Economic Consideration of Fertilizing Old World Bluestem

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Background

Originating from Europe and Asia, Old World Bluestem is a warm-season grass with high potential as a forage crop in Oklahoma. Palatable to cattle and horses and possessing cold and drought tolerances, many cultivars are capable of withstanding close grazing. There are six common varieties used in Oklahoma: 'Ganada', 'King Ranch', 'Plains', 'Caucasian', 'WW-Iron Master', and 'WW-Spar'. Old World Bluestem can adapt to conditions that other crops would be unable to endure such as low-iron soils and how easily the stand can become established.

Image 1: Plains (left) and Caucasian Bluestem (right) seed heads posted on Oklahoma Introduced Warm-Season Forage Grasses on the Oklahoma State University website http://forage.okstate.edu/oklahoma_introduced_warmseason.htm. (2006)

Old World Bluestem will generally produce higher yields when grown in loamy to clay loam soils. However, they are incapable of withstanding alkaline or excessively wet soils. Ideally, they should be planted on firm seedbeds at shallow depths of ¼" or less with a recommended seeding rate of 1-3 lbs pure live seed per acre. While late growing in spring, they are capable of surviving the hot summer months in Oklahoma. Forage production will be seen around mid-July however, by the end of May to the beginning of June about 70% of their growth will have occurred and the nutritive quality will begin to decline.

Materials and Methods

In an attempt to determine the economic effectiveness of applying nitrogen (N) and phosphorus (P) fertilizers to Old World Bluestem pastures, three pastures were set up with enclosures of 32'x32' consisting of 5'x6' plots and 5' alleys in the South Pasture of the OSU Cross Timbers Research Facility. Soil tests were conducted just prior to this study and the initial values for N and P for a 1.5 tons/acre yield goal indicated additions of 45 lbs/acre of N and 37 lbs/acre of P for these plots. The trial size was 30'x28'. Six different treatments were replicated three times in each pasture. These treatments were applied in the spring using Urea (46-0-0) and TSP (0-46-0). Treatment 1 was the control using 0 lbs/acre of N and P_2O_5. Treatment 2 had 30 lbs/acre of N and 0 lbs/acre of P_2O_5 applied, and the third treatment had 60 lbs/acre of N and 0 lbs/acre of P_2O_5 applied. Treatment 4 had 90 lbs/acre of N and 0 Lbs/acre of P_2O_5 applied. Treatment 5 had 120 lbs/acre of N and 0 lbs/acre of P_2O_5 applied, and finally the sixth treatment consisted of 120 lbs/acre of N and 75 lbs/acre of P_2O_5.

Once mature in the fall, the individual plots were hand clipped to approximately ½ inch above the soil surface and the biomass then analyzed using the **LECO TruSpec Carbon and Nitrogen Analyzer.** There were four main criteria measured: yield, crude protein (CP), Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF). Yield was used as a means to determine if there was an increase in the quantity of forage produced per acre. The crude protein includes both true protein and non-protein nitrogen values, and is calculated using the following formula: CP = %N x 6.25. In forages, the true protein consists of approximately 16% nitrogen, which is equivalent to 6.25 lbs of total protein per pound of nitrogen. This represents the potential for the nutritional needs of the livestock to be satisfied. The ADF value references the ability of an animal to digest the given forage, and is comprised of the cellulose, lignin and silica of the plant. As the ADF increases, the digestibility of forage will decrease. The NDF value represents is the total cell wall, which consists of the ADF fractions plus hemicelluloses. Neutral detergent fiber values are important in ration formulation because they reflect the amount of forage the animal can consume. As the NDF percentages increase, the dry matter intake will generally decrease.

Results

There was, as one would expect, a clear response to the nitrogen. As seen below (Figure 1), the first 30 lbs of nitrogen applied produced a 1 ton increase in yield, and proved the most profitable. In all, the average tons per acre steadily increased with each additional 30 lbs/acre of nitrogen added to each of the plots. Treatment 6 however, showed a decrease in yield by 0.73 ton/acre when 75 lbs/acre of phosphorus was applied to the final amount of nitrogen applied.

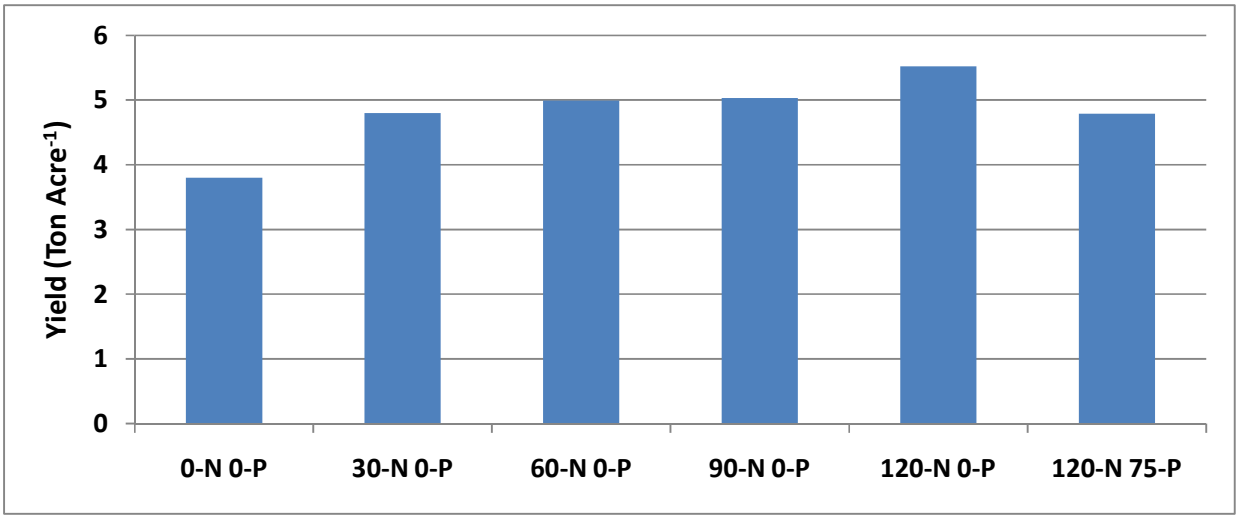

Figure 1: Average yields (Ton Acre^{-1}) of old world bluestem from each treatment averaged over each repetition and pasture

Examining the differences between phosphorus concentrations applied in treatments 5 and 6, the tonnage per acre is shown to have an average decrease of 0.74 tons per acre produced. The protein percentage showed an average increase of 0.58 tons per acre over the three pastures. ADF had an average increase of 0.37 tons per acre, and NDF showed an average increase of 1.02 over the three pastures. Being that the samples were harvested at maturity, this would have significant effect on ADF and NDF.

Arguably, one of the most important factors to analyze with this study was the economic payoff from a producer's standpoint. In order to do this, it was necessary to make some assumptions. Many producers typically graze their Old World Bluestem, but we will determine the economic payoff specifically based on the hay production among the treatments. We are assuming that it would cost $24/acre to swath and bale big (2000 lbs) round hay bales.[1] The fertilizer used was Urea costing $0.45 per pound for the nitrogen supply and DAP costing $0.39 per pound for P_2O_5.[2] We are also assuming that the big round bales will sell on average for about $60 per 2000 pound bale. Based on this study, the most profitable fertilizer application was treatment 2 where only added 30 pounds of nitrogen was applied. The least profitable fertilizer application was treatment 6, where we added 120 pounds of nitrogen and 75 pounds of phosphorus. As you can see from the results in Figure 2 below, the profits increase when 30 pounds of nitrogen was applied. However, there is a decrease in marginal returns when adding additional fertilizer beyond 60lbs/acre due to the fertilizer cost.

[1] The estimated costs were based on numbers from the Oklahoma Department of Ag-USDA Market News http://www.ams.usda.gov/mnreports/ok_gr310.txt (reported 11/2010).

[2] The fertilizer costs were based on estimates from Oklahoma State University Plant and Soil Sciences NPK web page http://npk.okstate.edu/ (reported on 11/20/2010).

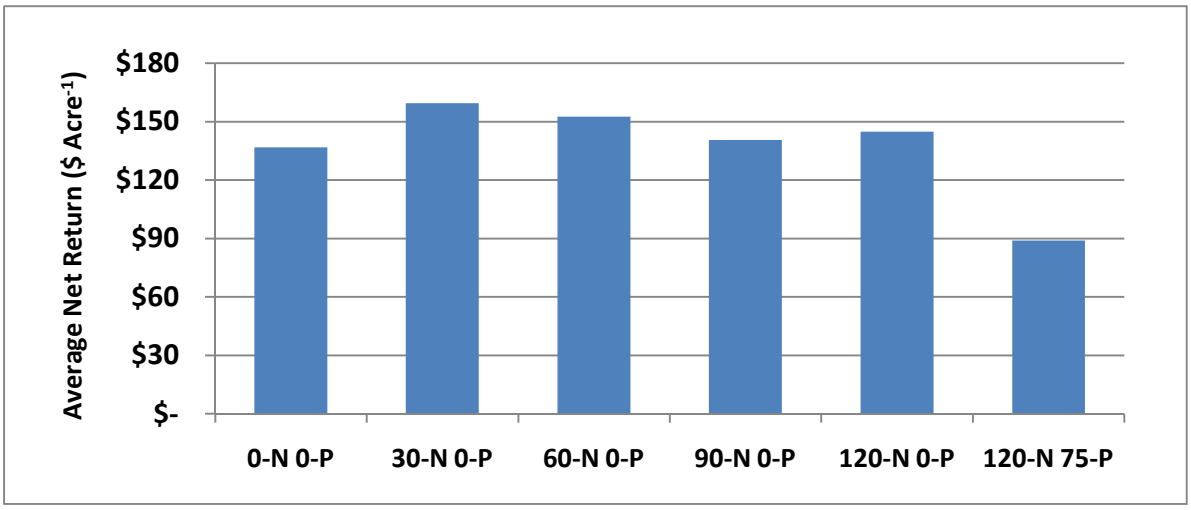

Figure 2: Total average net return on yields ($ Acre^{-1}) based on fertilizer application

Figure 3 shows the net returns for each individual pasture in the study. Within each pasture there was some variability with the net returns for the separate fertilizer treatments. Pastures 1 and 3 mirrors the total average net returns shown in Figure 2, where treatment 2 was the most profitable. However, pasture 2 was a bit different.

The yields in ton/acre for each field are shown below in Figure 3**.** Pasture 2 and 3 showed a decrease in tons per acre with treatment 6, whereas pasture 1 showed an increase of 0.38 tons per acre. Pasture 2 was observed to be the most responsive to each treatment, whereas pasture 1 was the least responsive. Figure 3 also demonstrates variability in yield and response to fertilization.

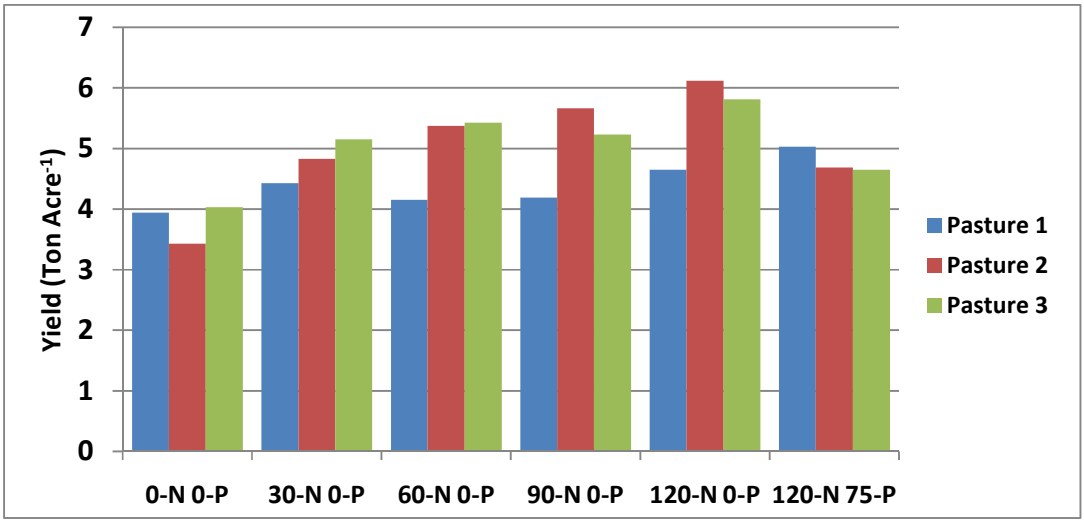

Figure 3: Average yields (Ton Acre^{-1}) produced from each pasture based on the amount of fertilizer applied

Conclusion

It appears clear that the addition of N was the only economically feasible way to increase profitability in Old World Bluestem pastures. The addition of 30-60lbs/acre of N was the most profitable from treatment 2 and 3. Based on this study, it should also be noted that it may be best to apply no more than 60 pounds of nitrogen to Old World Bluestem pastures based on the economic standpoint as indicated above. Looking at the averages of three pastures from this study, there was no observed economic benefit from adding P_2O_5 in treatment 6 to Old World Bluestem stands. Pasture 1 was the only pasture that showed an increase in yield, but the benefits did not outweigh the cost.

One final note, it should be stated that the results of this study was obtained from a single growing season, and will be duplicated in the future. In addition, it is necessary to point out that not all of the costs for producing hay are included in these assumptions.

References:

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