Forage Production, Use by White-tailed Deer, and Seasonal Crude Protein Level of Three Cool Season Forages in Georgia

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Abstract: In the southeastern United States, food plots are often used to compensate for annual fluctuations in forage quantity and quality. We evaluated forage production, seasonal use by white-tailed deer (*Odocoileus virginianus*), and seasonal crude protein levels of MaxQ fescue (*Festuca arundinacea*), Regal ladino white clover (*Trifolium repens*), and Durana white clover (*T. repens*) planted alone or in combination. We planted two 1-ha food plots in the Coastal Plain, Piedmont, and Blue Ridge physiographic regions of Georgia in November 2002. We measured forage production (kg/ha) and use every 30 (±3) days over one year. MaxQ fescue had greatest amount of standing crop across regions throughout most of the study period. Forage production and standing crops of Durana and Regal were similar throughout the study except during the second spring in the Coastal Plain, when Durana had greater standing crops than Regal. MaxQ fescue and combination plots produced similar amounts of forage over the three regions. Generally, Durana and Regal had greater use over the three study areas. Durana and Regal white clover consistently maintained higher crude protein levels than MaxQ fescue across the three research sites.

Key words: cool-season forages, crude protein, Durana ladino clover, *Festuca arundinacea*, food plots, forage production, forage use, Georgia, MaxQ, *Odocoileus virginianus,* Regal ladino white clover, supplemental food plots, *Trifolium repens*, white-tailed deer

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In the southeastern United States, supplemental food plots for white-tailed deer (hereafter, deer) may compensate for annual and seasonal fluctuations in forage quality or quantity (Halls and Stransky 1968, Short 1975). Besides facilitating deer harvest, supplemental foods plots produce abundant, high quality forages, and

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are often incorporated into management programs (Blair et al. 1979, Johnson et al. 1987). There are many varieties of cool season annuals/perennials that may be used as forage, and choice depends on factors such as time of year, soil pH, site location, soil drainage, temperature, available soil nutrients, possible pest problems, and amount of rainfall (Ball et al. 2002). Waer et al. (1992) tested 17 forages and reported that deer preferred forages that were growing rapidly and high in crude protein.

White clover is the most widely planted pasture legume due to its strong perennial nature, ease of establishment, aggressive running stolons, and broad adaptability under a wide range of climate conditions (Medeiros and Steiner 2000). Regal is a variety of ladino white clover that provides high quality, year-round forage for deer, especially between April and November. McDonald and Miller (1995) found that Regal was used most by deer out of eight cool season forages tested. Kammermeyer et al. (1993) reported that Regal ladino was the most economical of three varieties of ladino clover for the nutrition it provides and that ladino clovers provided an average of 24% crude protein for three years in Northeastern Georgia.

Durana white clover, an intermediate-leaved, common type of white clover, offers landowners a legume that provides increased stand persistence (Bouton et al. 2004). Durana has smaller leaves than ladino clovers, but produces more stolons, which enable the legume to grow vigorously in heavy soils (Brink et al. 1999). Bouton et al. (2004) reported that Durana may be more adaptive than Regal to grazing pressure and drought. Evaluations of Durana clover as an alternative to ladino clover for wildlife food plots have not been done.

Tall fescue, a cool season perennial grass, is widely planted (Bouton et al. 1993*a*, Bouton et al. 1993*b*, Joost 1995) and has many desirable agronomic characteristics. However, it has not been used for supplemental food plots because of low palatability and presence of a toxic fungal endophyte that produces ergot alkaloids (Hill et al. 1991). Consumption of the endophyte alkaloids can result in several detrimental effects including reduced reproduction and low weight gain in livestock (Latch et al. 1994, Bacon 1995, Forcherio et al. 1995, Fortier et al. 2001). Thus, fescue is often eradicated from wildlife food plots in favor of more suitable wildlife forages (Barnes and Washburn 1998).

Endophyte-free fescue varieties have demonstrated excellent animal performance in livestock trials, but were damaged or lost when grazed too closely (Ball et al. 2002). A new variety of fescue, MaxQ, has been developed by inserting a nontoxic "friendly endophyte." This non-toxic endophyte furnishes the excellent livestock performance of endophyte-free tall fescue with the toughness and persistence of toxic tall fescue (Hoveland 2000, Bouton et al. 2001). In livestock trials, MaxQ did not have palatability problems associated with older varieties (Parish et al. 2003). However, no research has been conducted on use of MaxQ fescue by deer.

Our objectives were to determine forage production and seasonal use by white-tailed deer of Regal ladino white clover, Durana white clover, and MaxQ fescue, when planted alone and in combination, to assess adaptability of these forages to the Blue Ridge, Piedmont, and Coastal Plain physiographic regions of Georgia, and to evaluate nutritional quality of each of these forages as measured by crude protein analysis.

Study Areas

We conducted our research in the Coastal Plain, Piedmont, and Blue Ridge physiographic provinces of Georgia and included study areas in Tift County (private property), Putnam County (B. F. Grant Wildlife Management Area [WMA]), Fannin County (Blue Ridge WMA), and Union County (Chestatee WMA). The Coastal Plain study area (Tift County) was on well drained to excessively drained Norfolk loamy sand soils with very gentle sloping (Jensen et al. 1959). Soils of the Piedmont site (Putnam County) were on well drained Cecil sandy loam soils with slopes ranging from 2% to 6% (Payne 1976). One Blue Ridge study area (Fannin County) was on deep, well drained, moderately permeable Cowee fine loamy soils with slopes ranging from 10% to 25%. The Union County study area was on very deep, well drained, moderately permeable Evard fine loamy soils with slopes ranging from 10% to 25% (Cabe 1996). Deer densities range from 6 to 10 deer per km^2 in Fannin and Union counties (Kammermeyer 2003), 8–12 deer/km^2 in Tift County (Georgia DNR, unpublished data), and 17–21 deer/km^2 in Putnam County (Kammermeyer et al. 2001).

Methods

We measured forage production and use by deer of Durana white clover, Regal ladino white clover, and MaxQ beginning in February 2003 and concluding in May 2004. We applied fertilizer and lime to each site according to soil test recommendations. We fertilized each site again in September 2003 with a complete fertilizer and March 2004 with potassium (K) only subsequent to March data collection (see below) to encourage forage growth. In August 2003, we mowed each site following data collection to discourage competing vegetation and enhance new growth. Prior to planting, we mowed and harrowed each site to remove existing vegetation and minimize weed competition. We inoculated all clover seeds with appropriate *Rhizobium* spp. prior to planting.

Within each physiographic region, we established two food plots located at least 1.6 km apart, with the three forages planted alone or in combinations. We divided each approximately 1-hectare site into five 0.2-hectare treatments. We randomly assigned sections and planted pure Regal ladino (8.4 kg/ha), pure Durana clover (8.4 kg/ha), pure MaxQ fescue (19.6 kg/ha), a combination of MaxQ fescue and Regal ladino clover (8.4 kg/ha; 5.0 kg/ha), and a combination of MaxQ fescue and Durana clover (8.4 kg/ha; 5.0 kg/ha).

We randomly placed three 0.5-m^2 exclosures on each 0.2-hectare section after planting to prevent deer browsing. We used two 1-m rebar stakes to anchor each exclosure. Exclosures were 1.22 m high and made of 14-gauge galvanized mesh wire with 5.06 x 10.16 cm openings. Forages were planted in October in the Blue Ridge and November in the Piedmont and Coastal Plain. These dates were a month later than those usually recommended for clover planting due to logistic problems. Consequently, start of top growth on clovers was slow before onset of cold weather and dormancy.

We began collecting forage data approximately 90 days after planting at each site. Following the 90-day establishment period, we clipped all plants within each exclosure to a uniform height of 2.54 cm from the ground and collected all clippings for analysis. We clipped an equal area (0.5 m^2) outside but adjacent to each exclosure during each sampling period. We placed clipping samples into a paper bag and labeled them. After this initial sampling, we clipped all sections every 30 days (± 3 days). After each sampling, we randomly moved the exclosures within each section for the next sampling period.

Within 1–2 days post clipping, we dried all samples in an oven at 95 C for at least 48 hours and weighed them to the nearest gram. We calculated mean amount of forage clipped from each plot in each month. We calculated standing crop (kg/ha), forage production, and use each month from dry weight data. We obtained standing crop for the sample period from dry weights of forage samples inside each exclosure. Forage production was calculated as dry forage weight from within exclosures minus dry forage weight from outside each exclosure, measured the previous month. Use was calculated as dry forage weight from within each exclosure minus dry forage weight from outside each exclosure in the month of sampling.

After we recorded weights, we combined samples obtained from outside the exclosures and extracted a 4-g subsample from the pure Durana, Regal, and MaxQ plots. We ground the 4-g subsamples in a Wiley mill (Thomas Scientific, Swedesboro, New Jersey) over a 5-mm screen. We analyzed each monthly subsample for crude protein at the University of Georgia - Warnell School of Forest Resources Forage Lab. We evaluated protein levels from April 2003–March 2004 to attain a complete year of data.

We assumed equal availability for forage to deer because all treatments were planted at each site. We did not account for forage consumed by herbivores other than deer. We used a single factor analysis of variance (ANOVA) procedure to test the null hypothesis that, within a region, monthly treatment means of each forage were equal. Models were created using standing crop, forage production, and utilization as the response variable, respectively. In each model, forage type and month were used as explanatory variables. We used the SAS mixed procedure model (SAS 2003) with repeated measures to analyze our data. We used Tukey's mixed model test (t-statistic) to separate forage means within each monthly sampling period (Zar 1999). All results were considered statistically significant at the alpha = 0.05 level. We obtained monthly precipitation data (mm) from the National Oceanic and Atmospheric Administration (NOAA) recording sites located closest to each research site.

Results

Because of a number of significant treatment-by-region interactions, data were analyzed separately within regions and months to determine treatment effects. In the Blue Ridge, we did not collect data during February 2003 and March 2003 due to lack of forage growth. In the Coastal Plain, rainfall was above average February to October 2003 and below average during the remainder of the study. Rainfall was above average from February to August 2003 and below average during the remainder of the study in the Piedmont and Blue Ridge (Fig. 1). Stephens (2005) reported detailed monthly results of standing crop, forage production, use, use rate, and crude protein. Here, we summarize trends for each crop within each region. Mean values (± SE) and results of statistical tests across all forages, months, and regions are in Stephens (2005). A complete summary of results is available from the authors (M. Mengak) or at the website (www.libs.uga.edu; electronic theses and dissertations).

Generally, MaxQ fescue and combination plots had greater standing crops than either clover among the regions throughout the study (Fig. 2). The MaxQ fescue and combination plots had similar standing crops throughout most of the study. Similarly, Durana and Regal standing crop values usually did not differ.

Durana had a greater standing crop than Regal during January (t_{20} = .43, P = 0.002), February (t_{20} = 3.40, P = 0.021), and April 2004 (t_{20}= 3.40, P = 0.021). Also, MaxQ/Durana combination plot had a greater standing crop than MaxQ/Regal during April (t_{20} =3.27, P = 0.022) and May 2004 (t_{20} = 3.36, P = 0.023). In the Piedmont, MaxQ/Durana combination plot had a greater standing crop than MaxQ/Regal combination plot during May (t_{20} = 3.68, P = 0.016), June (t_{20}= 3.37, P = 0.034) and November 2003 (t_{20}= –7.03, P = 0.04). In February 2004, MaxQ and MaxQ/Regal combination plot had the greatest standing crop. In the Blue Ridge, MaxQ had less standing crop than Regal (t_{20} =3.62, P = 0.013) and Durana (t_{20} = 6.02, P < 0.001) in September 2003. MaxQ had a greater standing crop than MaxQ/Regal during January (t_{20} = 4.30, P = 0.003), March (t_{20} = 3.70, P = 0.011) and April 2004 (t_{20} = 5.26, P = 0.003).

MaxQ fescue and combination plots generally produced similar amounts of forage among the plots during 2003 and 2004. Likewise, the forage production of both clovers was similar throughout most of 2003 and 2004 (Fig. 3). In the Coastal Plain, Durana produced more forage than Regal during January 2004 (t_{20} = 4.42, P = 0.022). MaxQ/Durana combination plot had greater forage production than MaxQ/Regal combination plot during January (t = 3.36, P = 0.023), March (t_{20} = 15.22, P = 0.018) and April 2004 (t_{20} = 3.30, P = 0.026). MaxQ produced the least amount of forage during May 2004. In the Piedmont, no differences were detected in forage production among forages during February and June 2003 and during January, March, and April 2004. In the Blue Ridge, all plots produced similar amounts of forage during October and November 2003, and during January, February, March, and April 2004. Durana production in May 2004 (t_{20} = –3.21, P = 0.032) was greater than MaxQ fescue production in May.

In the Piedmont, no difference in use was detected among plots throughout most of 2003. However, MaxQ fescue was utilized more than Regal (t_{20} = 1.36, P = 0.0162) and Durana (t_{20} = –5.97, P = 0.018) during November 2003. No difference in use was detected between plots in 2004. In the Blue Ridge, MaxQ/Regal combination plot was utilized more than MaxQ fescue during June (t_{20} = –10.12, P = 0.003) and July 2003 (t_{20} = –10.24, P = 0.026). MaxQ/Durana plot was utilized more than other plots in February 2004. Use did not differ during the remainder of 2004 (Fig. 4).

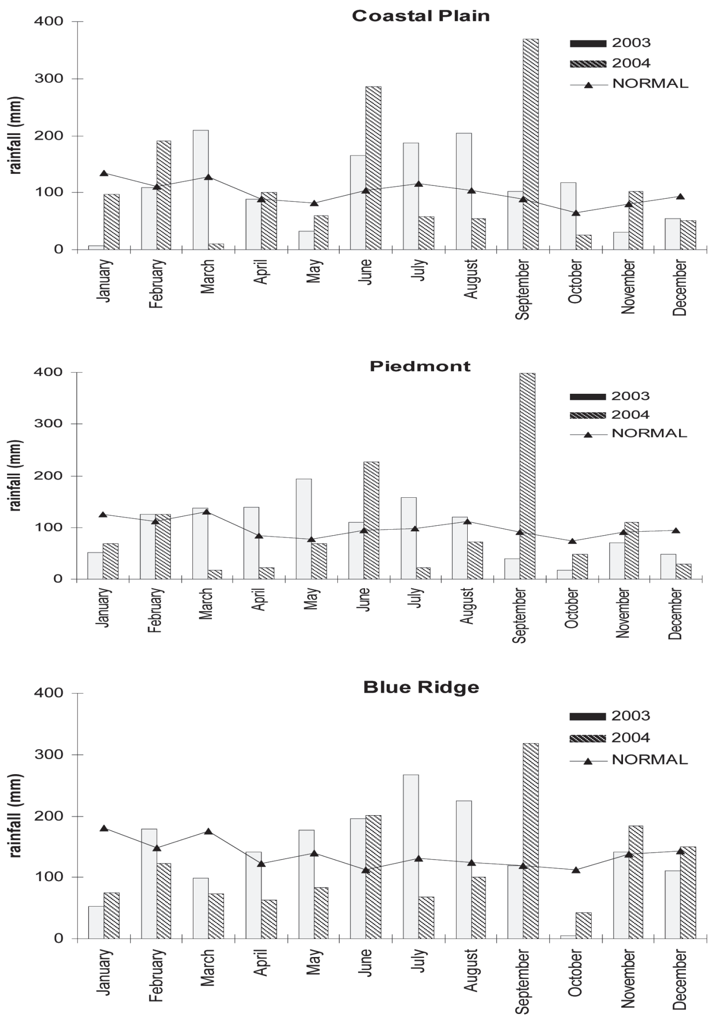

Figure 1. Precipitation data (mm) near study sites from 2003–2004. Data were obtained from the National Oceanic and Atmospheric Administration (NOAA) recording sites located closest to the research sites.

Crude protein levels (%) in Durana and Regal were consistently higher than MaxQ fescue throughout the study (Fig. 5). Both clovers averaged over 20.0% crude protein (CP) and MaxQ fescue ranged from 8.15%–18.24% CP over the three study areas. In the Coastal Plain, crude protein levels of Durana were greater than MaxQ in all months except April and December. Protein levels in Regal exceeded levels in MaxQ in the months of May, June, July, August, and October. In the Piedmont, the three forages were similar during June, November, and December 2003 but in other

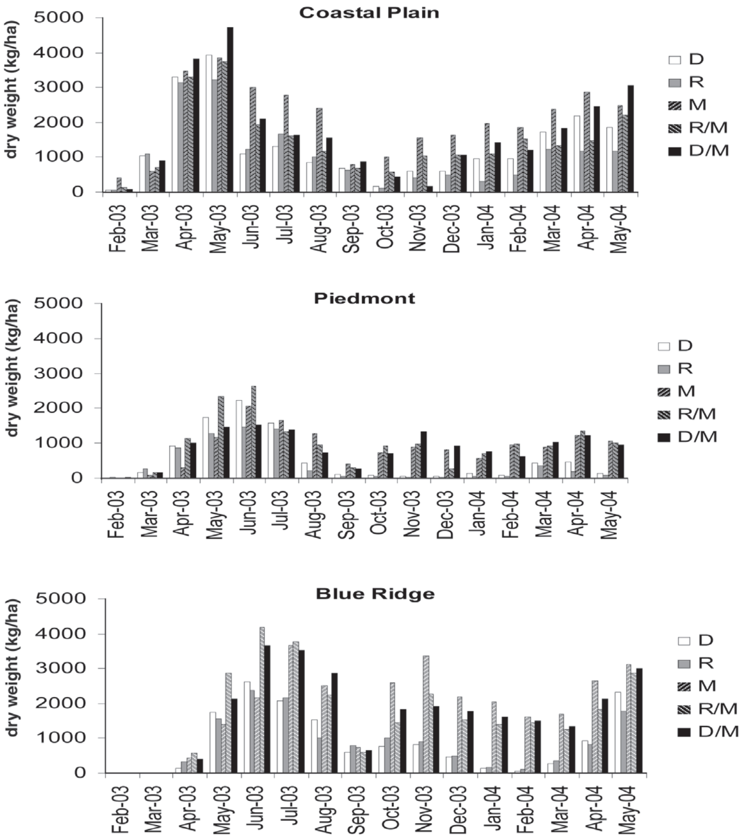

Figure 2. Mean monthly standing crop (kg/ha) of three cool season forages established in Tift, Putnam, Fannin and Union counties, Georgia, in November 2002. Fannin and Union county data collection started in April 2003 due to lack of forage growth. D = Durana clover; R = Regal ladino clover; M = MaxQ fescue; D/M = Durana/MaxQ combination plot; R/M = Regal/MaxQ combination plot.

months the clovers generally exceed the fescue in crude protein values. In the Blue Ridge, crude protein levels of both clovers were higher ($P \leq 0.05$) than MaxQ fescue during the entire study.

Discussion

Most previous food plot research relied on single species plots (Kammermeyer et al. 1993, McDonald and Miller 1995) or captive deer (Waer et al. 1992). Our study used both single species and combination plots. Variability in weather, soil

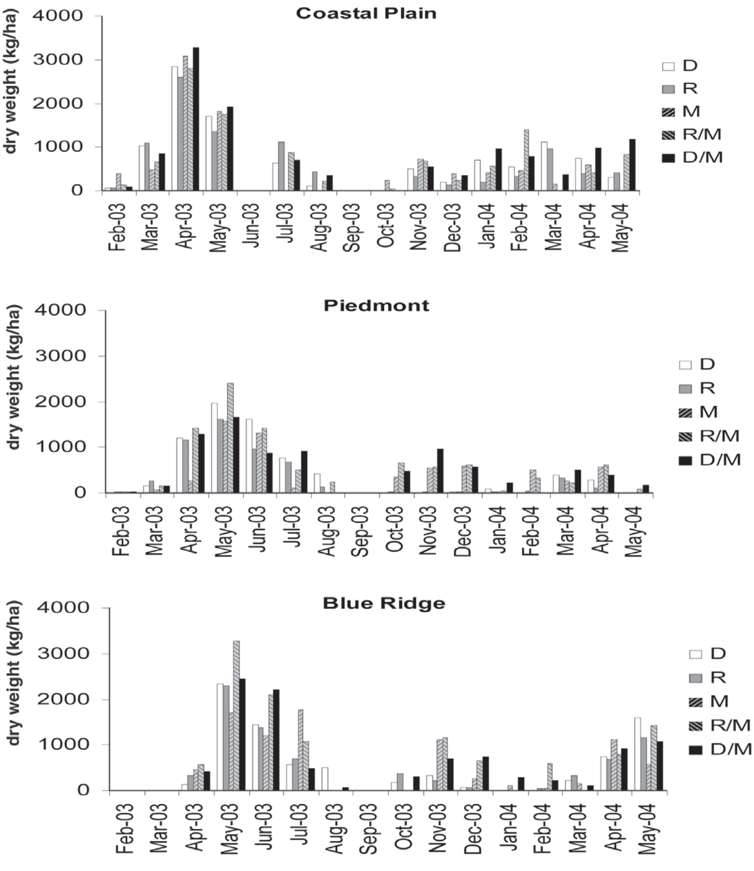

Figure 3. Mean monthly forage production (kg/ha) of three cool season forages established in Tift, Putnam, Fannin and Union Counties, Georgia, in November 2002. Fannin and Union county data collection started in April 2003 due to lack of forage growth. D = Durana clover; R = Regal ladino clover; M = MaxQ fescue; D/M = Durana/MaxQ combination plot; R/M = Regal/MaxQ combination plot.

fertility, plant species choice, and deer density make comparisons across studies complicated. However, several trends can be identified with regard to implementing a food plot program.

Several factors influenced forage growth at each site. Mean monthly precipitation was above normal during the first half of 2003 for the three study sites. Differences in standing crop and forage yield among the three sites may have been due to the rainfall variation among sites. During 2004, mean monthly precipitation was below normal over all sites, which possibly contributed to low standing crop values and production yields of the tested forages. All sites were mowed in August 2003

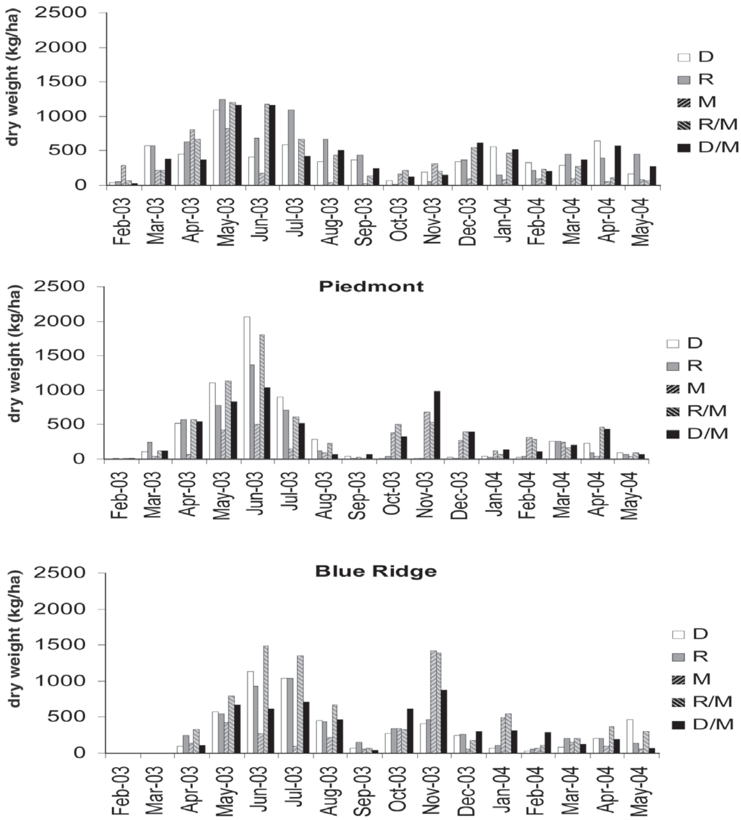

Figure 4. Mean monthly use (kg/ha) of three cool season forages established in Tift, Putnam, Fannin and Union counties, Georgia, in November 2002. Fannin and Union county data collection started in April 2003 due to lack of forage growth. D = Durana clover; R = Regal ladino clover; M = MaxQ fescue; D/M = Durana/MaxQ combination plot; R/M = Regal/MaxQ combination plot.

and fertilized during September 2003 and March 2004 soon after data was collected that month. This may have affected standing crop, production, and use values during the next month. Weed competition at the Putnam County (Piedmont) site, may have reduced production of planted forages. Weed competition has been noted as a significant problem in establishing food plots (McDonald and Miller 1995).

Overall production was somewhat consistent among forages. Bouton et al. (2001) studied MaxQ fescue in Georgia Piedmont and Coastal Plain and suggested that MaxQ fescue can tolerate stressful environmental conditions better than varieties of endophyte free fescue. In the Coastal Plain, production estimates for Durana

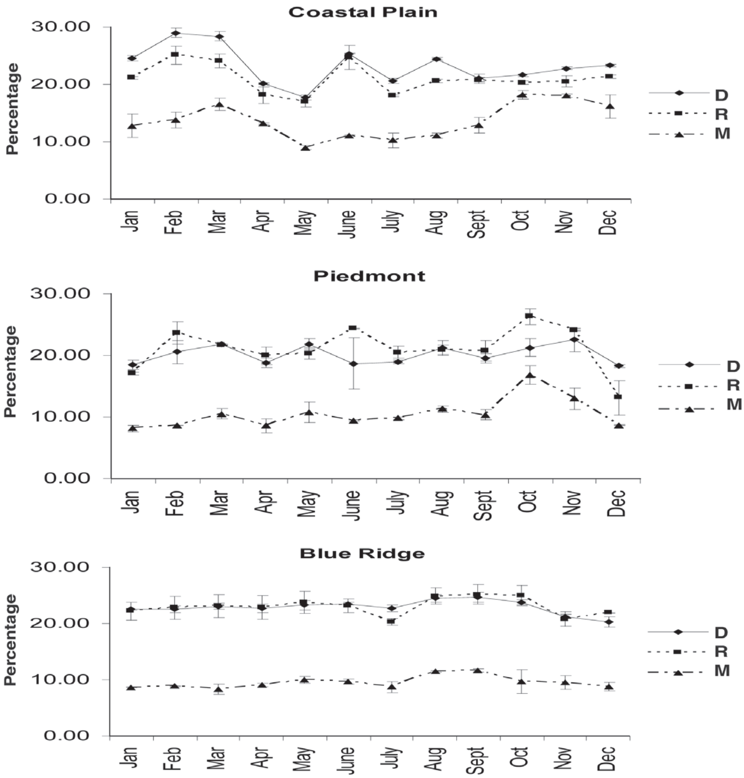

Figure 5. Mean monthly crude protein (%) of three cool season forages established in Tift, Putnam, Fannin and Union counties, Georgia, in November 2002 and sampled from April 2003–March 2004. Bars represent standard error. D = Durana clover; R = Regal ladino clover; M = MaxQ fescue.

in our study were slightly higher than Regal in 2004 suggesting that Durana has the capability to produce more forage than Regal during the second growing season. This was also noticed between the combination plots where MaxQ/Regal plots produced slightly less forage than MaxQ/Durana plots during 2004. Andrae et al. (2003) reported Durana having higher area coverage than Regal 3 years after establishment.

In our study, overall use varied among plots and regions. Generally, clovers were utilized similarly and MaxQ fescue was utilized least. A study in north Georgia (Kammermeyer et al. 1993) found no difference in use among three varieties of ladino clovers. Preference of combination plots over pure fescue plots likely was a result of the clover component producing higher quality forage itself and providing additional nitrogen for the fescue. Intensity of forage use during the early growth stages in the Putnam County site may have influenced later stand success. From these results, we suggest that Durana can withstand intense grazing pressure when compared to Regal and thus be able to produce more forage year after year under high deer densities. High use rates of fescue and combination plots in the Piedmont compared to the other regions were likely reflective of higher deer densities.

Crude protein (CP) is often considered to be an indicator of forage quality (Kammermeyer et al. 1993, McDonald and Miller 1995). This trait is very important when considering what forages to plant for deer in order to provide supplemental protein during the nutritionally stressful (late summer and late winter) periods of the year (McDonald and Miller 1995). Forage quality of Durana and Regal was similar over the study period. Both provide greater than 17% CP during late summer and late winter. McDonald and Miller (1995) working in the Georgia Piedmont found that Regal provided an average of 21.2% (range = 16.3%–24.9%) CP throughout their study. MaxQ fescue had the lowest mean CP of all tested forages during the study, and ranged from 8% to 13% crude protein during late summer and late winter. CP levels of MaxQ fescue increased in October as a response to the fertilizer applied during the previous month.

Management Implications

The ideal choice for a supplemental planting would be one that produces year-round high quality forage preferred by deer. Selecting the appropriate forage depends on local conditions (soil type, weather, native forage availability, deer density, etc.) and management objectives. In our study, Durana clover outperformed Regal in the Coastal Plain and Piedmont during the second growing season. In agricultural forage trails, Durana produced more than Regal at 3–4 years after establishment. Based on our results, and those in other reports, we suggest that Durana may be superior to ladino in terms of long term productivity. MaxQ fescue grew well in all three regions. However, based on low use rates, we do not recommend it as a food plot forage except in areas of high deer densities and low amounts of available native forage. If used, MaxQ fescue should be planted in combination with a legume to boost available CP levels as deer utilized combination plots more than pure fescue plots in all three regions.

Managers should select a variety of species to include in their food plot programs as each has advantages and disadvantages related to weather, deer density, soil fertility and ease of establishment. A mixture of warm- and cool-season food plots may best meet a variety of management objectives. However, a food plot program should be used with proper habitat management including use of natural forages and adequate population management.

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