Applying New Strategies for Raising Beef Heifers

W. E. Kunkle, R. S. Sand and P. Garces-Yepez
Animal Science Department
University of Florida, Gainesville 32611

Introduction

The best age to breed heifers for their first calf depends on the situation. Most beef producers across the U. S. breed yearling heifers to calve at two years of age. In Florida and across the southern gulf coast region, cattle production systems have at least two major differences from the midwest and plain states. First, forage nutrition levels of the tropical warm season forages are lower than those forages grown in the cooler and/or lower rainfall areas of the U. S.; therefore, more supplement is required to adequately grow heifers. Second, the use of some level of Brahman breeding in most of the cattle reduces the proportion that reach puberty by 14 to 15 months. This increases the costs and reduces the success therefore calving at 2 years of age is unprofitable in some situations.

The extra income when considering calving at 2 years of age depends on the percent of heifers reaching puberty and becoming pregnant, number of live calves born and raised to weaning, weaning weight, calf price, percent of first calf heifers rebreeding and the weight of cows when culled. The extra costs involve additional planting of annual forages, supplemental feeds, labor, facilities and supplies.

If heifers are intended to be bred at 26 to 28 months of age to calve at 3 years of age, the growth rate the first winter after weaning can be as low as .25 to .50 lb/day. If adequate quantities of moderate quality forage are available, these gains can be achieved by feeding .3 to .4 lb/day of natural protein and a complete mineral supplement offered free choice.

Calving at 2 years of age requires a high level of management to be successful and profitable. Several Florida cattlemen are successfully and profitably calving heifers at two years of age but this is a challenge to the best managers. This paper will focus on nutrition and management programs that should improve the success of these programs. The management practices discussed have research showing their benefit in improving productivity or reducing costs but not all practices will be applicable to all situations.

Breed Type and Target Weights

Breed type influences the age and weight when heifers will breed. It is recommended that heifers contain 50% or less Brahman or other later maturing breeds to assure a high proportion will reach puberty by 14 months even when the target weights are reached. If less than 75% of the heifers will reach puberty at the beginning of breeding season even when developed to the target weights, then the added costs often will be more than added income from the calves. This situation often occurs when heifers are over 50% Brahman breeding (Randel, 1994; Short et al., 1994a) or other later maturing breeds, especially when they have not been selected for early puberty. An indicator

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of early maturity is the scrotal circumference of the herd sire (Brinks, 1994). Sires with a large yearling scrotal circumference produce heifers that reach puberty at an earlier age. A yearling (12 months of age) scrotal circumference of 34 centimeters or larger is recommended for sires intended to produce heifers to calve at 2 years of age.

Target weights for successful development of heifers should be based on the mature weights of the heifers with minimum targets of 45% at weaning, 65% at beginning of breeding season and 85% at calving. An example program using this approach is shown in Table 1. It is suggested that heifers be selected that are 45% or more of their mature weight or over 450 lb for typical crossbred cattle in Florida. Heifers meeting these criteria should be grown to 65% or more of their mature weight by 14 months of age which is 650 lb for typical crossbred cattle. As an example, if heifers were weaned in mid-September (450 lb) and the breeding season started in mid-March (6 months after weaning), the heifers would need to gain 1.1 lb/day to average 650 lb at the beginning of the breeding season (Table 1).

Table 1. Target Weights for Growing and Breeding Heifers to Calve at Two Years of Age (1000 lb Mature Cow Weights).

Date	Days	Weight		Daily Gain	Comments
		Begin	Ending		
		lb	lb	lb	
9/15-3/15	180	450	650	1.1	Wean to Breeding
3/15-5/15	60	650	710	1.0	Breeding Season
5/15-12/15	210	710	875	.8	Grow but not fatten
12/15-4/1	105	875	825	-.5	Calving-no flesh loss
4/1-6/1	60	825	850	.5	Rebreeding in 90 days

Nutrition-A Key to Success

The TDN requirements for heifers increase with higher weights and higher gains (Table 2). Many residual pastures and hays available during the fall and winter have a TDN concentration of 50% or below. Forages with lower TDN concentrations also have lower levels of intake. The Florida Forage Testing Program analyzes forages and estimates TDN concentration, intake of forage and Quality Index. Quality Index is the TDN intake of forage offered free choice as a ratio of the maintenance requirement of the heifer. A Quality Index of 1.0 would be expected to meet the maintenance requirements of the heifer but allow no weight gain. The Florida Cooperative Extension Service offers a forage testing service that costs $8.00/sample and reports the TDN, crude protein, and Quality Index of the forage. Forage TDN concentrations are estimated from invitro organic

matter digestibility and the Quality Index is estimated from both the neutral detergent fiber (NDF) and invitro organic matter digestibility of the forage.

Table 2. Daily TDN and Protein Requirements of Heifers at Various Weights and Gains.[a]

Weight	Daily Gain	Dry Matter Intake	TDN		Crude Protein	
			lb/day	%	lb/day	%
lb	lb	lb/day				
500	0	9.8	4.9	50.0	.75	7.6
500	.5	11.0	6.2	56.0	.94	8.5
500	1.0	11.8	7.3	62.0	1.11	9.4
500	1.5	12.1	8.3	68.5	1.25	10.3
700	0	12.6	6.3	50.0	.89	7.1
700	.5	14.1	7.9	56.0	1.11	7.9
700	1.0	15.1	9.1	62.0	1.27	8.4
700	1.5	15.5	10.6	68.5	1.40	9.0

[a]NRC, 1984

Table 3. Daily Levels of 75% TDN Supplement Required For Various Gains of Heifers Fed Different Quality Forages.[a]

Gain	QI=1.0[b]		QI=1.2[c]		QI=1.4[d]	
	Level	Protein	Level	Protein	Level	Protein
lb/day	lb/day	%	lb/day	%	lb/day	%
1.0	6	15	4	13	2	8
1.5	10	13	8	12	6	12

[a]Quality Index (QI) = TDN intake as a multiple of maintenance (1.0 = maintenance).
[b]QI=1.0, TDN=47%, Crude protein=6%.
[c]QI=1.2, TDN=54%, Crude protein=9%.
[d]QI=1.4, TDN=58%, Crude protein=12%.

The amount of supplement needed to grow heifers at 1.0 or 1.5 lb/day for 3 different forage qualities is shown in Table 3. A forage such as residual bahiagrass pasture in the fall or mature hays often have a quality index near 1.0 and would require 6 lb/day of a 75% TDN supplement containing

15% crude protein for heifers to gain 1.0 lb/day. An estimated 10 lb/day of 75% TDN supplement containing 13% crude protein would be needed for the heifers to gain 1.5 lb/day. A supplement containing corn, soybean meal and minerals would contain approximately 75% TDN. It would require proportionally more supplement for those containing TDN concentrations under 75%. The levels of supplement and protein concentration in the supplement are lower for higher quality forages which provides an economic incentive to manage pasture and hay for high quality.

Supplements with high grain content have high TDN levels and high levels of starch. High levels of starch and sugar are rapidly fermented resulting in a lower rumen pH. This results in lower intake and digestibility of forage when starch intake reaches a critical level. Research using byproduct feeds that have low levels of starch but relatively high TDN has shown these feeds may have less negative effect on forage intake and digestibility resulting in a better response than expected from the level of TDN in these feeds. A recent comparison of corn, wheat middlings and soybean hulls fed at approximately .5% or 1% of body weight to growing steers offered good quality bermudagrass hay free-choice showed that gains, forage intake and NDF digestibility were similar for all three concentrates fed at approximately .5% body weight (Table 4). However, cattle fed corn at .94% of body weight had lower gains, reduced forage intake and a lower NDF digestibility than cattle fed soybean hulls at 1.16% body weight (supplemental TDN from soybean hulls and corn were similar). Cattle fed wheat middlings had responses intermediate to corn and soybean hulls. Feeds such as soy hulls, corn gluten feed, citrus pulp and wheat middlings (high digestibility but low in starch) appear to give better responses per unit of supplemental TDN when fed at approximately 1% body weight compared to grains and in many situations they are competitively priced.

Table 4. Corn, wheat middlings (WM), and soybean hull (SH) supplements for growing cattle fed hay[a].

	None	Supplements					
		Low-25% TDN			High-50% TDN		
		Corn	WM	SH	Corn	WM	SH
Daily gain, lb	.67	1.40	1.43	1.34	1.67	1.97	2.09
BCS change	-.57	.65	-.23	.23	.34	.13	.61
Intake, % BW							
Supplement	-	.43	.49	.53	.94	1.09	1.16
Hay	2.20	2.16	2.19	2.07	1.76	1.83	1.83
Total	2.20	2.59	2.68	2.60	2.70	2.92	2.99
Digestibility, %							
Organic matter	51.9	57.1	55.4	58.3	63.1	57.1	63.8
NDF	56.2	55.0	55.0	59.1	52.3	52.3	63.0

[a]Yepez and Kunkle, 1994, unpublished research, Univ. of Florida

Supplements containing natural protein from sources such as cottonseed meal or soybean meal usually give better results than supplements containing non-protein nitrogen (NPN) from sources such as urea. Growing cattle fed supplements containing NPN sources of crude protein usually have better

performance than heifers fed supplements with no added protein when the TDN to crude protein ratio is over 7 but the performance is often improved further when natural protein sources are used. NPN supplements usually give performance closer to natural protein supplements when fed to heavier weight heifers and when the supplements are fed at higher levels. A summary of 12 comparisons evaluating the effects of feeding .20 to .36 lb/day of rumen undegraded protein from feather, blood or corn gluten meals to growing cattle fed Florida warm season perennial grass pasture or hay showed that gains were improved .32 lb/day (Kunkle et al., 1994c).

Table 5. Nutrient Composition and Costs of Energy Supplements[a]

Feed	TDN	Crude Protein	Cost	Cost of TDN[b]
	% as fed	% as fed	$/unit	$/100 lb
Hay, round bales	50	8	60/T	6.00
Sorghum silage (30% DM)	18(60)	2(7)	18/T	5.00
Shelled corn				
bulk, 25 ton	80	8	105/ton	6.60
bagged, 100 lb	80	8	8.30/100 lb	10.40
Wheat midds				
bulk, 25 ton	73	16	105/ton	7.20
bagged, 50 lb	73	16	4.50/50 lb	12.30
Soybean hulls				
bulk, 25 ton	70	12	105/T	7.50
bagged, 50 lb	70	12	5.50/50 lb	15.70
Citrus pulp, 25 ton	71	7	100/ton	7.04
Hominy, 25 ton	83	10	115/ton	6.93
Blackstrap molasses, 25 ton	62	7	96/ton	7.75
Liquid supplement-16% CP				
bulk, 25 ton	53	16	128/ton	12.90
delivered to lick tank	53	16	160/ton	15.10
Steer grower-12%	65	12	5.50/50 lb	16.90
Broiler litter(80%)-corn(20%)	50	18	45/ton	4.50
Whole cottonseed, bulk-25 ton	80	22	105/ton	6.60
Rye pasture	70	15	100/acre	4-7.00

[a]Prices quoted during Fall 1994 from suppliers in central Florida, prices vary in different areas of the state and with different quantities purchased.
[b]Cost of TDN ($/100 lb) is calculated by dividing the cost of 100 pounds of feed by the TDN fraction (% TDN /100). Example for hay - $60./ton=$3./100 lb (60/20); 100 lb of hay contains 50 lb TDN and 100 lb TDN costs $6. (3/.50).

Selecting sources of energy and protein that provide the needed TDN and protein at as low a cost as possible is essential. The lowest cost sources of nutrients will depend on the cost of ingredients, quantities purchased, handling and storage system, processing and mixing required,

feeding system and labor available. The first decision is to narrow the list of ingredients to those that you can use in your system then compare prices based on the cost of the nutrients from each source. A recent comparison of costs of TDN from several sources shows broiler litter (80%)-corn (20%), rye pasture, whole cottonseed and sorghum silage to be some of the lower cost sources of TDN (Table 5). A comparison of costs of protein shows that broiler litter and whole cottonseed are some of the lowest cost sources of protein (Table 6). Limitations of each feed must be considered. As an example, whole cottonseed should be limited to 5 lb/day to avoid diarrhea caused by the high oil content.

Table 6. Nutrient Composition and Costs of Protein Supplements[a]

Feed	Crude Protein	TDN	Cost	Cost of Protein[b]
	% as fed	% as fed	$/unit	$/100 lb
Soybean meal				
bulk, 25 ton	48	78	200/ton	20.80
bagged, 50 lb	48	78	8.15/50 lb	34.00
Cottonseed meal				
bulk, 25 ton	41	72	190/ton	23.20
bagged, 50 lb	41	72	7.65/50 lb	37.30
Wheat middlings				
bulk, 25 ton	16	73	105/ton	32.80
bagged, 50 lb	16	73	4.50/50 lb	56.25
Range cubes	20	58	4.95/50 lb	49.50
Protein block, 33 lb	24	60	7.25/50 lb	60.40
Molasses blocks, 500 lb	24	60	63.50/500 lb	52.90
Liquid supplement, 16% CP				
bulk, 25 ton	16	53	128/ton	40.00
delivered to lick tank	16	53	160/ton	50.00
Liquid supplement, 32% CP				
bulk, 25 ton	32	47	131/ton	20.45
delivered to lick tank	32	47	155/ton	24.20
Whole cottonseed, 25 ton	22	80	105/ton	23.85
Broiler litter	20	42	40/ton	10.00

[a]Prices quoted during Fall 1994 from suppliers in central Florida, prices vary in different areas of the state and with different quantities purchased.
[b]Cost of protein ($/100 lb) is calculated by dividing the cost of 100 lb of feed by the protein fraction (% protein /100). Example for soybean meal - $200./ton=$102./100 lb (200/20); 100 lb of soybean meal contains 48 lb protein and 100 lb protein costs $20.80. (10/.48)

A complete mineral supplement should be fed along with the supplement. A complete mineral supplement containing salt, calcium, phosphorus and trace minerals is recommended. Mineral consumption varies across pastures, seasons and cattle but an average consumption of two ounces/day of a mineral containing 25% salt, 14 to 18% calcium, 8% phosphorus, .4% zinc, .2% iron,

.2% manganese, .15% copper, .016% iodine, .01% cobalt and .002% selenium has been sufficient in many situations.

Feeding 150 to 200 mg/day of an ionophore such as Rumensin or Bovatec can also improve gains of growing cattle fed forage based diets by .15 to .25 lb/day. Another antibiotic, Gainpro, was approved for feeding at 10 to 20 mg/day to cattle grazing pasture in 1994. A summary of five trials evaluating efficacy showed that feeding 10 mg/day of Gainpro improved gains .17 lb/day and feeding 20 mg/day improved gains .23 lb/day (Anonymous, 1994). Three pasture feeding studies with growing cattle in Florida showed that Gainpro increased gains .22 lb/day. These antibiotics alter the fermentation and improve efficiency of feed utilization.

These antibiotics must be consumed regularly to be effective and mixing in a supplement is a good way to provide these antibiotics. Cattle need to be fed these antibiotics at least every other day to be effective. They improve gains of cattle on pasture but finding an effective and economical feeding system is often difficult. Mixing ionophores in mineral supplements often reduces consumption or consumption is too sporadic which reduces their effectiveness. Gainpro mixed in a mineral supplement does not appear to reduce mineral consumption and gains were increased in several studies, but designing a mineral supplement consumed at consistent quantities across different pasture situations remains a formidable challenge to this method of delivery. Daily feeding in a carrier or protein supplement is often not cost effective unless other ingredients in the supplement increase performance. Gainpro appears to be safe and efficacious at daily intakes considerably above the approved feeding level (10 to 20 mg/day) and does not appear to be toxic to other species at levels usually fed to cattle but at the present time Gainpro is not approved for cattle intended for breeding.

Management Preweaning

The heifer weight at weaning will determine the gain needed from weaning to breeding. In some situations, it may be more cost effective to increase gains before weaning and decrease needed post-weaning gains. Creep feeding can increase gains but it should be used only when the weight is mostly muscle growth without a significant increase in fat. Research has shown that feeding a high energy creep feed to smaller framed heifers will depress their subsequent milk production because of fat deposits in the developing udder (Patterson et al., 1992). However, research with larger framed heifers showed no effect of creep feed on subsequent milk production. Therefore the decision to creep feed replacement heifers should consider the frame size and fleshiness of the heifers. Limit feeding a high protein creep feed such as cottonseed meal has shown economical increases in gains during the summer in Florida. Cottonseed meal mixed with 8 to 10% salt limited consumption to .65 lb/day, improved gains .30 lb/day and required 2.2 lb of protein supplement for each additional pound of gain at weaning (Kunkle et al., 1993). Creep fed calves also learn to eat dry feeds, which can reduce weaning stress under some situations. Creep feeding for 30 days has been shown to be sufficient to "bunk break" calves and reduce the stress of weaning.

The use of growth promoting implants in suckling calves improves gains and profits. Several trials have evaluated the effect of preweaning implants on subsequent pregnancy rates. A summary indicated that implanting once between 1 and 13 months showed no adverse effects on subsequent pregnancy rates, implanting at or near birth lowered pregnancy rates and multiple implants are more

likely to lower pregnancy rates than single implants (Hargrove, 1994). Therefore, selecting heifers that have received 1 implant (after 1 month) should improve weaning weight with no adverse effect on pregnancy rate.

Management-Weaning to Breeding

Heifers selected at weaning will determine the gains needed after weaning and the likely success of calving the heifers at 2 years of age. Heifers with over 50% Brahman usually have a lower percent that will reach puberty and become pregnant during the breeding season. Selecting heifers with higher weaning weights will decrease the gain needed before the breeding season. Selecting 15 to 50% more heifers than needed for replacements will allow culling those that do not perform. Heifers need to be kept separate from the cow herd and, if variable in weaning weight, it is often desirable to divide them into light and heavy weight groups. The light weight group can be fed additional supplement to reach the target weight by the beginning of the breeding season. This should improve the percent pregnant and be cost effective (Wiltbank, 1994).

The stress of weaning often results in sickness and low gains after weaning. A complete herd health program with appropriate vaccinations and parasite control prior to and at weaning can help reduce these losses (Richey, 1994). The first month after weaning is critical to meeting the target weights at breeding. Reducing weaning stress and sickness and keeping the heifers gaining weight is essential. This usually requires that heifers start eating supplements within a week after weaning. Pasturing the cattle on freshly regrown pasture can be helpful but feeding a very palatable supplement such as a commercial preconditioning supplement has proven successful for many cattlemen. Creep feeding the calves usually improves the consumption of feed immediately after weaning helping to reduce stress.

Any supplementation program needs to be monitored and supplements adjusted depending on the conditions. A few representative heifers should be weighed every 2 months and the feeding program adjusted to reach the target weights. Many ranchers use winter pasture to grow heifers but typically winter pastures are not ready to graze for 2 to 3 months after weaning. In this program heifers are often not given much supplement prior to winter pasture and may gain .5 lb/day or less. While grazing winter pasture, the heifers usually compensate and may reach the target weight by the beginning of breeding season. Marshall (1991) compared a program with continuous gain from weaning to breeding to a program with low gains for 2 to 3 months followed by rapid gains (low-rapid) to achieve the same weight at the start of the breeding season for both groups. Pregnancy rates were similar for both groups but heifers on the low-rapid growth program conceived later in the breeding season than heifers that gained continuously from weaning to breeding. Calving later would be expected to lower the weaning weights of their calves and reduce the percent of the cows that will rebreed. Therefore, better results can be expected if heifers are fed to gain weight and not get thin during the fall prior to grazing winter pasture.

Another management strategy that producers may want to consider to increase the number of heifers reaching puberty is exposing them to altered or sterile bulls prior to the breeding season. In Nebraska research, heifers exposed to a bull reached puberty 40 days earlier with 50% pregnant in the first 21 days of the breeding season compared to 16.5% pregnant for heifers not exposed to

the bull (Kinder et al., 1994).

Breeding heifers to calve 3 to 4 weeks prior to the cow herd is desirable to improve their rebreeding. First calf heifers usually require 2 to 3 weeks longer to come into estrus than older cows and calving earlier helps keep the heifers calving with the herd. A small pelvic opening has been shown to increase the chances of calving difficulty (Wiltbank, 1994). If extra heifers are kept culling those with a small pelvic area (less than 190 square centimeters at pregnancy testing) may reduce calving difficulties and calf deaths.

Management at Breeding

Reaching the target weight of 65% of mature weight at the beginning of the breeding season is essential. Heifers should be fed to gain approximately 1 lb/day during the breeding season. A breeding season shorter than that used in the cow herd is suggested. As an example, if a 90 day breeding season is used in the cow herd then a 60 day breeding season (starting prior to or at the same time breeding season for the cow herd) is suggested for the heifers. This allows the heifer extra time after her first calf for rebreeding.

Selecting bulls to reduce calving difficulty or dystocia is essential. The breed of bull and the bulls within the breed need to be selected to reduce problems at calving. Several breeds of cattle offer Expected Progeny Difference (EPD) estimates for bulls. Selecting bulls with a low EPD for birth weight can help reduce dystocia (Brinks, 1994; Bellows and Staigmiller, 1994). The added labor of assisting heifers, calf deaths, heifer deaths and lower percent of heifers rebreeding after difficult births make this a priority in selecting bulls to use on first calf heifers.

Estrus synchronization is another technique that may help increase the number of heifers that breed early in the calving season. Melengesterol acetate (MGA)-Prostaglandin (PG) and Synchromate B (SMB) are products that have been shown to induce earlier estrus in heifers that are close to initiating estrus (Short et al, 1994b; Odde and Holland, 1994). In Florida studies, feeding .5 mg/day of MGA for 14 days followed 16 days later with an injection of prostaglandin resulted in an 8 to 9% higher pregnancy rate compared to untreated cattle. These estrus synchronization programs can be used with artificial insemination or breeding with bulls.

Management-Breeding to Calving

Managing the heifers to reach 85% or more of their mature weight at calving is recommended. Body condition score (BCS) is more important than weight and a BCS of 6 is recommended at calving (Wetteman, 1994). BCS is closely related to the rebreeding and is much easier to monitor than weight. During the last 3 months of pregnancy, the calf grows considerably and cows may gain weight but loose BCS; therefore, monitoring BCS is an important indicator of nutrition in the heifer. The supplemental feed needed will depend on the forages and the month of the year. Grazing heifers on the better pastures will often provide sufficient nutrition for adequate gain and good body condition. Supplements containing minerals and growth promoting antibiotics can increase gains and protein supplements may improve gains under some conditions.

Management-Calving through Rebreeding

Heifers should be managed as a separate group or managed where they can be observed closely at calving. Calving difficulties are more common in heifers and frequent observation can increase the number of live calves and hopefully avoid heifer deaths. Good facilities are needed to manage cattle at calving. Heifers can lose weight and BCS very rapidly after calving because nutritional requirements increase dramatically. Rebreeding is closely related to the body condition at calving and weight loss after calving (Kunkle et al., 1994a, 1994b). If heifers calve early in the calving season in BCS 6, then moderate weight loss up to .5 lb/day will usually result in good pregnancy rates. Results of several ranch trials showed that first or second calf cows in BCS 5 or higher at pregnancy testing had pregnancy rates of 84% or higher compared to 53% for young cows in BCS 4 and less than 24% of young cows in BCS 3 (Table 7). Calving young cows in good body condition and maintaining this body condition is essential for good pregnancy rates.

Table 7. Relationship of Parity and Body Condition Score to Pregnancy Rate, %[a]

Parity[b]	Body Condition Score[c]			
	≤3	4	≥5	All
1	20	53	90	84
2	28	50	84	71
3	23	60	90	85
4-7	48	72	92	87
≥8	37	67	89	74
All	31	60	89	82

[a] Rae et al., 1993; Body condition scored at pregnancy testing.
[b] Parity is the number of calving opportunities, present age minus age at first calving (years).
[c] Body condition scored at pregnancy testing from 1 to 9, 3=thin, 4=borderline, 5=moderate.

Heifers have higher protein requirements after calving than mature cows. Studies at the Ona Research Center have shown dramatic improvements in rebreeding of heifers supplemented with protein (Pate et al., 1990). Heifers in these studies were in BCS 5 to 6 at calving but lost 1 to 1.5 BCS by the beginning of breeding season. Heifers were fed low quality hay and those supplemented with molasses (no added protein) had a 38% pregnancy rate, heifers supplemented with molasses-urea had a 60% pregnancy rate and those supplemented with molasses-cottonseed meal had a 70% pregnancy rate. Protein supplements did not improve the pregnancy rates of mature cows. These studies and others indicate that feeding adequate levels of protein to heifers is critical to have good reproductive performance.

Rebreeding heifers and cows may be delayed in some situations especially when cows are in marginal BCS and nutrition. Calf removal for 48 hours at 40 to 80 days after calving has been effective in initiating estrus in some cows (Wiltbank, 1994; Odde and Holland, 1994). This technique is most effective when cows are close to initiating estrus but is not usually effective in cows that are in good flesh (BCS 5 or more) or very thin (BCS 3 or less). The interruption of suckling for 48 hours appears to trigger the initiation of estrus. Most cows will still own their calves after the 48 hours of calf separation and this has not reduced weaning weights. This management technique may be useful for cows in BCS 4 if they are not initiating estrus and good facilities are available for 48-hour calf removal.

Other Factors

A good management program must include a good health program. Diseases and parasites can reduce cattle gains and reduce the calf crop. A minimal disease control program includes an effective vaccination program for brucellosis, leptospirosis and vibriosis. Additional diseases that may reduce performance include IBR, BVD, PI3, BRSV, Haemophilus Somnus, Pasteurella and Trichomoniasis (Richey, 1994). A control program for intestinal worms, flukes, horn flies and lice is needed. A comprehensive animal health management program developed in consultation with your veterinarian is essential.

The bull must be capable of breeding heifers and cows. Selection of bulls with adequate scrotal circumference and calving ease was discussed previously. Bulls must also be fertile, capable of inseminating a cow and have the desire to breed cows. An annual evaluation of bulls for breeding soundness is recommended (Chenoweth, 1994). Libido testing of bulls to evaluate their desire to breed cows can be useful in some situations.

References

Anonymous. 1994. Gainpro Resource Manual. Hoechst-Roussel Agri-Vet Company, Somerville, NJ.

Bellows, R.A. and R.B. Staigmiller. 1994. Selection for fertility. In: Factors Affecting the Calf Crop, pp 197-212, CRC Press, Boca Raton, Florida.

Brinks, J.S. 1994. Relationships of scrotal circumference to puberty and subsequent reproductive performance in male and female offspring. In: Factors Affecting the Calf Crop, pp 363-370, CRC Press, Boca Raton, Florida.

Chenoweth, P.J. 1994. Bull behavior, sex-drive and management. In: Factors Affecting the Calf Crop, pp 319-330, CRC Press, Boca Raton, Florida.

Hargrove, D.D. 1994. Use of growth promotants in replacement heifers. In: Factors Affecting the Calf Crop, pp 91-104, CRC Press, Boca Raton, Florida.

Kinder, J.E., M.S. Roberson, M.W. Wolfe and T.T. Stumpf. 1994. Management factors

affecting puberty in the heifer. In: Factors Affecting the Calf Crop, pp 69-89, CRC Press, Boca Raton, Florida.

Kunkle, W.E., P. Hogue, E. Jennings and S. Sumner. 1993. Protein supplement may improve gains of nursing calves. Animal Science Fact Sheet SS-ANS-11, 2 pp, Univ. of Florida.

Kunkle, W.E., R.S. Sand and D.O. Rae. 1994a. Effects of body condition on productivity in beef cattle. Fla. Coop. Ext. Service SP 144, 13 pp. (circular).

Kunkle, W.E., R.S. Sand and D.O. Rae. 1994b. Effect of body condition on productivity in beef cattle. In: Factors Affecting the Calf Crop, pp 167-178, CRC Press, Boca Raton, Florida.

Kunkle, W.E., D.A. Stateler, D.B.Bates, L.M. Rutter, W.F. Brown and F.M. Pate. 1994c. Protein levels and sources in molasses for growing cattle. Fla. Ruminant Nutr. Symposium, pp 89-103.

Marshall, T.T. 1991. Managing heifers in Florida to calve first at two years of age. Proc. Beef Cattle Shortcourse, pp 176-178, Univ. of Florida.

NRC, 1984. Nutrient Requirements of Beef Cattle (6th Rev. Ed.). National Academy Press, Washington, DC.

Odde, M.K. and M.D. Holland. 1994. Synchronization of estrus in cattle. In: Factors Affecting the Calf Crop, pp 251-261, CRC Press, Boca Raton, Florida.

Pate, F.M., S.W. Sanson and R.V. Machen. 1990. Value of a molasses mixture containing natural protein as a supplement to brood cows offered low-quality forages. J. Animal Sci. 68:618-623.

Patterson, D.J., R.C. Perry, G.H. Kiracofe, R.A. Bellows, R.B. Staigmiller and L.R. Corah. 1992. Management considerations in heifer development and puberty. J. Animal Sci. 70:4018-4035.

Rae, D.O., W.E. Kunkle, P.J. Chenoweth and R.S. Sand. 1993. Relationship of parity and body condition score to pregnancy rates in Florida beef cattle. Theriogenology 39:1143-1152.

Randel, R.D. 1994. Unique reproductive traits of Brahman and Brahman based cows. In: Factors Affecting the Calf Crop, pp 23-44, CRC Press, Boca Raton, Florida.

Richey, E.J. 1994. Keep herd health simple and make it fit the beef cattle operation. In: Factors Affecting the Calf Crop, pp 263-286, CRC Press, Boca Raton, Florida.

Short, R.E., R.B. Staigmiller, R.A. Bellows, D.C. Adams and J.G. Berardinelli. 1994a. Effects of

suckling on postpartum reproduction. In: Factors Affecting the Calf Crop, pp 179-187, CRC Press, Boca Raton, Florida.

Short, R.E., R.B. Staigmiller, R.A. Bellows and R.C. Greer. 1994b. Breeding heifers at one year of age: biological and economic considerations. In: Factors Affecting the Calf Crop, pp 55-68, CRC Press, Boca Raton, Florida.

Wetteman, R.P. 1994. Management of nutritional factors affecting the prepartum and postpartum cow. In: Factors Affecting the Calf Crop, pp 155-165, CRC Press, Boca Raton, Florida.

Wiltbank, J.N. 1994. Challenges for improving calf crop. In: Factors Affecting the Calf Crop, pp 1-22, CRC Press, Boca Raton, Florida.