(1964) suggested that for maximum growth nitrate-N levels of 500 and 1000 ppm are required in the blades of Idaho fescue and Italian ryegrass, respectively. These values are similar to the nitrate-N concentrations of 0.09 to 0.11% which we found to represent statistically significant accumulations of nitrate in the species studied. Thus, it appears that nitrate accumulation at these levels in a grass indicates that maximum growth is being produced under the existing conditions and that additional N is unnecessary.

Nitrate accumulation was greatest in Malpais bluegrass growing under the warm-temperature regime and in *Entolasia* growing under the cool-temperature regime, even though both grasses were semidormant under these conditions. Obviously, N applications to Malpais bluegrass during the warm season or to *Entolasia* during the cool season could be hazardous. Application of N to any of the other species during the cool season at rates up to 150 lb N/acre and during the warm season at rates up to 100 lbs N/acre (150 lb N/acre to tall wheatgrass and coastal bermudagrass) would not be hazardous. Except for coastal bermudagrass, which would be dormant under cool conditions, this additional N would be utilized and increase production as long as there was sufficient moisture for growth.

The most significant result of this study, however, is the indication that the total N and nitrate concentrations of grass species are affected by temperature and that the response to temperature changes among grass species is variable. Furthermore, generalizations as to plant response to N by groups of similar grasses such as warm-season or cool-season species should be avoided in the absence of supporting data. Thus, successful rangeland fertilization or selection of range species for reseeding require an awareness of temperature-nitrogen effects. Only those species which can utilize additional N under anticipated temperatures should be fertilized.

LITERATURE CITED

HYLTON, LYNN O., AND ALBERT ULRICH. 1968. Critical nitrate-N concentrations for growth of two strains of Idaho fescue. J. Range Manage. 21: 321–325.

HYLTON, L. O., JR., D. E. WILLIAMS, A. ULRICH, AND D. R. CORNELIUS. 1964. Critical nitrate levels for growth of Italian ryegrass. Crop Sci. 4:16–19.

JOHNSON, C. M., AND A. ULRICH. 1950. Determination of nitrate in plant material. Anal. Chem. 22:1526–1529.

MARTIN, W. E., C. PIERCE, AND V. P. OSTERLI. 1964. Differential nitrogen response of annual and perennial grasses. J. Range Manage. 17: 67–68.

WILSON, A. M., G. A. HARRIS, AND D. H. GATES. 1966. Fertilization of mixed cheatgrass-bluebunch wheatgrass stands. J. Range Manage. 19: 134–137.

WRIGHT, M. J., AND K. L. DAVIDSON. 1964. Nitrate accumulation in crops and nitrate poisoning in animals. Advances in Agron. 16:197–241.

MANAGEMENT NOTES

Use Seeded Ranges in Your Management[1]

PAT O. CURRIE

Range Scientist, Rocky Mountain Forest and Range Experiment Station[2], Fort Collins, Colorado.

Highlight

Seeded ranges in conjunction with native range can effectively increase productivity and income from ponderosa pine ranges of Colorado. Average weight of weaned calves was 33 lb higher, and gross income per calf $8.95 larger from combined use of seeded and native range than from native range alone. Cows received better nutrition on seeded ranges, which may increase their lifelong production. Similar benefits can be expected by grazing yearlings. Seeding requires an initial investment of about $8.50 per acre which can be repaid within 3 years as a result of increased grazing capacity. Several grasses are recommended for seeding on the basis of their proven performance to meet specific forage needs.

Seeded ranges help a livestock operator balance his yearlong forage supply and maximize profits in his operation. To take advantage of seeded ranges, though, an operator should be aware of the value and potential uses of various species. For more than 20 years the Rocky Mountain Forest and Range Experiment Station has been conducting research in the ponderosa pine zone of Colorado to determine adaptability, establishment, forage values, proper seasons of use, and general management of ranges seeded to introduced or indigenous grasses. From this work, in which 85 species of grass were tested for adaptability, several were found to be very good. Each had its own unique characteristics to fill certain needs and provide green feed during spring or fall when native ranges are dry.

Three grasses are outstanding for furnishing early spring and late fall grazing: Russian wildrye, crested wheatgrass, and Sherman big bluegrass. Russian wildrye has the desirable characteristic of starting growth early in the spring so that it can be used to good advantage in providing forage early and reducing winter feeding. In comparative tests it consistently had sufficient height growth to be grazed in early or mid-April, 5 to 20 days earlier than crested wheatgrass. Grazing to approximately a 3-inch stubble height was found best; weight gains, although smaller than for crested wheatgrass, averaged about 1.5 lb/day and 50 lb/acre for yearling heifers.

At Manitou Experimental Forest, with typically a moist April followed by lower moisture in late May and early June, Russian wildrye often stops growth and leaves tend to dry and turn yellow as moisture decreases. Crested wheatgrass, on the other hand, usually grows some and remains green with limited precipitation. Because of this difference

[1] Received June 6, 1969; accepted for publication July 24, 1969.

[2] Forest Service, U. S. Department of Agriculture, with central headquarters maintained at Fort Collins, in cooperation with Colorado State University.

in response to moisture, we found it was hard to beat crested wheatgrass for late spring grazing either in pure stands or planted as a mixture of 40% crested wheatgrass, 40% smooth brome, and 20% yellow sweetclover. Yearling gains were consistently good with daily and per acre gains averaging 1.67 and 59.2 lb, respectively, for pure stands and 1.81 and 71.6 lb for the mixture ranges.

Sweetclover disappeared from the mixture stands 2 years after grazing began, and the smooth brome in about 5 years. As these species were lost from the stands, however, they were replaced by crested wheatgrass. The fact that weight gains were 11% higher than average during the first 5 years indicates the relative importance of brome and sweetclover in the mixture.

Crested wheatgrass, either in pure stands or a mixture, is quite tolerant of grazing to a 2-inch stubble height or approximately 65% use by weight year after year. In fact, it will tolerate grazing to a 1-inch stubble height or about 80% use, but this level is not recommended because it will decrease livestock gains. It should be grazed to a 2-inch level to keep wolf plants from developing and to maintain a good, vigorous stand.

Sherman big bluegrass, like Russian wildrye, is ready to be grazed in early April, about 20 days earlier than crested wheatgrass. Its most notable feature, however, is its growth in late fall. Though grazed as late as October 31, it has grown 3 or 4 inches in November. Sixty-five percent use is recommended, as for crested wheatgrass. At this level, gains during 7 years averaged 1.71 lb/day and 78.4 lb/acre. Daily gains were 0.2 lb lower, and gains per acre 6.7 lb higher, than those from the mixture of crested wheatgrass and smooth brome.

Management Application

To further evaluate the seeded species and determine their place in a yearlong management system, 24 range cows owned by Glen Johnston of Woodland Park are being grazed on the Manitou Experimental Forest under the management plans shown in Fig. 1. One herd of 12 cows grazes native ranges according to practices usually followed on mountain ranches. The other 12 graze seeded ranges part of the time.

Stocking rates are based upon average forage yields and proper uses for the ranges and species concerned. Between

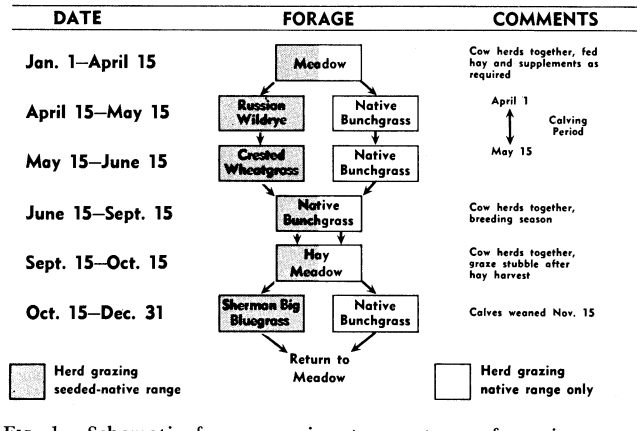

FIG. 1. Schematic for comparing two systems of grazing management. Two cow herds of 12 head each follow the same systems year after year.

30–40% of the forage on native range is grazed each year as recommended by Smith (1967). Stocking of seeded ranges is regulated so as to obtain degrees of use recommended above.

The same cows are used in each management system year after year. When the study was started 6 years ago they were 2-year-old heifers, similar in weight and grade. To minimize genetic variation in calves, one herd sire was used to breed all 24 cows for the first 5 years. Currently his younger half-brother is the herd sire. Calves are usually dropped between April 1 and May 15, and weaned approximately November 15 each year.

Weaning weights of calves for the 6 years of study have averaged 451 lb where seeded ranges are included in the grazing system, compared to 418 lb where only native ranges are grazed. Based on the average price of calves on the Denver market each year, the additional gross income per calf weaned from the seeded-native range system averaged $8.95.

Both the quality of the forage and fluctuation in market prices from year to year, can markedly influence returns. In 1964, for example, forage supply on native range was sufficient but cured early in the fall. Calf prices on the Denver market averaged lower than usual at approximately $23/CWT. Calf weights for the seeded management system averaged 415 lb compared with only 358 lb for calves weaned from the early cured native range. As a result, gross income for that year was $13.19/calf more from the seeded ranges; these ranges gave back their highest return under adverse growing and market conditions.

The difference in weaning weights was apparently a true function of forage quality. For the first 5 calf crops, the average age at weaning differed by only one day between the 2 herds. In 2 years, calves from the native range systems were a little older and in the other years calves from the seeded-native range system were oldest. These differences were not in successive years so that a trend for cows to breed back earlier has not been established. Adjusted 200-day weaning weights have also consistently favored the seeded-native system of management. In the 2 years when calves on this system were youngest, their 200-day adjusted weights averaged 40 lb/calf heavier than those where only native range was grazed.

Most of the difference in weaning weights during all years resulted from grazing Sherman big bluegrass in the fall. As shown in the following tabulation, the 43 lb gain during the 30-day fall period was almost double that on native range; and from mid-April til mid-June, gains on seeded stands were only 2 or 3 lb higher than on native range.

	Seeded-native	Native only
Russian wildrye (spring)	47	44
Crested wheatgrass (spring)	46	44
Big bluegrass (fall)	43	22

The possible long-term influence of Russian wildrye and crested wheatgrass should not be minimized, however, particularly from the standpoint of nutrition. For example, Malechek (1966), from fistulated animals in the same study, found that protein in the diet of cows that grazed both seeded and native range was adequate or excessive during 10 months of the year, as compared to 8 months for cows that grazed only native range. Earlier growth and later dormancy of the seeded species probably accounted for this difference.

In addition to larger weaning weights of calves and better nutrition of the cow herd, a further advantage of seeded ranges is that they require a much smaller acreage. The larger weight gains and added income were produced on 120 acres of seeded range while 220 acres of properly grazed native range were required to produce the weights shown. If an additional 100 acres were seeded to make the ranges comparable on an acreage basis, approximately 10 more cows and calves could be grazed for 4.5 months. Thus, the same amount of seeded range would produce about 13.5 lb/acre or 3,000 lb more beef/year than native range. Based on a seeding cost of $8.50/acre and 6% return on the investment, seeding costs on the full 220 acres would be repaid in less than 3 years by selling calves at the average $27/CWT market price.

The decision whether or not to incorporate cool-season grasses into an operation depends of course on each livestock operator and his particular circumstances. Should he decided to use cool-season grasses, however, then ranges suitable for seeding would be taken from those native bunchgrass ranges normally used in early spring or late fall. This would extend the green forage period on either side of the summer ranges, reduce feeding costs, and provide a longer period of higher nutrition for the cow herd.

LITERATURE CITED

MALECHEK, JOHN C. 1966. Cattle diets on native and seeded ranges in the ponderosa pine zone of Colorado. U.S. Forest Serv. Res. Note RM-77. 12 p. Rocky Mountain Forest and Range Exp. Sta., Fort Collins, Colo.

SMITH, DWIGHT R. 1967. Effects of cattle grazing on a ponderosa pine-bunchgrass range in Colorado. U.S. Dep. Agr. Tech. Bull. 1371. 60 p.

VIEWPOINTS

Are We Going to Be The Last to Convert?

In recent times most scientific societies have converted to the metric system in order to be in step with scientists around the world. During the transition period both systems are being used by some societies to facilitate easy adjustment of readers to the new units. Are we going to wait until everyone else has made the change before we give the idea our consideration? Appropriate committees in the Range Society should begin to study ways and means of making the conversion.

Great Britain will change to the metric system of measurements in 1971 and the U.S. Government is presently studying the possible effects of a switch on American industry. The advantages for simpler calculations in Great Britain are certainly obvious to anyone who has struggled with currency in England in addition to other units of measurement. We cannot afford to continue with our present haphazard mixture of units while the rest of the world uses the metric system—especially while other societies in the U.S. make the transition.

The change would not be as difficult as one might imagine since kilograms per hectare are almost equal to pounds per acre. Other easy equivalents would become obvious if we started using the metric system. The problem is similar to learning a foreign language because only when you use the language enough to begin thinking in that language do you use it with facility.

In setting up experiments where a conversion to the metric system is planned we should use round numbers for the metric system rather than fractions or odd numbers within the English system. For example, use 20°C and 30°C (equal to 68°F and 86°F) rather than 65°F and 85°F (equal to 18.3°C and 29.4°C). A good example of equivalent values was printed in the May 1969 issue of Agronomy News which many will find easy to remember: a "round" female figure measuring 36–24–36 in inches is an amazing 914–610–914 in milimeters!—*C. M. McKell. Department of Range Science, Utah State University, Logan, Utah.*

Individual Sustaining Members

In recognition of additional support to the American Society of Range Management for the calendar year 1969.

Alan A. Beetle
Francis T. Colbert
E. J. Dyksterhuis
Clinton H. Wasser