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LATE-PLANTING OF ANNUAL RYEGRASS IN THE UPPER TRANSITION ZONE OF ALABAMA

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ABSTRACT

The 2016 drought caused unfavorable planting conditions for cool-season annual forages during the fall establishment window in Alabama. Limited information is available on the growth potential of cool-season annual grasses planted outside the recommended window of establishment as an emergency forage option following drought conditions. The objective of this study was to determine the impact of late-planting annual ryegrass *(Lolium multiflorum)* on seasonal dry matter production, number of grazing days, and forage nutritive value as part of a beef heifer development program at the Sand Mountain Research and Extension Center in Crossville, AL. Two annual ryegrass *(Lolium multiflorum)* varieties [Winterhawk (early maturing) or Marshall (late maturing) ryegrass] were planted across three planting dates in winter 2016/2017 (December 15; February 1; March 1) into a prepared seedbed. Each variety × planting date combination was replicated in two 2.0-ac paddocks. Seasonal herbage accumulation, nutritive value and forage utilization were measured across the grazing season. Data were analyzed using the PROC MIXED (SAS 9.4) for a completely randomized design in which pasture was the experimental unit. Overall, annual ryegrass herbage accumulation ranged from 3,999 to 10,999 lb DM/ac across planting dates. December planting dates provided two to three grazing events for heifers in this project. February and March planting dates only supported one grazing event beginning in May. There were 70 days (March – June) of grazing provided for heifers in this trial. During the one-year evaluation, delayed planting of annual ryegrass provided adequate forage dry matter production to support late-spring grazing for growing heifers. The combination of relatively mild climatic conditions and adequate rainfall supported favorable growing conditions for ryegrass. February plantings were most affected by frost causing yield loss.

INTRODUCTION

In the Southeast US, the recommended planting period for cool-season forage grasses is from October through early November (Ball et al., 2015). This range of dates coincides with favorable temperatures for cool-season forage emergence and decreasing photoperiod length. Periodically, beef producers face planting delays during this time period due to prolonged drought conditions as a carryover effect from the summer months, or unseasonably dry conditions during the planting window. As winter rainfall increases, producers may consider an early winter establishment period for cool-season annuals and assume establishment risks during this time period. Cool-season annual grasses are desirable for use in beef cattle systems because 1) this coincides with a time when warm-season forages are dormant, and 2) they provide high quality and productive grazing during the spring months (Beck et al., 2008; Gunter et al., 2012). In tall fescue dominant regions of the Southeast, cool-season annuals may be used as a supplemental grazed forage resource in addition to tall fescue during the winter and early spring months (McKee et al., 2017). Delayed planting of winter annuals may be desirable as a source of emergency forage during the winter months in years following summer drought conditions. However, these systems fall under significant risk for winter kill if periods of cold weather occur shortly after seed germination, which may reduce stand viability and growth potential. Annual ryegrass is a fairly cold tolerant cool-season forage that is widely used in the southeastern region of the US, and seed is relatively inexpensive and widely available. Differences in maturity among commercially available varieties of annual ryegrass (early, mid- and late-maturing ecotypes) may influence forage growth distribution potential, and time to the first grazing event in delayed-planting situations. The objective of this study was to evaluate herbage accumulation and forage nutritive value characteristics of early- or late-maturing annual ryegrass varieties planted in the winter months in North Alabama.

MATERIALS AND METHODS

Research Site

A one-year grazing evaluation was conducted at the Sand Mountain Research and Extension Center in Crossville, Alabama (34°17’12”N 85°58’30”W) during winter 2016 through spring 2017 to evaluate herbage accumulation and forage nutritive value of annual ryegrass following a delayed planting window. The pasture soil type was a Hartsells fine sandy loam. Paddocks used for the study had previously been utilized for multi-year cool-season annual grass grazing trials.

Forage treatments

Twelve 2.0-ac paddocks were used in 2016 and 2017 for the trial. Two annual ryegrass varieties (‘Winterhawk’ or ‘Marshall’) were planted into a prepared seedbed across three planting dates: December 15, 2016; February 1, 2017; or March 1, 2017. Winterhawk annual ryegrass is an early-maturing variety, whereas Marshall has greater late-season production (Arnold et al.). Each variety × planting date combination was replicated in two 2.0-ac paddocks. Paddocks were fertilized with nitrogen (50 lb/ac), phosphorus (40 lb/ac), and potassium (40 lb/ac) after planting on December 15, February 1, and March 1 and were applied according to Auburn University Soil Testing Laboratory Recommendations (Mitchell and Huluka, 2012). An additional application of nitrogen (50 lb/ac) was applied on April 11, 2017 to all paddocks. Paddocks were managed using rotational stocking when pastures achieved a mean canopy sward height of 8.0-in. Beef heifers (initial BW ~ 752 lbs; n = 44 animals) grazed annual ryegrass beginning March 27, 2017 through June 15, 2017. All procedures were approved by the Auburn University Institutional Animal Care and Use Committee (Protocol No. 2017-3434) prior to initiation of the study.

Forage harvest, sampling and laboratory analyses

Sward height estimates were collected prior to and after grazing to determine pasture height using a pasture grazing stick (n = 15 pre- and post-grazing heights per paddock). A double-sampling method (Frame, 1981) was used to estimate forage accumulation among late-planted annual ryegrass varieties. Sward height was the indirect measure and clipped forage mass from exclusion cages was the direct measurement. Two 0.25-m^2 exclusion cages were placed in each paddock prior to grazing initiation, and a post-grazing forage mass sample was collected using hand clippers to leave a 3-in above ground stubble height from the cage when heifers were rotated to a new pasture area. Fifteen post-grazing sward heights were collected following a grazing event. Seasonal forage mass was estimated using a prediction equation developed from the sward height and clipped forage mass samples.

Clipped forage samples were dried at 50° C for 48 hr, weighed, pooled into individual paddock composites, mixed thoroughly for uniformity, and ground to pass a 1-mm screen in a Wiley Mill (Thomas Scientific, Philadelphia, PA). After processing, all forage samples were scanned using a Perstorp Analytical 5000 near infrared spectrophotometer (Foss North America, Eden Prairie, MN). Concentrations of acid detergent fiber (ADF), neutral detergent fiber (NDF), crude protein (CP), and total digestible nutrients (TDN) were estimated using prediction equations developed by the NIRS Forage and Feed Testing Consortium (Hillsboro, WI). Concentration of TDN was calculated as %TDN = 88.9 – (ADF, % DM basis x 0.779) according to Linn and Martin (1989). Subsamples of forage samples were analyzed for NDF and ADF (Van Soest et al., 1991) and for CP according to the Kjeldhal procedure (AOAC, 1990). These values were compared with those predicted by the NIRS Forage and Feed Testing Consortium equations for validation.

Statistical Analysis

Data were analyzed using the PROC MIXED procedure of SAS 9.4 (SAS Institute, Cary, NC). The experimental unit was considered to be paddock. The statistical model included forage variety, planting date, and variety × planting date interaction as independent variables. Forage response variables were analyzed as repeated measures over time. The PDIFF option of LSMEANS was used to separate treatment means when protected by F-test at $\alpha = 0.10$.

RESULTS AND DISCUSSION

During fall 2016, abnormally dry fall conditions persisted through the typical cool-season forage planting window of October through November. Average precipitation in Crossville, AL was 0.15 inches in September and 0 inches in October 2016. In November, rainfall did not occur until the last two weeks of the month. Frequency of rainfall increased in November and December, but was 60 and 50% less than the 30-year average, respectively (Figure 1). Mean air temperature was above the 30-year average for September, October, and November, illustrating unseasonably warm, drought conditions following the summer production period Figure 2).

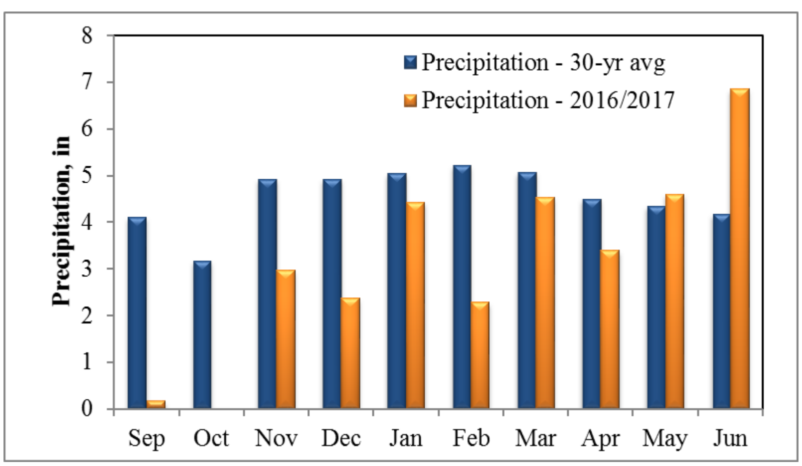

Figure 1. 30-year mean and 2016/2017 precipitation from September through June in Crossville, AL.

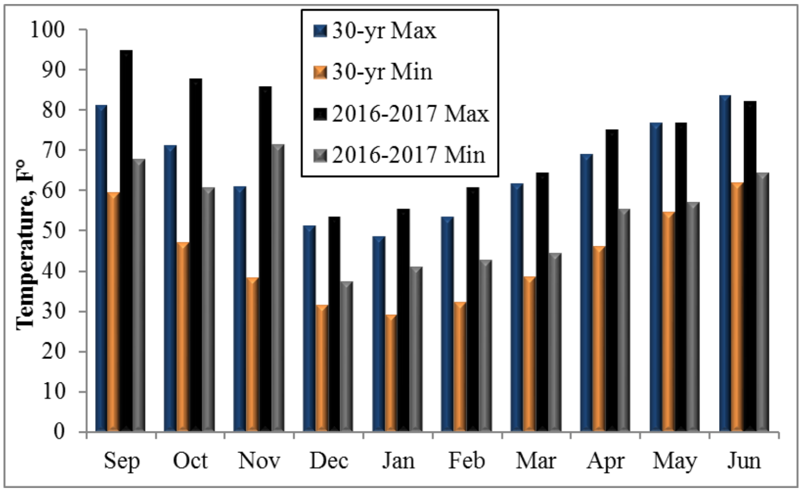

Figure 2. Mean maximum and minimum 30-year and 2016 through 2017 air temperatures for Crossville, AL.

The average time for annual ryegrass pastures to reach the target height for grazing was 87, 98, and 80 days post-planting for December, February, and March seeding dates, respectively. Seasonal herbage accumulation is reported in Table 1.

Table 1. Seasonal herbage accumulation (lb DM/ac) of late-planted annual ryegrass varieties during winter 2016-2017 in Crossville, AL. SE=standard error. Within a column, means without common superscripts differ (*P* < 0.10). Annual ryegrass varieties were planted on December 15, 2016, February 1, 2017, or March 1, 2017, respectively.

	Planting Date		
Forage Variety	**12/15/16**	**2/1/17**	**3/1/17**
Marshall	8,083	3,903	6,517[a]
Winterhawk	7,302	3,667	3,140[b]
SE	*716*	*445*	*854*

Table 2. Forage variety x planting date on pre- and post-grazing forage mass (kg DM/ha) and percent utilization. Pre- and post-grazing mass means are reported for three grazing events for December plantings, two grazing events for March plantings, and one grazing event for February plantings. Forage utilization is the amount of pre-graze forage mass utilized post-grazing. Within a column, means without common superscripts differ (*P* < 0.10). SE=standard error.

	Planting Date	**Pre-graze foragemass, lb DM/ac**	**Post-graze forage mass, lb DM/ac**	**Forage Utilization, %**
Marshall	12/15/16	4147[b]	1745	58
	2/1/17	5538[b]	1969	64
	3/1/17	7426[a]	2105	71
Winterhawk	12/15/16	2100[c]	769	63
	2/1/17	3957[b]	800	80
	3/1/17	3603[b]	1194	67
SE			*763*	*55*

A forage variety × planting date effect (*P* = 0.045) was observed for seasonal herbage accumulation as shown in Table 2. Winterhawk annual ryegrass planted in March had less herbage accumulation than when planted in December, but did not differ from the February planting date. No differences were observed in December- or March-planted Marshall ryegrass; however, herbage accumulation of Marshall was less in February compared with these planting dates. The combination of relatively mild winter climatic conditions beginning in December 2016 and adequate rainfall supported favorable growing conditions for annual ryegrass in this study. Frost events occurred largely in early January, and again in mid-February. February-planted annual ryegrass was most affected by frost timing, and herbage accumulation was more negatively impacted in this system than with December or March planting dates.

Spring-planted oats have been used in Oklahoma to provide a short-term forage crop, with establishment typically occurring between February 1 and March 10 (Redfearn and Edwards, 2012). Forage production potential is typically between 1,500 and 2,000 lb DM/acre using 60 to 75 lb N/ac after establishment. The authors reported that spring-planted oats over-mature rapidly as temperatures increase in the late spring months (April and May), but can commonly support between 30 to 60 days of grazing for mature beef cows (Redfearn and Edwards, 2012). Contreras-Govea and Albrecht (2006) evaluated forage yield and quality of spring sown-early summer harvest oat in Wisconsin. Oats were harvested 77 d after planting for hay production, and produced 7.7 Mg ha^{-1}, but were lower in nutritive value than summer planted-fall harvested oats. Whole plant IVTD (in vitro true digestibility) was 79.6% for fall harvested oats, whereas spring-planted had a mean IVTD of 67.1%. Decreased forage digestibility of spring-planted oats was attributed to lower stem digestibility compared with fall plantings (56.7% vs. 79.3%, respectively).

There was no effect (P > 0.10) of planting date, forage variety or planting date × forage variety interaction on nutritive value parameters. However, a seasonal date effect (Table 3) was observed such that quality declined from the time of the initial grazing event in mid-spring through early summer.

Table 3. Forage nutritive characteristics of late-planted annual ryegrass varieties during winter 2016-2017 in Crossville, AL. Within a column, means without common superscripts differ (P< 0.10). [1]Samples collected from December and February plantings only for March and April harvests; Samples collected from December, February, and March planting dates for May and June harvest.

Month	CP,%	NDF,%	ADF,%	TDN,%
March	21.7^a	37.8^a	17.2^a	75.5^a
April	12.6^b	60.6^b	41.4^b	56.7^b
May	12.8^b	61.5^b	39.5^b	58.1^b
June	11.3^b	62.8^b	38.5^b	58.9^b
SE	*1.9*	*4.8*	*4.6*	*3.0*

Average forage TDN percentage decreased (P = 0.07) from 75.5% in March to 58.9% in early June. Crude protein concentrate ranged from 21.7% at the start of the grazing season, and decreased (P = 0.013) to 11.3% in early summer. These values were above the NRC (2016) requirement for growing heifers during this time period and helped support target gain levels of 1.5 lb/d or greater throughout the evaluation.

IMPLICATIONS AND CONCLUSIONS

During the one-year evaluation, late-planted annual ryegrass provided adequate forage dry matter production to support grazing for growing heifers for 70 days in North Alabama. Mild climatic conditions during the winter months allowed for successful establishment of annual ryegrass in this trial. However, year-to-year variation in temperature and frost events can greatly influence production and stand health, increasing production risk with late-planting cool-season annuals. Multi-year evaluations of cool-season annual forages are needed to determine the feasibility and dependability of establishing these forages during the winter- or spring-planting window in the Southeast US. Late-planting of cool-season annuals should only be considered in years following summer drought as a source of emergency forage.

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