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Biomass Production Varies Among Native Prairie-Grass Species

Brian J. Wilsey
Iowa State University, bwilsey@iastate.edu

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Abstract
Native grasslands provide a multitude of benefits to society including forage production, wildlife habitat, and nutrient and CO2 sequestration. There has been increasing interest in using native perennial grassland plantings to produce cellulose-based biofuels. However, there is little information on how biomass production might vary among different native species in a comparable field setting in Western Iowa. Perennial warm-season grasses such as big bluestem, Indian grass, switchgrass, little bluestem or side-oats grama often dominate prairies. In Western Iowa, all five of these species dominate in at least some grassland plantings. In an ongoing study, we are studying how different warm-season grasses vary in their biomass production, weed suppression, and rare prairie species recruitment. Prairie species recruitment will be reported in more detail in future reports. Here, focus is on the differences in biomass production and weed suppression among grass species.

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Brian Wilsey, assistant professor
Department of Ecology, Evolution, and Organismal Biology

Introduction

Native grasslands provide a multitude of benefits to society including forage production, wildlife habitat, and nutrient and CO_2 sequestration. There has been increasing interest in using native perennial grassland plantings to produce cellulose-based biofuels. However, there is little information on how biomass production might vary among different native species in a comparable field setting in Western Iowa.

Perennial warm-season grasses such as big bluestem, Indian grass, switchgrass, little bluestem or side-oats grama often dominate prairies. In Western Iowa, all five of these species dominate in at least some grassland plantings. In an ongoing study, we are studying how different warm-season grasses vary in their biomass production, weed suppression, and rare prairie species recruitment. Prairie species recruitment will be reported in more detail in future reports. Here, focus is on the differences in biomass production and weed suppression among grass species.

Materials and Methods

The experiment consisted of planting equal-sized seedlings of one of five native grass species (big bluestem, Indian grass, switchgrass, little bluestem, or side-oats grama) into experimental plots during early May 2005. Plots were planted with each species in either single species monocultures or mixtures containing all five species. Seedlings were planted in 1-m^2 plots at a density of 72 plants/plot. Furthermore, seedlings were either from locally collected seed or were from cultivars. Thus, plots were set up in a 6 (each of the five species plus mixture) × 2 (local seed or cultivar) factorial design in three blocks (SW, N, or E facing slope), with two replicate monocultures within each block and four replicate mixtures in each block for a total of 96 plots. Transplants were used instead of seed to control rate of establishment and plant density, which enables more careful comparisons across species. Planted plots were allowed to establish during the 2005 and 2006 growing seasons before the first harvest was made in September 2006.

Results and Discussion

There were differences among species in their biomass production (Table 2). Indian grass, switchgrass, and little bluestem were more productive on average (661.5 g/m^2) than big bluestem or side-oats grama (ANOVA, Duncan's tests, P values <0.05), which averaged 424.1 g/m^2. However, there were no differences in productivity among the top three species (P>0.05). Earlier analyses have found differences in lateral spread between seedlings from locally collected seed and cultivar seed. However, these differences did not result in greater productivity: there was no difference in productivity between plots planted with seedlings from locally collected seed and cultivar seed (P>0.05). There was also no difference in productivity between single species plantings and five-species mixtures (P>0.05). The overall mean for monocultures was 563.5 g/m2 versus a mean of 566.5 g/m2 for mixtures. This suggests that productivity was not higher in mixtures than monocultures in the year of the study.

Weeds generally made up less than 10% of the total biomass at harvest. Nevertheless, there were differences among species. Little bluestem

had more weed biomass at 54.1 g/m^2 than switchgrass at 13.1 g/m^2.

Prairies forbs, which were added to the plots in a seed mix in 2005, are potentially important to the long-term productivity of grasslands due to their N-fixing ability (leguminous forbs) and their weed suppression abilities (non-leguminous forbs). Little bluestem had higher prairie forb biomass (44.7 g/m^2) than did other species (5.2–14.9 g/m2) (ANOVA and Tukey's test, P values <0.05). This suggests that prairie forb establishment was higher in plantings that contain little bluestem than plantings containing other species.

Results to date suggest that native perennial prairie grass species differ in their biomass production. Switchgrass, Indian grass, and little bluestem were highly productive. Little bluestem also contained the highest amount of prairie forb biomass. Big bluestem and side-oats grama were less productive at this site. Growing species in mixture did not increase or decrease productivity, which suggests that biomass production may not be higher in mixtures than monocultures when legumes are not in the mix. However, mixtures have attributes such as greater pest resistance that may make them attractive candidates for grassland plantings in many situations. It is suggested that mixed plantings of switchgrass, Indian grass, and little bluestem with leguminous forbs may provide the greatest benefit and further research should be done to compare mixtures and monocultures of these species.

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Table 1. Mean biomass production for grasses, weeds (unplanted species), and combined total (all g/m^2) in plots planted with different species of perennial warm-season grasses in 2006.

Species-Seed Source	Grasses	Weeds	Total
Big blue–Rountree	439.2	23.9	470.6
Big blue–Local	428.3	20.3	460.8
overall mean	433.7	22.1	465.7
Indian–Holt	617.6	47.8	678.3
Indian–Local	723.0	20.6	753.9
overall mean	670.3	34.2	716.1
Little blue–Camper	667.7	51.7	751.2
Little blue–Local	593.4	56.4	707.5
overall mean	630.6	54.1	729.4
Side-oats–Butte	396.4	55.0	470.5
Side-oats–Local	432.4	12.9	456.0
overall mean	414.4	34.0	463.3
Switch–Pathfinder	762.9	18.5	784.0
Switch–Local	604.4	7.6	619.8
overall mean	683.6	13.1	701.9
Mix–Cult.	553.5	30.5	597.2
Mix–Local	573.5	48.8	636.3
overall mean	563.5	39.7	616.8

Big blue=big bluestem, Indian=Indian grass, Little blue=little bluestem, Side-oats=side-oats grama, Switch=switchgrass, Mix=five species mixtures, Cult.=cultivar, Local=locally collected seed (Custom Seed Co.).