.*, tend to be the most pathogenic of the gastrointestinal parasites and consequently the most important economically.

Ostertagia, known as the brown stomach worm, is capable of entering an arrested state of development for as long as six months. Because of this unique ability, two types (Type I and Type II) of ostertagia infection are recognized. Type I ostertagiasis is most typically seen in the southeast during the winter and spring in heifers during their first season at grass. The clinical syndrome is characterized by diarrhea, weight loss, decreased appetite, and hypoproteinemia (low blood protein) exhibited as submandibular edema (bottle jaw). Damage to abomasal digestive glands in the stomach is caused by both the larvae and adult worms during their development, but in particular, by emergence of the adult L_5 from the glands.

Type II ostertagiasis occurs in young stock (yearlings and first and second calf heifers) that have had at least one grazing season. In the southeast it is most commonly observed in late summer and early fall. The clinical signs are similar to those described above, but usually more severe. Also, it differs from type I in that the occurrence is more sporadic with smaller numbers of animals in a herd affected. Type II disease is caused by the accumulation of arrested larvae acquired during the late spring of the previous grazing season. Signs of disease are evident in the fall as the adults emerge from the glands as described earlier for Type I. An early summer deworming with an anthelmintic capable of eliminating those arrested larval forms can prevent Type II ostertagiasis.

Trichostrongylus axei and *Haemonchus* spp. induce a clinical syndrome similar to that of Ostertagia with a few minor exceptions. In sufficient numbers, *Trichostrongylus axei* is a serious parasite that causes diarrhea, weight loss, mild anemia, and rough hair coats. Heavy infections with *haemonchus*, in both larval and adult stages, can result in profound anemia as both larval and adult stages are blood suckers. *Haemonchus*, unlike ostertagia, causes infection during warm, wet weather and may be troublesome during the summer months in Florida.

Intestinal Worms: Worms found in the intestinal tract include: *Cooperia* spp., *Strongyloides papillosus*, *Trichostrongylus colubriformis*, *Nematodirus helvetianus*, *Bunoostomum phlebotomum*, *Oesophagostomum radiatum* and *Trichuris discolor*. Heavy infections with these worms result in poor digestion, weight loss, diarrhea, stunted growth and occasionally, coughing and dermatitis. Some of these worms penetrate the skin and migrate to the lungs and other tissues. Others are blood suckers and all damage the intestinal tract to varying degrees. These worms, however, are not generally as damaging as the stomach worms described previously.

Lungworms: *Dictyocaulus viviparous* is the lungworm of cattle. It is a major cause of respiratory disease in cattle in the southeast as well as in the more temperate climates. Infections typically occur in young stock (less than one year old) grazing on pasture. Climatic factors have a major influence on the incidence of this disease with most outbreaks occurring during the warm, wet spring and summer months. Affected animals show only a slight cough in the early course of the disease. Later on the coughing becomes severe and breathing becomes difficult. Animals may be seen stretching their

heads and necks to facilitate breathing. When the disease reaches this stage (usually 3-6 weeks following from onset), death loss may be high. Animals that survive the acute infection will develop a variable degree of immunity, however, many will not be productive due to permanent lung damage.

The life cycle of lungworms is different from that described earlier for stomach and intestinal worms. In the lungworm cycle (Figure 10), cattle ingest infective L_3 while grazing. These larvae penetrate the gut wall and enter the blood stream where they are carried to the lungs. They undergo further development in the bronchi and bronchioles of the lung to the adult stage. Here they lay eggs which are coughed up and swallowed. The eggs hatch larvae in the intestinal tract to L_1 larvae which are passed in the feces. They develop to the L_3 larval stage in manure pat and soil. The L_3 larvae can remain infective for months in the manure pat or on vegetation where the larvae migrate following rainfall.

There are several products available for treatment of lungworms. Other important considerations for control should include efforts to reduce exposure of young cattle to infective larvae. Young, susceptible animals should not be grazed on pastures contaminated by older animals especially during the spring and summer months. Deworming of yearlings should be accomplished so that pasture contamination can be avoided.

Trematode and Cestode Parasites of Cattle

Liver flukes (Trematodes) and tapeworms (Cestodes), unlike the nematode parasites described above, depend on an intermediate host for completion of their life cycle.

Liver Fluke Infection (Fascioliasis): Liver flukes are common in the southeast, particularly along the Gulf Coast and central and south Florida. They are often responsible for significant economic losses in beef cattle from reduced production efficiency and

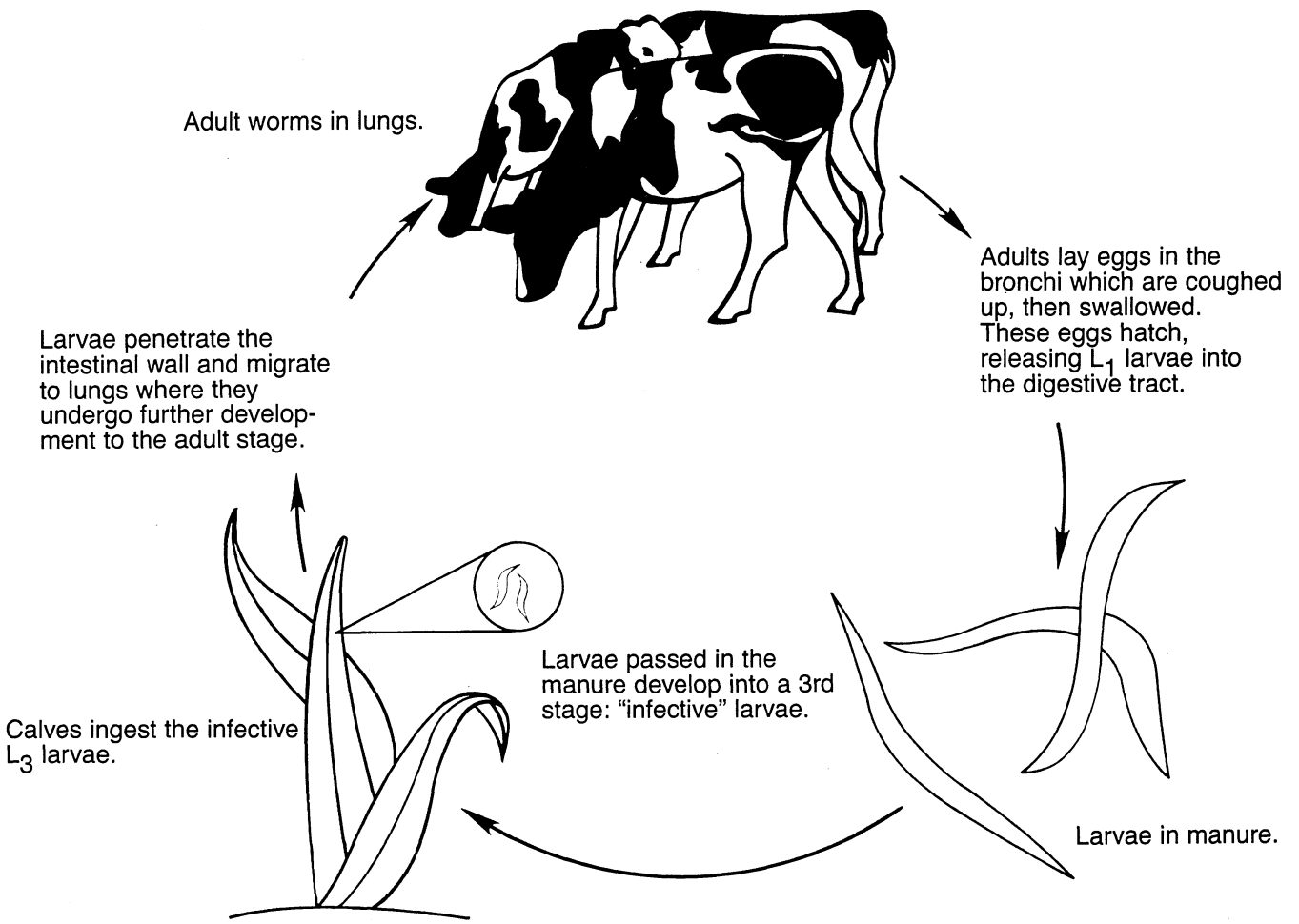

Figure 10. Life cycle of *Dictyocaulus viviparous*, the lungworm of cattle.

liver condemnation at slaughter. In dairy replacements, primary losses result from occasional deaths, depressed growth, poor feed conversion, and impaired reproduction. While liver fluke infection may cause acute disease in cattle, it is often chronic and asymptomatic (showing no symptoms).

Completion of the life cycle of the liver fluke (Figure 11) requires the presence of a lymnaeid snail which serves as the intermediate host. In Florida, only two species of snails, *Lymnaea cubensis* and *Pseudosuccinea columnella*, are capable of fluke transmission. These snails are not found in or near large bodies of permanent water or on dry land. They prefer soils with a neutral pH and thus are not commonly found in cypress heads where soils are too acid. Ideal habitat for these snails is water-saturated soil in poorly drained pastures, irrigation ditches, and around springs.

Adult flukes living in the bile ducts of the liver lay eggs that eventually enter the gastrointestinal tract with the bile. These eggs are passed in the manure and hatch, releasing free-living miracidia. The miracidium infects a lymnaeid snail, develops into a cercaria which leaves the snail to encyst on vegetation as a metacercaria. This is the stage infective for cattle, which ingest metacercariae while grazing. Following ingestion, metacercariae invade the wall of the gastrointestinal tract and migrate to the liver. During migration, they continue to develop into immature flukes. Upon reaching the liver they invade and continue their migration through the liver tissue and eventually enter the bile ducts where they develop to adults, feed on blood, and begin to lay eggs.

A two-pronged approach is necessary to control liver flukes: snail population control, and the use

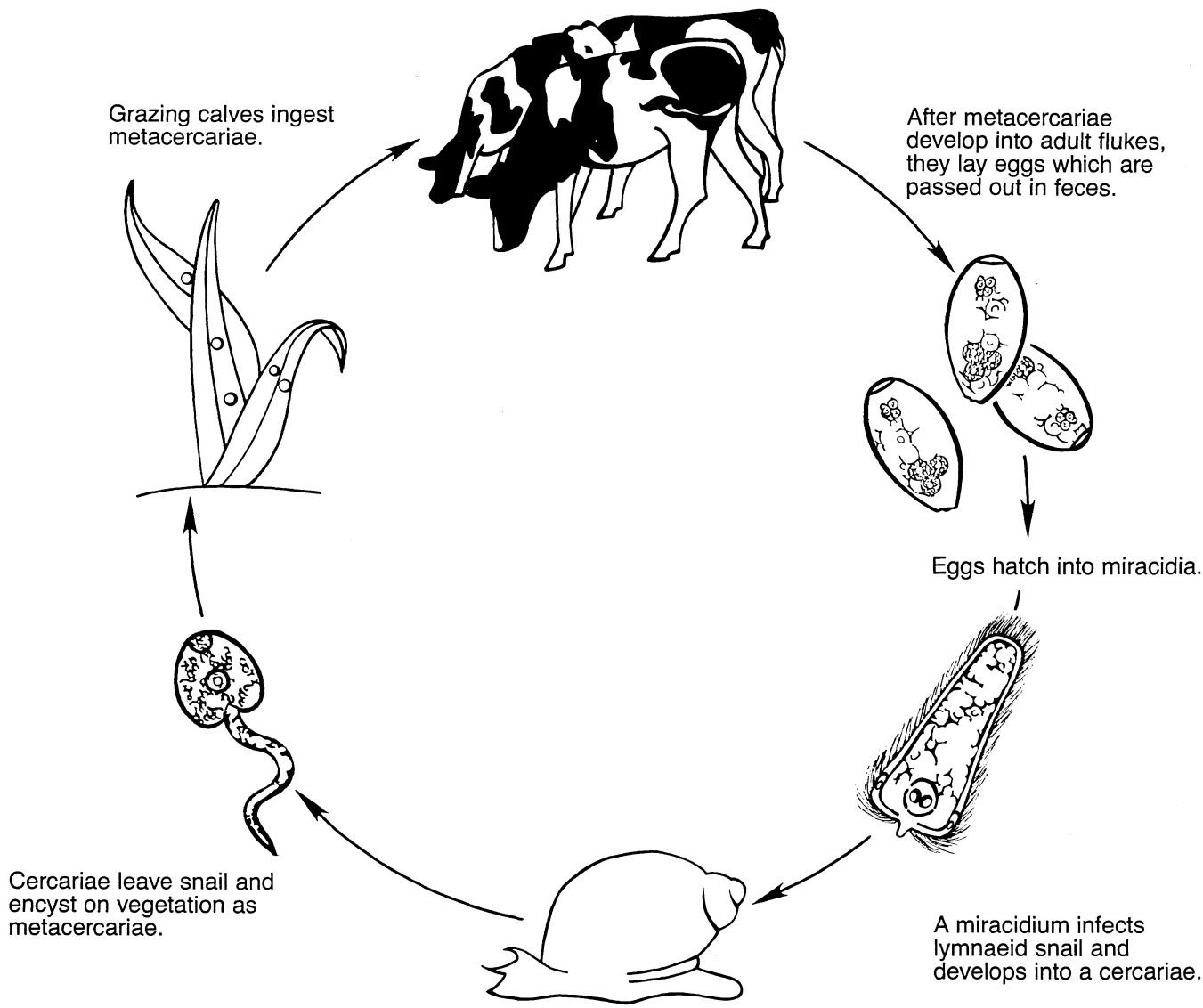

Figure 11. Life cycle of *Fasciola hepatica*, the liver fluke of cattle.

of anthelmintics to reduce pasture contamination. Controlling snail populations may not be practical under certain conditions, but improving pasture drainage, repairing leaky water pumps and irrigation lines, and fencing off localized areas prone to heavy contamination with metacercariae will help in reducing potential exposure.

Strategic anthelmintic treatment regimes are currently being studied in Florida. Present recommendations suggest treatment in the fall (September through December) and again in late spring, prior to the summer rainy season (Table 10). Curatrem (clorsulon) is the only treatment presently available for liver flukes.

Tapeworms: Tapeworm infection is common in young replacement heifers during their first grazing season. Tapeworms rarely cause serious disease, but in extremely heavy infections may be responsible for depressed growth rates.

Like the liver fluke, the tapeworm requires an intermediate host to complete its life cycle. Free-living mites feed on the egg-bearing segments of the adult tapeworm that are passed in manure. Tapeworm infection develops when infective mites are eaten during grazing. Adult tapeworms attach themselves to the mucosal wall of the small intestine. Tapeworms grow in segments as they absorb nutrients from ingesta in the small intestine. Infections in older cattle are usually of minimal consequence. There is no effective treatment.

External Parasites

Lice: Cattle in the United States are troubled by four species of sucking lice and one species of biting lice. Lice can cause death in heavily infested calves, but often only slow weight gain and reduce feed conversion efficiency. Heavy infestations of sucking lice often cause a blood loss sufficient enough to result in serious anemia. Anemic calves become weak, and are increasingly susceptible to other diseases which may lead to death. Biting lice feed on skin and cause the animal to develop a scruffy appearance with hair loss and raw, reddened skin . Infected animals lose hair when they rub, scratch, lick, and bite the irritated skin.

In Florida, probably the most important louse is the tail louse, (*Haematopinus quadripertusis*), a sucking louse found only in the Gulf Coast states and Puerto Rico. These lice inhabit the brush or switch of the tail; immature forms may be found near the eyes and eyelids and in the ears.

Cattle lice control methods include pour-on insecticides, dust bags, sprays, and backrubbers.

Flies: Flies of major importance in livestock in Florida are horn flies, house flies, and stable flies. Nationwide losses to these pests are estimated to be in excess of $400 million annually through decreased weight gain, lower milk production and control costs. Because of their rapid reproductive rate, flies quickly develop resistance to insecticides, making them one of the most difficult parasites to control.

Grazing heifers are likely to suffer from horn flies. The flies' mouthparts pierce skin and suck blood from the animal's back and shoulders. In this location they are less accessible to switching tails.

Table 10. Liver fluke control recommendations for Florida using Curatrem[a].

Yearly Weather Pattern	Severity of Flukes on Dairy		
	Low	Moderate	Severe
Average rainfall	autumn only (reduced dose)[a]	autumn only (full dose)[b]	autumn & spring (full dose)
Dry spring/dry autumn	autumn only (reduced dose or none)	autumn only (reduced dose possible)	autumn & spring (full dose)
Wet spring/dry autumn	autumn only (reduced dose possible)	autumn and spring (full dose)	autumn & spring (full dose)
Dry spring/wet autumn	autumn only (full dose)	autumn only (full dose)	autumn & spring (full dose)
Wet spring/wet autumn	autumn & spring (full dose)	autumn & spring (full dose)	autumn & spring (full dose)

[a] Curatrem - Merck, Sharp and Dhome.
[b] Reduced dose: 1/4 oz. (7 1/2 ml) per 400 lbs body weight.
[c] Full dose: 1/4 oz. (7 1/2 ml) per s00 lbs body weight.

Self-application devices, such as dust bags and back-rubbers, provide daily fly control to pastured cattle. Calves in isolated pens should be sprayed or dusted individually.

Confined cattle are more vulnerable to stable flies and house flies. Similar to the horn fly, the stable fly is a voracious pest. They cause blood loss poor feed conversion, annoyance and irritation. Swarms of flies can cause pastured or drylot cattle to bunch together. This, during the summer months, increases heat stress.

The house fly is the vector of numerous animal and human diseases. One of the more important of these diseases in heifers is pinkeye. In northeastern states, the face fly transmits pinkeye. The face fly does not presently occur in Florida, but its role in spreading pinkeye has been assumed by the house fly. Both species feed on secretions of the eyes, muzzle, and other mucus membranes. As cattle bunch together, the disease spreads rapidly throughout the herd. Pinkeye vaccination continues to grow in popularity as a means to reduce the incidence of pinkeye in herds.

Control methods for stable flies and house flies consists primarily of insecticide self-application devices or regular spraying or dusting. Problems with fly populations resistant to the insecticides used in eartags have made these of limited value in fly control.

Summary

Many dairy farmers and skilled calf raisers have been successful in raising replacement dairy heifers through good management techniques such as those described in this circular. The importance of good management cannot be overemphasized since a sizable investment is incurred in any good heifer raising program. To protect this investment, start with good breeding and follow through with solid management and careful attention to details. Remember that even the best facility is no better than the manner in which it is managed and average quality heifers tend to be average quality cows. Well-planned facilities and programs allow dairy farmers an opportunity to use their time and labor more efficiently in raising healthy replacements.

This publication was produced at a cost of $1,643, or 82 cents per copy, to provide information on raising replacement heifers to Florida dairy operators and other interested persons. 8-2M-88

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