Value of Maintaining Legumes in Pasture Stands Increasing

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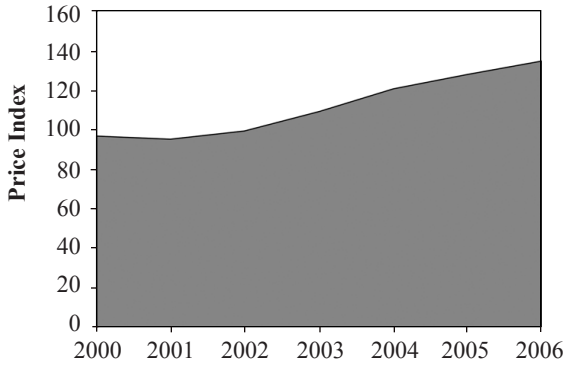
It is no secret that input costs for crop production are increasing. The price index for nitrogen (N) fertilizer in 2006 was ~30% greater than 2002 according to USDA (Figure 1). In the Midwest, pastures are dominated by cool-season perennial grasses that respond favorably to N fertility. Response to N fertilization can be influenced by several factors including species and weather. Research conducted at the University of Wisconsin-River Falls during 2004 and 2005 illustrated that the response to N was species and timing dependent with smooth bromegrass + alfalfa > orchardgrass + red clover > Kentucky bluegrass + white clover (Cosgrove, http://www.uwrf.edu/grazing/PNNitrogen.pdf). Additionally, responses to N application were greater for split applications (May 1, June 15 and August 1) than for a single application. Yet, the forage production response, expressed as pound of forage DM/lb of N, was greatest for the May 1 application for smooth bromegrass and orchardgrass (26.5 and 21.0, respectively). When considering the economic returns, the work illustrated under these conditions, the net return/ac was $86.74 for three applications of 50 units of N for smooth bromegrass, while a single application of 50 units on May 1 was $73.95 using $322/ton of urea and $137.93/ton of dry hay. Under stockpiling conditions, date of N application was not reported to have an impact on DM accumulation of bermudagrass in Oklahoma when applied on either August 15, September 1, September 15, October 1 or October 15 (Guretzky et al. 2008, Forage and Grazinglands) which may partially be due to precipitation and soil moisture conditions. Therefore, predicting forage responses to N fertility is dependent on weather and species.

Figure 1. *Historical nitrogen fertilizer price index trend in which base of 100 equals price during 1982*



In a preliminary meta-analysis of more than 40 research articles comparing N fertilization of grasses to interseeding legumes utilizing beef stocker calves, greater DM intakes on legume-grass pastures were noted, compared to steers grazing grass with N fertilizer. This higher intake may explain the higher rates of gain observed for legume containing pastures (1.54 vs. 1.34 lb/d, legume and grass + N, respectively). Even though individual animal performance was greater for legume-grass pastures, total productivity or gain/unit of land tended to be greater for grass plus N fertilizer, partially due to numerically greater forage DM production.

Interseeding legumes into cool-season pastures is a common practice. Legumes capture atmospheric N allowing it to enter the forage production system. In the fescue belt, interseeding legumes has also been shown to minimize fescue toxicosis and improve animal performance (Gay et al., 1988, Appl. Ag. Res.). One of the largest challenges with legumes under grazing conditions has been persistence and the varying contribution towards the botanical composition in the stand. Frost seeding or interseeding is routinely conducted in an attempt to maintain legumes in pasture, but in practice success is achieved less than 50% of the time. It would be ideal to identify legumes that are persistent under grazing conditions that do not require reseeding.

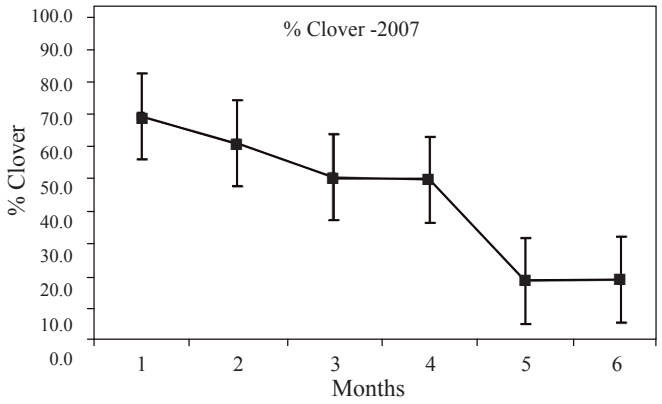
Kura clover has been found to be very persistent under grazing conditions (Mourino et al., 2003, Agronomy Journal). Additionally, kura clover-grass pastures resulted in greater gain/unit of land than red clover-grass pastures averaging 912 lbs/ac vs. 714 lbs/ac, respectively (Mourino et al., 2003, Agronomy Journal). Holstein steer daily gains were reported to be 0.44 lbs greater/day for those grazing kura clover-grass pastures than those grazing red clover-grass areas. Animal performance differences were associated with greater legume proportion in the kura clover-grass pastures. According to research conducted at the University of Wisconsin, the fertilizer N replacement value of kura clover-smooth bromegrass combination ranged from 66-290 lbs of N/ac and this replacement value was highly correlated to the yield of the legume fraction in these mixtures (Zemenchik et al., 2001, Agronomy Journal). These results highlight the value of achieving and maintaining high proportions of legumes in mixtures with cool-season forages.

During 2005-2007, a research trial was conducted at the Arlington Beef Cattle Research & Teaching Center comparing pastures containing soft-leaf tall fescue seeded alone or with either kura or white clover to study clover contribution to animal performance. Monoculture soft-leaf tall fescue pastures received N fertilizer. Two, 5.6 ac pastures/treatment were established and rotationally grazed. Forage production, quality and animal performance was monitored.

White clover suffered severe winter damage and subsequently was not grazed in two of the three years while kura clover was unaffected. Kura clover proportion averaged nearly 50% over the season, declining to less than 20% as it went dormant in autumn (Figure 2). Winter hardiness of forages is extremely important in northern regions and though species may be lower yielding, the ability to persist often outweighs yield.

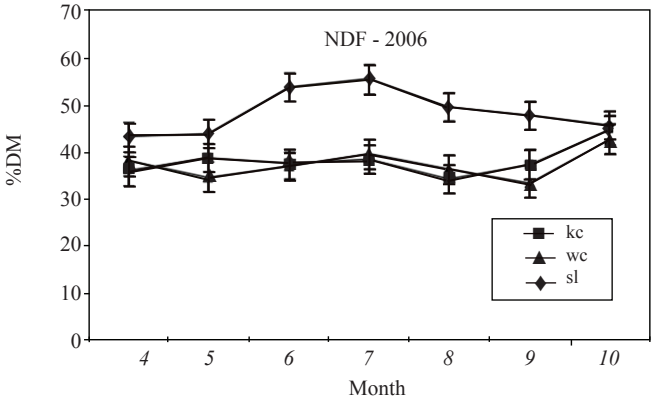
Forage quality differences were variable across the treatment

Figure 2. *The percentage of kura clover in mixed soft-leaf tall fescue and kura clover pastures by month of grazing*



years. During 2005 and 2006, digestibility was greater for kura clover-grass pasture compared to soft-leaf tall fescue-only pastures while no differences were observed in 2007. The crude protein content did not differ between the two pasture combinations for any of the three years. Fiber concentration (both neutral and acid detergent fiber) levels were different only in 2006 with kura clover pastures being lower than the soft-leaf tall fescue pastures. The lack of differences may be partially explained by the grazing management. Rotational grazing allows for grazing of predominantly high quality vegetative regrowth each grazing cycle, maintaining relatively constant forage quality over the grazing season (Figure 3).

Figure 3. *The concentration of neutral detergent fiber (NDF) from kura clover (kc),white clover (wc) seeded with soft-leaf tall fescue or soft-leaf tall fescue alone (sl) over the growing season*



Animal performance was observed to be similar in two of the three years. Production/unit of land was also not observed to be statistically different between grass plus N fertilizer and grass with clover, however, clover pastures were numerically greater than fertilized pastures two of the three years. When investigating DM intake, grazing Holstein steers were noted to have intakes of 2.9% and 2.1% of body weight for the soft-leaf tall fescue plus kura clover and soft-leaf tall fescue plus N fertilizer, which support the findings from the meta-analysis.

In conclusion, cool-season forages respond favorably to N fertilization. Even with increasing N fertilizer prices, the response in forage production often results in a positive net return. However, the threshold application rate should be examined to maintain profit margins in grazing conditions. The utilization of legumes to replace N fertility has been shown to be a successful alternative, yet sustaining legumes in pastures requires management. Lastly, comparisons between N fertilization to interseeding with legumes shows variability, however, animal performance and production/ unit of land is equal to or enhanced with legume incorporation.