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INFLUENCE OF AUTUMN TEMPERATURES ON ANNUAL RYEGRASS SEEDLING GROWTH

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Summary

Shoot and root mass and main-stem tiller and leaf appearance were determined on six varieties of annual ryegrass (*Lolium multiflorum* Lam.) grown in growth chambers for 6 weeks at day/night low, medium, and high temperatures of 64°/42° (LT), 77°/55° (MT), and 90°/68°F (HT). Shoot and root mass increased exponentially with time. Biomass response to temperature was greatest at MT and least at LT. Temperature had a greater effect on root than shoot mass. Tiller appearance followed a sigmoidal trend with time with a rapid increase in tiller number between week 2 and 4. Main-stem leaf appearance increased linearly with time and increased as temperature increased. The MT treatment was the most favorable for annual ryegrass seedling development.

Introduction

An estimated 800,000 acres of annual ryegrass are grown in the eastern half of Texas each year (Evers, 1995). Popularity of ryegrass for winter pasture is due to ease of establishment, adaptability to a wide range of soil types, and tolerance to poor management. In Texas, ryegrass is planted from September to December. Early planting is recommended since ryegrass growth is suppressed by low winter temperatures (Weihing, 1963). Early forage production (October to December) is improved by early planting, but the risks of losing a ryegrass stand to drought also increases. Total forage production is also reduced by late planting. In northeast Texas, September plantings are made into a disked seedbed or sod to prevent competition from warm-season grasses and weeds and allow better seed placement to develop a deep root system early. When seed are broadcast on a short grass sod, mid-October is the recommended planting date. Basing planting dates on average daily air temperatures could be used across the annual ryegrass growing region to enhance ryegrass establishment and early forage production.

Grass production is the result of the appearance and growth rate of tillers and leaves. As

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leaf area and light interception increases, the photosynthetic capacity of the plant increases. This enhances growth rate and production of new leaves and tillers (Skinner and Nelson, 1994). Rapid tillering during establishment of annuals is important to ensure the production of sufficient leaf area for complete light interception as soon as possible. Besides aiding establishment, tillering is essential for regrowth after grazing. Understanding the effect of autumn temperatures on annual ryegrass seedling growth, and leaf and tiller appearance would be helpful for determining optimum planting dates and the consequences of late planting.

Procedure

Annual ryegrass cultivars 'Gulf', 'Grazer', 'Jackson', 'Marshall', 'Surrey', and 'TAM 109' were grown in "Super Cell" cone-tainers (8 in. long, upper end 1.5 in. in I.D.). Three seed were planted in a potting media containing 3 parts sand to one part peat moss and thinned to one seedling after emergence. One rack (98 cone-tainers) of each cultivar was placed in each of three growth chambers set at day/night temperatures of 64°/42°, 77°/55°, and 90°/68°F, with 12 hr days. These temperatures represent average monthly high and low temperatures during September, October, and November at Overton, Texas. Photosynthetic active radiation level in the growth chambers at seedling height was 347 μ mol $m^{-2}s^{-1}$. Ryegrass seedlings were watered and fertilized as needed to maintain growth. Upon emergence of the coleoptile and first leaf, seven uniform seedings from each variety in each growth chamber were selected for daily observations of main-stem leaf, tiller, and inflorescence appearance. Fourteen additional seedlings were removed from each rack at weekly intervals up to 6 weeks to determine shoot and root mass. The average of all varieties for weekly shoot and root biomass, main-stem leaf appearance, and tiller numbers were fit to response functions using least squares linear regression (Advanced Graphics Software Inc., 1995).

Results and Discussion

During the first 6 weeks of seedling growth, shoot mass increased exponentially with time (Fig. 1). From week 2 to 5, shoot mass increased faster at the MT and HT treatments than at the LT treatment. At 5 weeks, shoot mass was 50% greater at the MT than at the LT. Under the constant temperatures of this study, shoot mass at LT was similar to the other treatments by 6 weeks. However, under field conditions, these November temperatures are followed by cooler winter temperatures which limit seedling growth until late February. Root mass also increased exponentially with time but at a slower rate than shoot mass (Fig. 2). Temperature effects on root mass became apparent at 3 weeks and increased with time. After 5 weeks, root weights at MT were 300% greater than in the LT and 40% greater than in the HT. The poor winter and early spring growth of late planted ryegrass observed in the field is probably the result of reduced root growth due to low temperatures.

Tiller number followed a sigmoidal response with time (Fig. 3). There was a rapid increase in tiller number between week 2 and 4. This is likely related to the emergence of the third leaf on the main tiller. The HT treatment had a slightly higher tillering rate than the MT until week 3, when the MT produced more tillers. Response of leaf appearance on the main-stem to temperature was linear (Fig. 4). In contrast to the other ryegrass seedling parameters measured, the HT had the highest rate of leaf appearance (3.4 days per leaf). At 3 weeks the average main-stem leaf number was 5.8, 4.6, and 3.6 for HT, MT, and LT, respectively. The HT reduced time to maturity with about 30% of the plants producing seedheads, which reduced tiller appearance.

The 77°/55°F air temperature treatment was the most favorable for ryegrass seedling shoot and root growth and tiller production. Optimum planting time in the field would be 2 to 3 weeks before these optimum temperatures would normally occur so that the period of rapid seedling growth and tillering coincides with 77°/55°F day/night temperatures. This assumes, of course, that moisture is not limiting. All seedling parameters, especially root mass, were depressed by LT. Therefore, late planted ryegrass is more sensitive to winter temperatures and drought because of a shallower root system.

Literature Cited

Advanced Graphics Software, Inc. 1995. Slidewrite plus version 3 for windows. Carlsbad, CA.

Evers, G. W. 1995. Introduction to annual ryegrass. p. 1-6. Symposium on annual ryegrass. Texas Agric. Exp. Stn. MP-1770.

Skinner, R. H., and C. J. Nelson. 1994. Role of leaf appearance rate and the coleoptile tiller in regulating tiller production. Crop Sci. 34:71-75.

Weihing, R. M. 1963. Growth of ryegrass as influenced by temperature and solar radiation. Agron. J. 55:519-521.

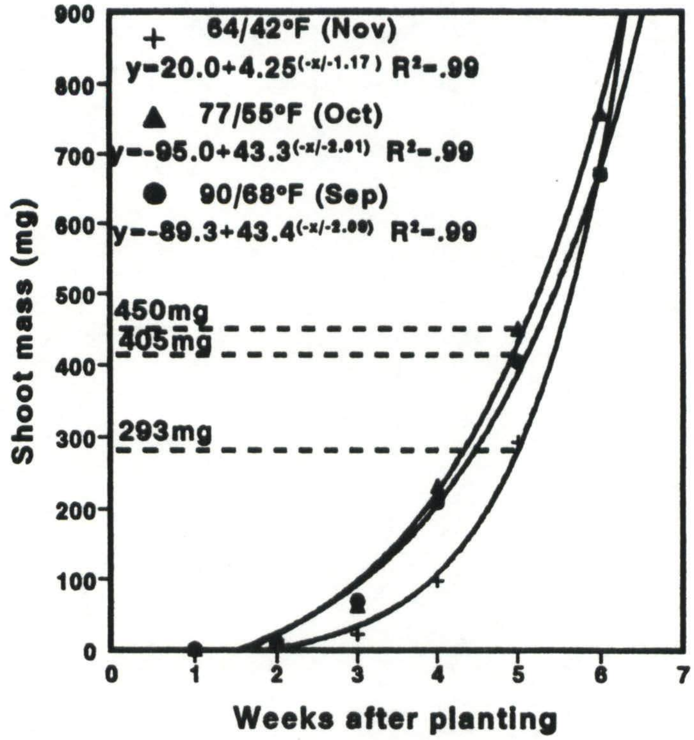

Figure 1. Influence of three autumn temperatures on mean shoot weight of six annual ryegrass cultivars.

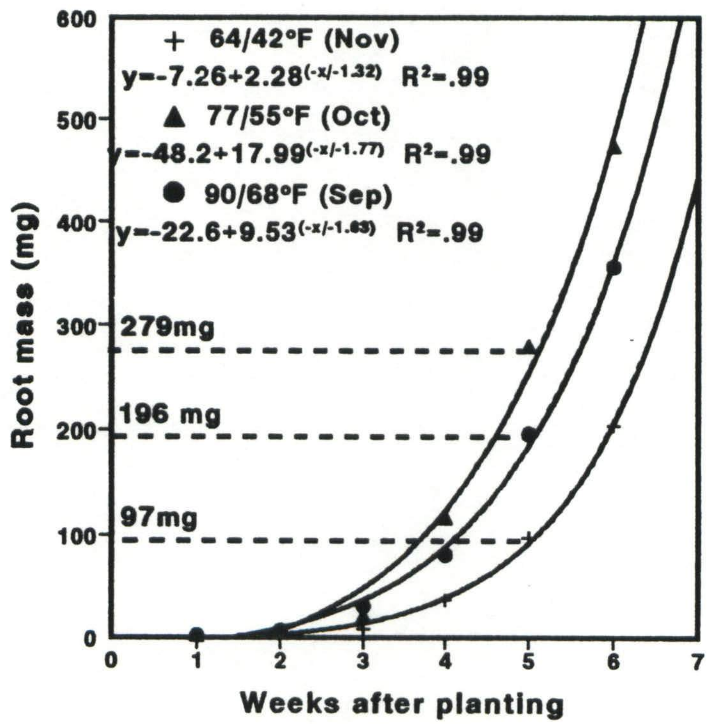

Figure 2. Influence of three autumn temperatures on mean root weight of six annual ryegrass cultivars.

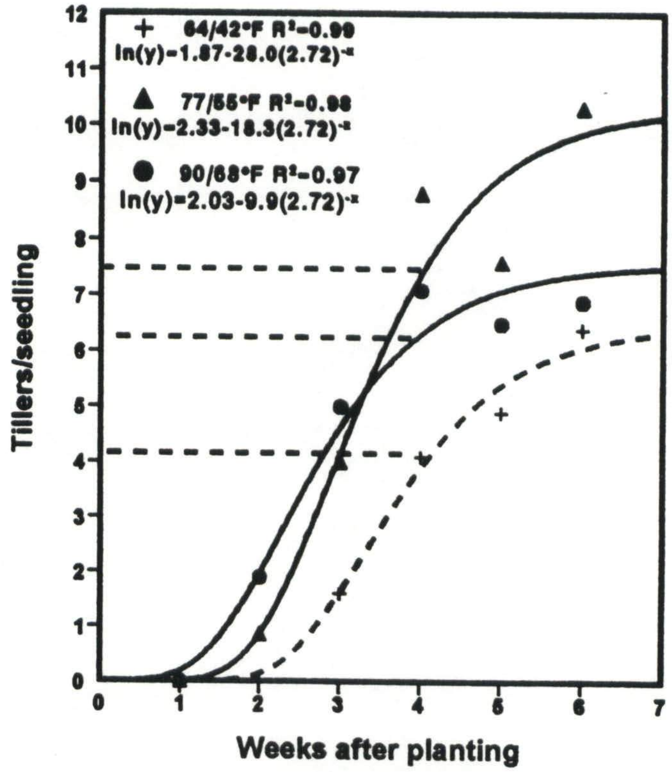

Figure 3. Influence of three autumn temperatures on the mean tiller appearence of six annual ryegrass cultivars.

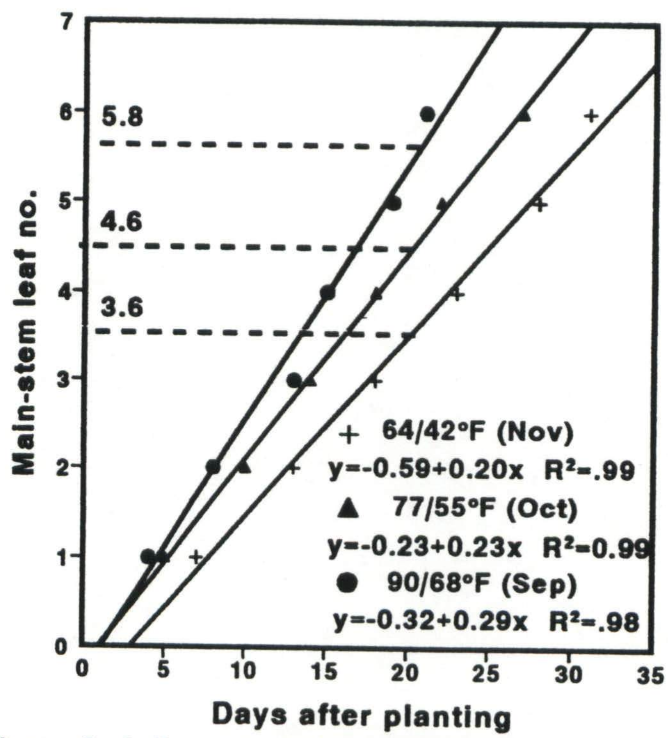

Figure 4. Influence of three autumn temperatures on the mean leaf appearence on the main stem of six annual ryegrass cultivars (x=days after planting).