

## SOIL FERTILITY CONSIDERATIONS FOR FORAGE PRODUCTION ON CONVERTED CONSERVATION RESERVE PROGRAM LAND

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As existing USDA Conservation Reserve Program (CRP) contracts expire, producers in the Southern Great Plains region are confronted with various options for conversion of these acres. Managing the converted CRP land in a forage production mode is one option that should be carefully considered. Knowledge of the responsiveness of a particular grass species to added fertilizers is necessary in order to make well-informed decisions.

Much of the CRP land in the Southern Great Plains area was seeded to introduced grasses such as Old World bluestems (*Bothriochloa ischaemum* L.), and weeping lovegrass [*Eragrostis curvula* (Schrader) Nees]. Various other warm-season native species such as big bluestem [*Andropogon gerardi* (Vitman)], blue grama [*Bouteloua gracilis* (H.B.K.) Lag. ex Griffiths], sideoats grama [*B. Curtipendula* (Michx.) Torr.], little bluestem [*Schizachyrium scoparium* (Michx.) Nash], sand bluestem (*Andropogon hallii* Hack.), switchgrass (*Panicum virgatum* L.), and Indian grass [*Sorghastrum nutans* (L.) Nash] were also used. According to the scientific literature, these grasses vary significantly in response to cultural and fertilizer management.

The Southern Great Plains region is characterized by variable rainfall and soil resources. Rainfall increases from west to east, which in turn generally results in a higher likelihood of achieving a reasonable response to nitrogen (N) fertilizers by many grass species. Soil resources are generally adequate for grass production, although certain inherent characteristics such as high soil pH levels can result in iron chlorosis and other nutrient availability problems with some grasses. Organic carbon and total N measurements indicate that many soils have lost much of their indigenous fertility due to stimulation of oxidation of "organic matter" by tillage and cropping over the last century or so. This loss of native soil fertility (prior to enrollment) in much of the CRP lands is considerable and will affect the yield potential of acres subsequently converted to forage production. Soil potassium levels are generally adequate for grass production in much of the region, however, heavily cropped sandy soils may be deficient in some areas.

Much far-sighted and proactive research work has been conducted by Berg and others at the USDA-ARS Southern Plains Range Research Station near Woodward, OK. Berg (1985) noted that soil pH, and N and phosphorus (P) nutrition were important for Old World bluestem (OWB). He stated that most OWB cultivars were somewhat tolerant of acid soils in the range of pH 5.3 to 6.0. Cultivars such as Caucasian, WW-Spar, and Ganada failed at soil pH 4.1. Soils with severely acidic surface layers should probably be limed in order to achieve optimum production. Soils with surface layers that are calcareous in nature can result in iron chlorosis which can not be presently economically corrected by fertilization. Manure application was mentioned as a potential amelioration on small acreages, with approximately 20 tons per acre suggested.

Since the N status of most CRP land is low, N fertilizer response information is important. Due to considerable biomass accumulation over the duration of CRP enrollment, considerable volumes of high carbon:N ratio material have been added over time. This additional biomass would be expected to immobilize at least some fertilizer N. Initial information from some CRP conversion research sites indicates that higher than normal N fertilization rates may be necessary to achieve optimum wheat grain yields (Dao et al., 1996). Lamberth et al. (NRCS-TAEX unpublished data) have collected N fertilization yield response data from 'Plains' OWB and 'Ermelo' lovegrass for 3 years on a low-soil phosphorus CRP site involved with the Seymour Hydrologic Unit Project in north-central Texas. Their data show that N response is variable by year, and that multi-year means are important for characterizing the responses (Fig. 1 and 2).

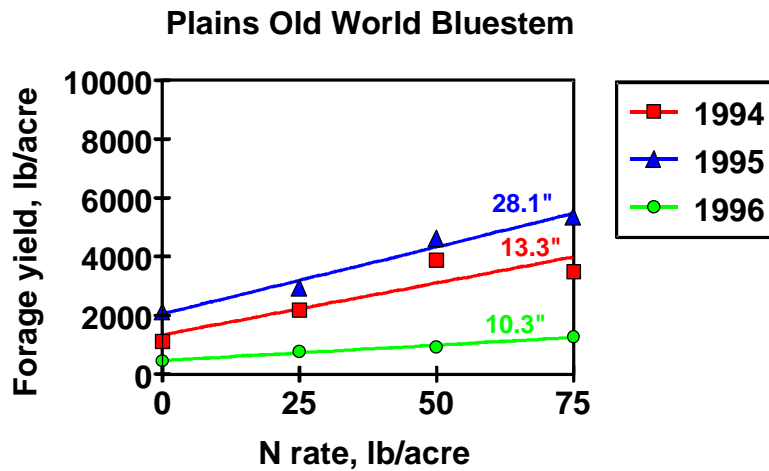


Figure 1. Nitrogen fertilizer response of a CRP planting of 'Plains' Old World bluestem as affected by growing-season precipitation in north-central Texas, 1994-1996.

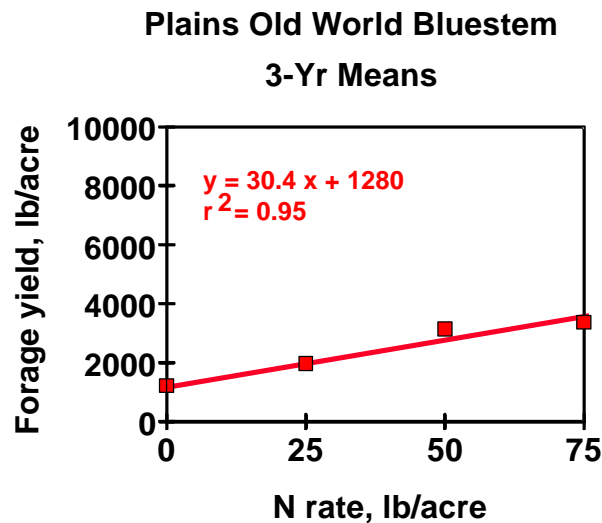
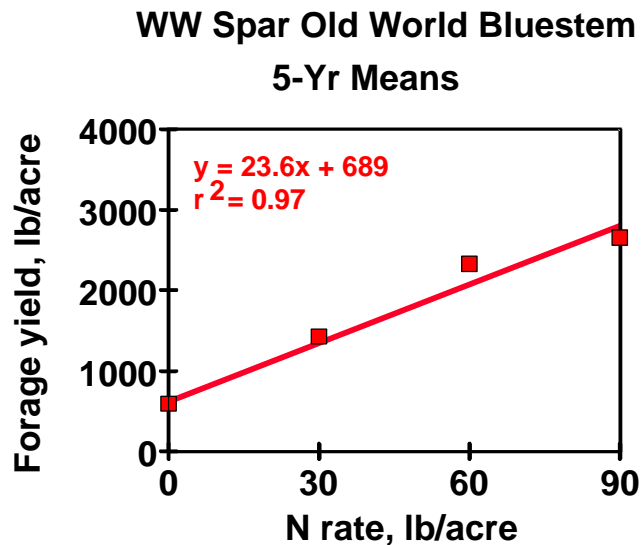


Figure 2. Three-year mean nitrogen fertilizer response of a CRP planting of 'Plains' Old World bluestem in north-central Texas.

Berg (1990) summarized his OWB N response work conducted over a five-year period at two sites during the 1980's (see 5-year means for one low-soil phosphorus site, Fig. 3). Under environmental conditions observed at Woodward, OK, an average of about 900 lb/acre of forage dry matter was obtained without any added N. An average of about 33 lb of dry matter was produced per lb of applied N with 30 and 60 lb N/acre applied in April each year. The 90 lb N/acre rate increased dry matter yields above the 60 lb rate in only one year with above average precipitation for the area. He also reported that a split application of 30 lb N/acre in April and 30 lb N/acre again in June was generally not as effective as 60 lb N/acre applied in April. Partial "die out" of OWB was noted, and was enhanced by addition of N fertilizer at one site.



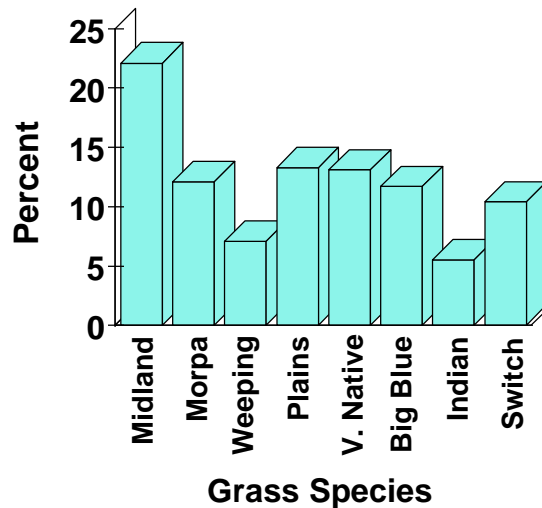
**Figure 3. Five-year mean nitrogen fertilizer response of 'WW-Spar' Old World bluestem in western Oklahoma.**

Additional work reported by Berg (1993) indicated that burning of residual biomass decreased dry matter yields from 6 to 30% per year. He also stated that 50 lb N/acre as ammonium nitrate resulted in 20% more dry matter yield than urea in one year and equal yield in two other years. He concluded that OWB should only be burned when necessary to reduce the residual biomass prior to N application. When urea was applied as a broadcast application three to four weeks after initiation of spring forage growth (during a period of high rainfall probability), potential for ammonia volatilization loss was reduced.

Nitrogen fertilization response of several warm-season native grass species (including blue grama, sideoats grama, little bluestem, sand bluestem, switchgrass, and indian grass) planted in a mixture on marginal cropland was reported by Berg (1995). These grasses produced approximately 23 lb of dry matter per lb of N applied during the year of establishment when near-normal rainfall was received. During subsequent years, response was approximately 10 lb of dry matter produced per lb of N applied. Residual effects after fertilization termination were noted for two years, and blue grama made up much of the biomass production during that time.

Weeping lovegrass was also planted on considerable acreage across the Southern Great Plains and it has a forage yield potential of up to 5 tons per acre. McIlvain and Shoop (1970a and 1970b) and Rommann and McMurphy (1974) reported that lovegrass has higher management requirements to maintain palatability than many other grasses. Management options include burning residual biomass in the spring, with N applications of 30-40 lb N/acre recommended beginning in April and after each round of grazing/haying as soil moisture permits. “Die out” is possible if stress environments are encountered in conjunction with high N rates. Dalrymple (1969) noted that under higher moisture regimes, higher yields are possible and N fertilization rates of up to 200 lb N/acre are satisfactory. The authors also noted that rotational grazing may be important to reduce spot grazing and maintain palatability of lovegrass.

Phosphorus fertilization response data is somewhat lacking from actual CRP test sites. Taliaferro et al. (1975) and McMurphy et al. (1975) reported both N and P response data for several warm-season perennial grass species. When averaged over N rates, the relative differences of various species is interesting to note (Fig. 4). ‘Midland’ Bermuda grass had the highest P requirement, while ‘Morpa’ and common weeping lovegrass, ‘Plains’ OWB, and monoculture plantings of big bluestem, Indian grass, and switchgrass had somewhat comparable requirements as virgin native range.



**Figure 4. Average yield reduction (across all nitrogen rates) due to “inadequate” soil P.**

In summary, where CRP sites are considered for forage production, the soil should be tested in order to determine the current nutrient status. The N fertilization rate is governed by species and rainfall regime. In drier regions, “die back” has been noted in some CRP grasses due to N fertilization and in order to reduce the potential for stand loss, lower N rates may be in order. In higher rainfall areas, higher N rates are more appropriate. Phosphorus fertilization should be dictated by soil analysis, and careful considerations of potential increases in yield from various species should be weighed against the cost. Haying results in considerable nutrient removal over time, and the fertilizer program should meet or exceed those needs based on philosophy of management. Under grazing conditions, approximately 80-85% of the nutrients consumed by cattle are returned to the soil in manure and urine, however,

considerable potential for ammonia volatilization losses exists on high pH soils and distribution can be less than desirable (Russelle, 1992; Whitehead, 1995).

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