Cow-Calf Buffet

As it applies to cattle performance and stocking rates on summer irrigated grazing ground, Utah State University researchers have discovered that three forages are better than one.

by ***Ed Haag***

In their quest for an alternative to Utah's traditional rangeland grazing system, Randy Wiedmeier and his colleagues, participating in the Utah State University (USU) Irrigated Pasture Research Program, have been faced with the task of selecting the grazing forage best suited for their needs. What they discovered says a great deal about keeping one's mind open to more than one option.

After three years of evaluating various perennial and annual plants, the USU researchers settled on an endophyte-free tall fescue as the foundation forage.

"It was by far the most desirable considering ease of establishment, total yearly DM (dry-matter) yield, ability to deal with heavy concentrations of dung pats, ability to deal with heavy stocking density and hoof damage, ability to hold out weed encroachment, and overall persistence," Wiedmeier says, adding that orchard grass was a fairly close second regarding yearly forage yield, but it proved more vulnerable than the fescue to dung pat cover and hoof damage.

Cattle make choices

Juan Villalba, researcher at USU's Department of Wildland Resources, views grazing ruminants as anything but simple eating machines that are genetically programmed to consume anything that is put in front of them. He, as do a growing number of animal behaviorists, says that if cattle are given a choice of plants to graze they will often self-select for feed efficiency.

For Villalba, forage selection, in cattle, is a learned experience — "a process of interactions that allow individuals to learn through trial and error (individual learning) and from the experience of others (social learning)," he says.

He goes on to point out that food preferences are a product of positive smell and taste stimulation and the memory of how the animal's digestive system responded to a specific plant.

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These post-ingestive consequences and their corresponding memories allow animals to respond negatively to foods with little or no nutrition and foods high in toxins. It also helps them select nutritious foods, foods with health benefits and combinations of foods that complement one another biochemically.

He cites, as an example, a study he and his colleagues conducted feeding an endophyte-infected fescue free-choice with alfalfa and bird's-foot trefoil. Endophyte-infected fescue contains toxic alkaloids known to limit the plant's consumption, while alfalfa and trefoil possess buffering agents that mitigate these toxic alkaloids.

"We supplemented the fescue on pasture with the two legumes, and when the animals ate the alfalfa and trefoil they spent a great deal more time eating fescue than the animals not given a choice," Villalba says.

Similarly, in a study conducted by researchers from the University of Melbourne, it was confirmed that when offered a free choice between different forage species presented in a pasture association, ruminants will choose a mixed diet, even when one dietary component could meet all of their nutritional needs.

For the researchers this was an indicator of preference for a reason other than nutritional value. As in Villalba's study the Australian researchers offered ruminants a choice of grasses and legumes — in their case the legume was clover. Their data clearly showed that the animals eating only clover (with relatively high rumen degradable protein content) ate for shorter durations than animals eating only grass (with relatively low rumen degradable protein content), or a mixture of grass and clover.

From their observations the researchers hypothesized that preference in the ruminants was driven not by nutritional needs but by feed efficiency requirements identified by the animals themselves.

They contend that the short duration of feeding on clover alone was due to the rate of release of ammonia from the soluble protein

Table 1: First study data

	Choice	Fescue	Alfalfa	Brome	Bird's-foot trefoil
Total DM harvested, lb./acre	12,509	15,682	13,987	10,229	7,764
Carrying capacity, pairs/acre	1.78	2.23	1.99	1.45	1.10
Calf daily gain, lb.	2.76	2.60	2.13	2.68	2.42
Total calf gain, lb./calf	442	416	341	429	387
Calf gain/acre, lb.	787	928	679	622	426
Calf gain/DM	0.0629	0.0592	0.0485	0.0608	0.0549
Actual calf WW, lb.	662	659	608	631	647
Cow body weight change, lb.	6.0	-4.2	-69.2	14.2	-41.7
Cow BCS change	+0.17	+0.17	-0.42	-0.17	-0.17

DM = dry matter; WW = weaning weight; BCS = body condition score.

fraction of the forage, and subsequent uptake in the blood to levels that can approach toxicity if the ammonia is not removed by excretion as urea.

"Mixing grass with the clover allows animals to eat longer meals, perhaps because the better dietary balance of energy to soluble protein helps control ammonia accumulation rates," report the University of Melbourne researchers in their abstract. "Rumen ammonia and gas profiles from in vitro studies suggest that digestive efficiency is optimal at a dietary clover:grass ratio of approximately 0.7:0.3, which corresponds closely to the partial preferences observed in free-choice field experiments."

Mono crops vs. mixes

While Wiedmeier was using a non-endophyte variety of fescue that did not contain toxins, he did see, in the use of the legumes, a potential for improving feed efficiency as well as the obvious soil nutrient benefits of adding two nitrogen-fixing plants to his pasture mix.

To test the premise that forage mixtures in irrigated pastures would result in superior cow-calf productivity compared to monocultures, Wiedmeier partitioned a 10.75-acre field into 15 plots of 0.72 acre [48 feet (ft.) × 655 ft.] using electric fencing. Each plot was then randomly assigned and sown to one of five forage treatments, three plots per treatment. These included a low-bloat grazing alfalfa, an endophyte-free tall fescue, bird's-foot trefoil, meadow brome and a mixture (equal proportion of the above four forages).

In order to offer better free-choice and accurately monitor the intake of each plant in the mixed pastures, the forages were not interspersed at planting. Instead they were sown separately as four adjacent, parallel strips (12 ft. × 655 ft.). Cattle were allowed access to all four strips each day on these plots.

Thirty spring-calving cow-calf pairs were stratified into 15 groups of two pairs each, which were then randomly assigned to the 15 pasture plots. Management-intensive grazing (MiG) procedures were used with cattle receiving a fresh paddock each 24 hours.

Daily paddock allotments were confined using electric polywire fencing in front of and behind the cattle. Pasture forage harvested was estimated using raised plate meter readings before and after grazing. Pasture allotments were adjusted daily to allow maximum intake.

Pastures were sprinkler-irrigated as close as possible after grazing. Irrigation was limited due to drought conditions and mechanical problems. Wiedmeier stresses that in later studies, with better control of the irrigation process, results were significantly better.

Table 2: Current data, 2007

Pasture forage type	Calf ADG, lb.	Cow BCS Change (1-9)
Mixed	3.65	+0.40
Tall fescue	3.51	+0.25
Alfalfa	2.98	-0.36
Bird's-foot trefoil	3.47	+0.33
Meadow brome	3.42	+0.28

Mixes prove superior

For Wiedmeier, data from the monocrop grazing forage was predictable. The tall fescue produced more grazeable forage and had a higher carrying capacity than any of the other forage species compared or the combination of species. Each acre of tall fescue carried 2.23 cow-calf pairs during the 160-day grazing period, or each cow-calf pair required about 0.45 acres.

The alfalfa also exhibited a high carrying capacity, 1.99 cow-calf pairs per acre for the 160-day grazing period (see Table 1), but resulted in the poorest performance of both cows and calves of any forage or combination.

The brome was the second-to-the-lowest carrying capacity, while the bird's-foot trefoil was the lowest of all; monocrop and mixed included.

The first year's study results not only substantiated previous research on monocrop grazing options but it also confirmed Wiedmeier's suspicions regarding the use of more than one type of forage on the same pasture.

"Allowing the cattle a choice of the four forage species resulted in the highest daily calf gain," Wiedmeier says. "It was responsible for the most efficient calf gain, and the choice of forage species enhanced nutrient utilization compared to grazing monocultures."

Fine-tuning the mix

Wiedmeier notes he and his colleagues have collected two more years of data since publishing the results of their first-year study.

"While it is much the same, we have managed to make some real improvements to the system," he says.

Probably the most important is the mix, which has been pared down to three plants. While the alfalfa alone was the poorest performer of all the monocultures planted, and the bird's-foot trefoil had the lowest yields, when they were combined with the endophyte-free fescue the resulting stand had the highest carrying capacity of all the plantings and the highest average daily calf weight gain — 3.65 pounds (lb.) per day (see Table 2).

"Our new recommendation is an irrigated pasture composed of 50% tall fescue, 37.5% alfalfa and 12.5% bird's-foot trefoil," he says. "We noted an improvement if there was a tannin-containing legume, like bird's-foot trefoil, in the mix. However, our previous study indicated that a high percentage of bird's-foot trefoil would cut carrying capacity. It starts late and quits early. So we kept the percentage low."

Using a mix of three, as opposed to four forages, has increased production from 12,509 lb. per acre in the first study to 13,100 lb. per acre, says Wiedmeier, adding that most importantly the daily weight gain of calves has gone from 2.76 lb. per day to 3.65 lb. per day.

In the years since their initial study, Wiedmeier and his colleagues have made some minor modifications to their grazing regimen.

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Table 3: Forage production costs, 2007

Item	$/acre/year
Annualized establishment cost (seeding, fencing, drinking water lines, etc.)	45.00
Land ownership cost	73.00
Irrigation cost (handline sprinkler, 16.7" applied)	85.00
Nitrogen fertilizer (on grass portion only)	68.00
Repairs	10.00
Labor	20.00
Depreciation	21.00
Total annual operating cost	322.00

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"We normally graze 12 to 14 of these large, heavy-milking cows with their rapidly growing terminal calves on 8.7 acres of this forage mix for the entire 168-day grazing season," he says. "Our pastures are 630 feet by 600 [feet]. We graze down the 600-foot side, moving approximately 20 feet (per) day. Thus, it takes us 30 days for each grazing circuit."

He goes on to point out that by the time the cattle make it to one end, the other end is ready to graze again. So turn-around is 30 days. Wiedmeier adds that he is sure they could do better, but competition for irrigation water usually prevents them from irrigating at the optimum period after grazing.

As for the cost per pound of DM, Wiedmeier calculates this year's cost of production at $322 per acre (see Table 3, page 179).

"With these figures we are estimating the value of the forage from these mixed pastures at: $322 ÷ 13,100 lb. of DM = $0.025 per lb. DM," he says, adding that acreage required per cow per year is quite low with this production system. "We are looking at 8.7 acres ÷ 13 pairs = 0.69 acres per pair for the summer grazing season."

To calculate the total summer feeding cost for a cow-calf pair, Wiedmeier takes the average DM intake of each cow-calf pair averaged over the grazing season —

approximately 47 lb. DM per day × 168 days × $0.025 per lb. DM = $197.40 + (supplement cost: $0.03 per day × 168 days = $5.04) = $202.44 per pair for the summer season.

Timely irrigation important

If there is a single source of frustration that Wiedmeier and other researchers working with the Irrigated Pasture Research Program have experienced, it is in their lack of ability to access water when they really need it. "The competition for water can delay an application by days," he says. "Every day past the optimum time is a day of production lost."

To confirm the importance of maintaining a timely irrigation schedule, Wiedmeier and colleague Dale ZoBell, beef Extension specialist, initiated a study comparing the seasonal production of forage that was watered seven days after grazing — considered the optimum time to water — with the production of forage that was irrigated 14 days after grazing.

"Although the same resources were expended to the pasture, when irrigation water was applied at either a seven-day or 14-day post-grazing delay, the seven-day delay resulted in a 19.8% increase in yearly forage DM production compared to that of the 14-day delay," Wiedmeier says.