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Molasses-Based Feeds and Their Use as Supplements for Brood Cows[1]

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Introduction

Molasses-based supplements have been fed to cattle in Florida for decades. In the early years these supplements consisted of molasses alone, but the formulation of molasses supplements progressed and now includes the addition of crude protein, minerals, vitamins, feed additives and intake limiters. A molasses-based mixture can be a high crude protein supplement added to concentrate feeds, a medium to high crude protein supplement fortified with minerals and vitamins fed in a lick-wheel tank or an energy supplement fed in open troughs to cattle grazing pasture or native range. It can be a simple mixture of molasses and urea, or a complex mixture containing molasses, other liquids, natural protein, non-protein nitrogen, phosphorus, several trace elements, vitamins or other feed additives.

While diversity of formulation has been a strong point of molasses-based mixtures, it has also created confusion. Each of the preceding examples can be useful under certain conditions, but of limited value in other situations. For a supplementation program to be successful the class of cattle to be supplemented and the quantities of nutrients supplied by other feeds (forage or other supplements) must be known. Then a proper molasses-based supplement can be selected and fed in quantities to supply needed nutrients.

Purpose

The first objective of this circular is to discuss molasses-based feeds in general. This includes an overview of the numerous ingredients used to formulate molasses-based feed mixtures, advantages and precautions of feeding molasses-based feeds, types of feeding equipment, and when and where to use different formulations. This will help producer select and feed a molasses-based supplement that best fits their situation.

The second objective is to help cow/calf producers determine the benefits of feeding molasses-based supplements to the brood cow herd. This will be accomplished by presenting production results from two recent long-term experiments which evaluated typical molasses-based supplements that were fed to brood cows grazing Florida pastures.

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Ingredients Used In Molasses-Based Mixtures

Molasses is the component used most often in liquid feeds and the two forms commonly fed in Florida are produced in the state. Sugarcane molasses (blackstrap) is a by-product of the manufacture of cane sugar. Standard sugarcane molasses contains 79.5° Brix (percent solids by weight) and not less than 48% total sugars expressed as invert sugar. Heavy millrun blackstrap is more concentrated and contains 85° to 90° Brix. Blackstrap molasses is the ingredient most often used in molasses-based feeds fed in Florida. Citrus molasses also is produced in Florida from concentrated press liquor obtained from the manufacture of dried citrus pulp. It contains not less than 71° Brix and 45% total sugars as invert sugar.

A number of other liquid ingredients are often used in molasses-based feeds. These include phosphoric acid, ammoniated polyphosphate, lignin sulfonates, fish solubles, whey, and various fermentation products (Table 1). The wide variety of other ingredients used in molasses-based liquids (Table 1) and their value is proportionally related to the quantity of nutrients they contribute to the mixture (crude protein, energy, minerals, and vitamins). The extent to which a specific ingredient is used is influenced by nutrient content, availability, and cost. Molasses-based mixtures can also contain antibiotics or fermentation modifiers (ionophores), but the specific formulation must have FDA approval based on its level of consumption and effectiveness.

Advantages of Molasses Feeds

Molasses-based feeds have a number of advantages as a supplement:

- They utilize and increase the value of by-products from Florida industries and provide a locally available, economical feed for cattle.
- Cattle consume molasses rather slowly even when it is offered on a free-choice basis. These feeds provide a consistent supply of nutrients to all cattle in a herd over an extended period. Fewer feed troughs are needed than with dry supplements.
- There is little waste.
- They serve as a good carrier for many ingredients which will be uniformly dispersed in a stable mixture.
- They provide a readily available source of energy.
- Molasses mixtures require less labor in handling and feeding if proper equipment is available.
- Molasses supplements are high in magnesium, potassium and sulfur.
- Molasses mixtures can increase total dry matter intake when fed with concentrate or forage diets.

Considerations When Feeding Molasses Mixtures

A number of precautions should be considered when purchasing and using molasses-based mixtures. These are listed as follows:

- Ingredient formulation and nutrient content can vary widely among manufacturers and/or molasses sources.
- Overconsumption or underconsumption may occur.
- Labeling may be inconsistent.
- Materials of low nutritional value may be included.
- Molasses mixtures may contain considerable amounts of water (moisture on the analysis tag).
- Flow characteristics of molasses mixtures may be reduced during cold temperatures.

- Molasses mixtures may ferment if the moisture level is too high.
- It is difficult to incorporate some materials into a molasses mixture; suspension characteristics should be evaluated to be sure materials do not separate.
- Adequate quantities of forage or roughage should be provided when feeding molasses supplements.

Some molasses-based mixtures contain urea. A major concern when feeding molasses-based mixtures containing urea is toxicity. To prevent this, a few simple precautions should be taken:

- Never feed mixtures from an open trough in which the equivalent crude protein from non-protein nitrogen exceeds 15%, unless it is a formula that limits intake.
- Never offer starving or underfed cattle free access to medium or high non-protein nitrogen molasses supplements. Fill them up with forage or other feeds first.
- Always provide adequate quantities of forage or other feeds along with the high non-protein nitrogen molasses supplement.

Evaluating Molasses-Based Feed Formulas

It is important to learn as much as possible about the composition of a molasses-based mixture in order to select the correct formula at the lowest cost. The most helpful source of information is the feed analysis tag. An example is presented in Figure 1. Study all feed analysis tags carefully.

Be certain that nutrients or items listed on the tag are contained in significant quantities and relate to cost. In terms of cost of the feed and the quantity required by cattle, the two most important nutrients are energy and crude protein. Minerals and vitamins are important, but are required in small quantities, and the cost of adding them is relatively small. Minerals and vitamins also may be provided in a mineral supplement available to cattle all year.

GUARANTEED ANALYSIS

Crude protein	Min 20%
(This includes not more than 14% equivalent protein from non-protein nitrogen).	
Crude fat	Min 2%
Crude fiber	None
Calcium (Ca)	Min 0.3%, Max 1.0%
Phosphorus (P)	Min 0.5%
Magnesium (Mg)	Min .0001%
Copper (Cu)	Min .003%
Iron (Fe)	Min .006%
Cobalt (Co)	Min .0002%
Zinc (Zn)	Min .015%
Iodine (I)	Min .0002%
TSI (Total sugars as an invert)	Min 30%
Moisture	Max 35%
Vitamin A	Min 15,000 IU/lb
Vitamin D	Min 4,000 IU/lb
Vitamin E	Min 5 IU/lb

Ingredients: Cane molasses, urea, phosphoric acid, condensed molasses solubles, animal fat preserved with BHA, calcium sulfate, vitamin A palmitate, vitamin D activated sterol, vitamin E supplement, manganese sulfate, ferrous sulfate, copper sulfate, ethylene diamine dihydriodide, cobalt sulfate, zinc sulfate.

Figure 1. Typical feed analysis tag for a liquid feed.

The following guidelines can be used to evaluate the information on the feed analysis tag:

1. Energy content - It is difficult to evaluate the energy of molasses-based supplements, since standard energy values such as total digestible nutrients (TDN) are not used. Some feed tag analyses that are indicative of the energy value include the following:

a. Total sugars, invert sugars, or carbohydrate content. These nutrients supply energy in molasses based feeds; each 1% of sugar approximately equals 1% TDN.

b. Moisture content. Water supplies no energy or protein and reduces the nutritive value.

c. Ash or mineral content. A high ash or mineral content reduces the energy value.

d. Brix value. It is a measure of the solid component (by weight) and generally indicates the sugar content.

e. Fat content. Fat often is added to molasses supplements to improve the energy value; each 1% of fat is equal to approximately 2.25% TDN.

2. Crude protein - Crude protein can be derived from natural protein and non-protein nitrogen (usually urea). These two forms make up the total crude protein content. However, crude protein from natural protein is often better utilized than that from non-protein nitrogen, particularly in situations where forages low in TDN are fed. An indicator of natural protein content is the difference between total crude protein and crude protein from non-protein nitrogen, both listed on the feed tag.

3. Mineral content - Determine if the quantities listed are significant in relationship to the requirements of the animal. Requirements can be found in NRC (1984).

a. Phosphorus (most important).

b. Calcium, magnesium, and potassium.

c. Trace elements (copper, iron, cobolt, selenium, zinc, manganese, iodine).

4. Vitamin content - As with minerals, determine if the quantities listed are significant in relation to requirements. Important vitamins are A and E.

Equipment

Because they are liquid, molasses supplements can be handled easily with little labor and fed on a free-choice or limited basis. Molasses-based supplements can be transported in 55-gallon drums and fed in any container that holds liquid (Figure 2), or transported in trucks or tractor-drawn tanks and fed with modern lick-wheel equipment (Figure 3).

Open troughs are convenient for feeding molasses-based supplements, although minor drawbacks are encountered. For example, the feed is exposed to weather as well as birds and other animals. Also, cattle and calves may occasionally be pushed into the trough. Intake of molasses mixtures by brood cows can be relatively high from open troughs; greater than 10 pounds/cow daily has been observed. Molasses mixtures can be limit-fed by filling open troughs only twice a week. If a 3- or 4-day supply is

Figure 2. Brood cows eating a molasses mixture from old bathtubs. Courtesy of John Black, U.S. Sugar Corporation, Clewiston, Florida.

Figure 3. Modern lick-wheel equipment.

provided at one time to brood cows being fed 3 to 5 lbs/head/day, it will require one or more days for the cattle to eat that feeding. All cattle will have a chance to eat, and their performance will be as good as with daily feeding. Molasses-based supplements which control intake at 1 to 3 lbs/head/day are also available for open trough feeding.

Lick-wheel tanks offer the advantage of limiting intake of molasses mixtures. They are essential when feeding molasses mixtures which contain high levels of urea. The lick-wheel tank also protects the molasses mixture from dirt, rain, birds, insects, etc. A lick wheel for each 8 to 10 cows is suggested, but varies with conditions.

Mixing molasses slurries (molasses mixtures with dry feed ingredients) is a recent concept, and special problems are encountered relative to obtaining uniform feed products that can be handled. Feed companies have developed molasses slurries, and some Florida producers mix molasses slurries on the ranch. For ranch mixing it is recommended that the mixing unit be self-contained in the tank used to deliver molasses mixtures to the feed trough or lick tank. A tank mixer currently used on some Florida ranches is shown in Figure 4. For detailed information on design and construction of a slurry mixer, it is recommended that interested individuals contact the U. S. Sugar Corporation, Clewiston, Florida; Alico Ranch, LaBelle, Florida; or Lykes Brothers Ranch, Inc., Brighton, Florida.

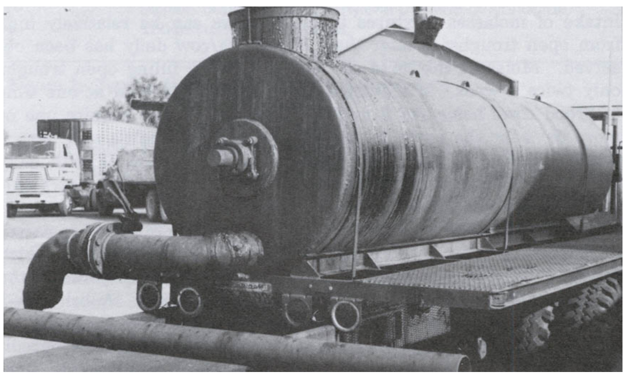

Figure 4. A 1000-gallon mixing tank used to blend molasses slurries and deliver them to feed troughs and lick wheel tanks. Courtesy of John Black, U.S. Sugar Corporation, Clewiston, Florida.

A slurry fed in research trials at the Ona AREC contained 73% standard molasses, 25% cottonseed meal, 1% urea and 1% water. This mixture was thick and difficult to handle. A slurry of 85.5% standard molasses with 12.5% feather meal, 1% urea, and 1% water worked in a mix tank and flowed without problems. This mixture also worked well in a lick-wheel feeder from which yearling heifers consumed more than 4 lbs/head/day. It appears that each dry feed ingredient reacts differently when mixed with molasses, but the 15 to 20% level of dry ingredient may be the upper limit for making a workable slurry with standard molasses. The flow of any mixture can be improved by adding water or other liquids less viscous than molasses. Some trial and error may be necessary to develop the proper combination of ingredients to make a workable molasses slurry.

When and Where to Use Molasses-Based Supplements

Molasses-based mixtures are used primarily as winter supplements for brood cows in Florida when the quantity and/or quality of forages is limited. Molasses-based supplements are used at moderate levels (3 to 5 lbs/head/day) as an energy supplement and may contain ingredients to supply crude protein, minerals and vitamins. They may be fed in limited quantities (I to 3 lbs/head/day) to supply some energy, but mainly crude protein and other nutrients. The winter season can also be critical, because cows in south Florida are usually nursing calves and are often being rebred. During this production period, adequate levels of energy, protein and other nutrients are very important.

Nutrients added to molasses will be beneficial if they are not supplied in adequate amounts by the forage or other supplements. For example, both a mineral mixture and a molasses mixture containing adequate minerals need not be offered. Also, many of the nutrients are contained in the consumed forage. Some nutrients, such as certain trace elements and vitamins, are inexpensive because of the small quantities used in a mixture and are added for insurance.

Adding non-protein nitrogen or natural protein increases the cost of a molasses-based supplement and should be used only when needed. The quantity of crude protein needed in a molasses-based supplement, and the resulting benefits, depend upon the crude protein content of the consumed forage. Beef cows nursing calves and grazing forage with 10% or more crude protein, or a dry cow grazing forage with 7 to 8% crude protein, probably will not benefit from added crude protein in a molasses-based supplement. It should be noted that millrun blackstrap molasses produced in Florida naturally contains 7% or more crude protein as compared to only 2 to 4% in molasses produced in other areas. Probably the only situation where forage from a perennial grass pasture in Florida would contain more than 10% crude protein in the winter is on organic soils.

The usual situation in Florida is that forages from grass pastures on sandy soils contain much less than 10% protein in the winter and are low in TDN. This is certainly the case for bahiagrass, Florida's most common pasture forage. In these situations, a molasses-based supplement containing 15 to 20% crude protein should be fed at moderate levels (3 to 5 lbs/head/day).

Response of Brood Cows to Molasses-Based Supplements

Molasses as an Energy Supplement

A five-year experiment was conducted at the Everglades Research and Education Center at Belle Glade from 1980 to 1985 (Pate, Crockett and Phillips, 1985). Brangus-type cows (124 head) grazed continuously on Roselawn St. Augustinegrass (*Stenotaphrum secundatum*) grown on organic soil at a stocking rate of 1.25 cows/acre. The breeding season was from January 1 to March 10. The grass contained 13 to 15% crude protein and 40 to 45% total digestible nutrients (TDN) on a dry matter basis during the winter. This crude protein level far exceeded the 10% level recommended by the National Research Council (1984) for cows nursing calves, but the TDN was far below the 56 to 58% recommended level. This provided a good situation to measure the value of molasses as an energy supplement because the pasture forage provided more than adequate crude protein.

The experiment compared three molasses treatments: (1) no molasses, (2) molasses during the breeding season (December 15 to March 1), and (3) molasses during the calving and breeding season (October 15 to March 10). Millrun blackstrap cane molasses was fed twice weekly in open troughs at a rate of 5 lbs/brood cow/day.

Cows fed molasses during the breeding season weaned approximately 7 more calves per 100 cows, weaned a similar sized calf and produced 36 lbs more calf per cow in the breeding herd than cows not fed molasses (Table 2). Cows fed molasses during the calving and breeding season weaned approximately 6 more calves per 100 cows, had a 24-lb heavier calf at weaning, and produced 52 lbs more calf per cow than cows not fed molasses.

Molasses feeding also resulted in heavier cow weights throughout the year and less cow weight loss during the winter breeding season. This probably explains the improved reproductive performance observed for cows fed molasses. A heavier cow weight in September also would be economically beneficial due to greater returns for marketing cull cows.

Molasses as an Energy and Protein Supplement

Florida's sandy soft pastures, most of which are bahiagrass, have both low energy (40 to 45% TDN) and crude protein (6 to 8%) during the winter. Thus, it is commonly recommended that a molasses mixture fortified with crude protein be fed to brood cows.

A four-year experiment was conducted at the Ona Agricultural Research and Education Center from 1984 to 1988 which compared three molasses mixtures: (1) a 6% crude protein standard blackstrap molasses, fed at 2.9 lbs/cow/day, (2) a 17.5% crude protein standard blackstrap molasses-urea mixture fed at 3.2 lbs/cow/day (3 lbs molasses, 0.13 lbs urea, 0.13 lbs water), and (3) a 17.5% crude protein standard blackstrap molasses-cottonseed meal-urea mixture fed at 2.8 lbs/cow/day (2 lbs molasses, 0.7 lbs cottonseed meal, 0.03 lbs urea, 0.03 lbs water). All supplements provided equal amounts of TDN.

The molasses mixtures were fed to Braford cows (approximately 130/year) grazing bahiagrass pasture. The breeding season was from March 1 to June 1. Cows were fed free-choice a low-quality stargrass hay (5.5% crude protein) for an average of 110 days starting in December or January and ending in April or May depending upon weather and pasture. Molasses mixtures were fed twice weekly in open troughs from an average starting date December 16 to an average ending date of April 22.

Cows fed molasses with urea weaned 7 more calves per 100 cows and their calves weighed 10 lbs more at weaning compared to cows fed molasses only (Table 3). Cows fed molasses-cottonseed meal-urea weaned 12 more calves per 100 cows and their calves were 6 lbs heavier at weaning compared to cows fed only molasses. Calf production per cow in the breeding herd was increased 39 and 57 lbs, respectively, by adding either urea or cottonseed meal-urea to the molasses mixture. The cows' weight differences were not substantial across treatments, but cows fed the molasses-cottonseed meal-urea supplement tended to be slightly heavier throughout the year than cows fed molasses or molasses-urea.

Younger cows had a greater response to the addition of crude protein to molasses than older cows (Table 3). Three-year-old first-calf heifers fed molasses-urea had a 16% higher pregnancy rate than cows fed only molasses. Three-year-old first-calf heifers fed molasses-cottonseed meal-urea had a 32% higher pregnancy rate than cows fed molasses only. Even 4- to 6-year-old cows fed either molasses-urea or molasses-cottonseed meal-urea had a 14% and 16% higher pregancy rate, respectively, than cows fed molasses only. Seven- to 13-year-old cows exhibited no response in increase pregnancy rate to the addition of urea to molasses, and a slight response to the addition of cottonseed meal-urea to molasses (weaned 4 more calves per 100 cows). The results show the importance of feeding young cows molasses mixtures fortified with crude protein, part of which should be a natural protein.

Recommendations

1. Molasses-based supplements should be fed to brood cows in most situations in Florida during the winter. Start feeding in the fall or early winter, at the beginning of the calving season, and continue through most of the breeding season. *Do not wait until pastures are overgrazed to start feeding molasses mixtures.*

2. Forage quality is very important in selecting the correct molasses-based supplement. It is advised that forages be tested for crude protein, digestibility (TDN) and possibly minerals too if the quality is unknown.

3. Because Florida grasses are low in digestibility during the winter, feed 3 to 5 lbs of a molasses mixture/cow/day. Adjust the quantity fed and duration of feeding as conditions of the cow herd and pastures dictate. Adjusting intake to the desired level may require twice-weekly feeding rather than free-choice feeding.

4. Florida grasses grown on sandy soils also are low in crude protein in the winter. In this situation feed 3 to 5 lbs of a molasses mixture containing 15 to 20% crude protein. The best response will be obtained when more than 50% of the crude protein in the mixture is derived from a natural protein, like cottonseed meal, soybean meal, or feather meal.

5. It is important that younger cows, particularly first-calf heifers, be fed molasses mixtures containing added crude protein. However, all cows 6 years of age or younger benefit from adding crude protein to the molasses mixture. The response in calf production is very large, and more so to natural protein than to urea.

6. On occasion a pasture forage may have relatively good digestibility, but low crude protein. This is possible for hemarthria *(Hemarthria altissima*) or pangola digitgrass (*Digitaria decumbens*) in the fall or early winter. In this situation 1 to 2 lbs of a molasses mixture containing 30 to 35% crude protein can be fed.

7. Study the feed label when selecting a molasses-based supplement. Place major emphasis on energy and crude protein content when comparing mixtures as to nutrient quality and cost. Indicators of high energy are high sugar levels, high Brix, added fat and low moisture. The better crude protein is from natural protein. If not given on the label, a good indicator of percent natural protein is the difference between percent total protein and percent equivalent protein from non-protein nitrogen.

8. Be careful when feeding mixtures containing high levels of urea (more than 15% crude protein from non-protein nitrogen). Never allow starving cattle free access to these mixtures, fill them up with forage or other feed first. It is advisable to feed high-urea mixtures in a lick tank to prevent over consumption.

9. Molasses-based mixtures fed at 3 to 5 lbs/head/day can be fed twice weekly in open troughs with good success. Each feeding will usually last one or more days, allowing all cows access to the supplement, even with limited trough space.

Literature Cited

NRC. 1984. Nutrient Requirements of Beef Cattle. 6th Ed. National Academy Press, Washington, D.C.

Pate, F. M., J. R. Crockett, and J. D. Phillips. 1985. Effect of calf weaning age and cow supplementation on cow productivity. J. Anim. Sci. 61:343-348.

Table 1. Ingredients used in molasses-based feeds.

Energy Ingredients
Sugarcane molasses
Citrus molasses
Beet molasses
Starch molasses (corn and sorghum, Hydrol)
Hemicellulose extract (wood molasses, Masonex)
Fats, tallow, oils
Condensed extracted glutamic acid fermentation product (Dyna Ferm)
Lignin sulfonate (NH_4, Ca, Mg)
Whey
Wet brewers solubles
Fish solubles
Citrus and cane molasses distillers solubles
Wheat distillers solubles
Miscellaneous liquid residues from production of Bakers yeast, potable alcohol, enzymes, distilled vinegar, citric acid, and amino acids
Condensed soybean solubles
Condensed molasses solubles
Nitrogen Ingredients
Urea
Ammonium polyphosphates
Ammonium sulfate
Ammoniated thio-sulfate
Corn solubles
Fish solubles
Ammoniated lignin sulfonate
Natural protein ingredients
Mineral and Vitamin Ingredients
Vitamins A, D, and E
Calcium chloride or sulfate
Phosphoric acid
Ammonium polyphosphates
Magnesium sulfate
Sodium chloride, sulfate, or bicarbonate
Ethylene diamine dihydroiodide (iodine)
Sulfate or chelated form of iron, copper, cobalt, zinc, manganese, and boron
Sodium selenate or selenite
Other
Ionophores (monensin and lasalocid)
Suspension agents (gums and clays)
Antibiotics

Table 2. Response of crossbred brood cows to season supplementation with blackstrap molasses while grazing St. Augustinegrass grown on organic soil (5 years data, 1980-1985).[a]

Item	**Time of Molasses Supplementation**		
	None	**Breeding[b] season**	**Calving and breeding season[c]**
Weaning rate, %	77.2	84	82.9
Calf weaning weight, lbs	553	551	577
Calf production/cow, lbs	427	463	479
Increased calf production/cow over no molasses, lbs	---	36	52
Cow data at different times of year			
September (weaning)			
Weight, lbs	1020	1029	1051
Condition scored[d]	7.2	7.27.4	
January (start breeding)			
Weight, lbs	1022	981	1040
Condition score	7.1	6.8	7.2
March (end breeding)			
Weight, lbs	910	919	961
Condition score	4.4	4.6	4.9
Blackstrap molasses/cow, lbs	0	425	725
Pounds of molasses/additional pound of calf	---	11.8	13.9

[a] For more detailed information on study see Pate, Crockett and Phillips (1985).

[b] Cows fed 5 lbs/head/day to heavy millrun blackstrap molasses on a twice weekly schedule from December 15 to March 10 (425 lbs/cow over 85 days). Breeding season was from January 1 to March 10.

[c] Cows fed 5 lbs/head/day of heavy millrun blackstrap molasses on a twice weekly schedule from October 15 to March 10 (725 lbs over 145 days).

[d] Condition score of cow based on a range of 1 to 9 with 1 being extremely thin and 9 extremely fat.

Table 3. Performance of crossbred brood cows fed different molasses-based mixtures during the winter while grazing bahiagrass pasture (4 years' data, 1984-1988).

Item	**Molasses**[a]	**Molasses-urea**[b]	**Molasses-cottonseed meal-urea**[c]
Weaning rate, %	63.8[f]	70.9[fg]	75.7[g]
Calf weaning weight, lbs	441	451	447
Calf produced/cow in breeding herd, lbs	281	320	338
Increased calf production/cow over molasses alone, lbs	---	39	57
Pregnancy rate for different age cows, %			
3 year olds	34.5[f]	50.8[fg]	66.5[g]
4, 5 and 6 year olds	60.7	74.0	76.5
7 to 13 year olds	74.8	74.7	78.6
Cow data at different times of year			
November (pre-calving)			
Weight, lbs	1092	1091	1106
Condition score[d]	5.5	5.7	5.7
March (start breeding)			
Weight, lbs	936	927	949
Condition score	4.2	4.3	4.5
June (end breeding)			
Weight, lbs	988	983	1002
Condition score	4.4	4.5	4.5
August (weaning)			
Weight, lbs	1027	1011	1036
Condition score	4.9	4.9	5.1
Molasses mixture fed/cow, lbs[e]	368	406	356
Hay fed/cow, lbs	1816	1753	1856

[a] Standard blackstrap molasses, 79.5° Brix; 6% crude protein (2.9 lbs/cow/day).
[b] Standard molasses, 92%; urea, 4%; water, 4%; 17.5% crude protein (3.2 lbs/cow/day).
[c] Standard molasses, 73%; cottonseed meal, 25%; urea, 1%; water, 1%; 17.5% crude protein.
[d] Condition score of cow based on range of 1 to 9 with 1 being extremely thin and 9 extremely fat.
[e]Molasses mixtures were fed for 127 days with an average starting date of December 16 and average ending date of April 22.
[fg]Means in the same row followed by a different superscript differ (P <= .05).