ALLELOPATHIC EFFECTS OF TWO GRASSES ON SEED GERMINATION OF THREE WILDLIFE FOOD PLANTS

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ABSTRACT

There is growing interest among landowners in south Texas to include wildlife food plants in planting mixtures with introduced grasses. The objective of this study was to determine effects of leachate from buffelgrass (Cenchrus ciliaris) and Kleberg bluestem (Dichanthium annulatum) on seed germination of 3 grasses commonly planted for bobwhite quail (Colinus virginianus). Seeds of sorghum (Sorghum almum), 'Verde' Kleingrass (Panicum coloratum), and blue panicgrass (P. antidotale) were placed on substrata moistened by leachate of roots or leaves of buffelgrass or Kleberg bluestem. Experiments were conducted in a controlled environment chamber at 59-77° F (12 hours with darkness-12 hours with light). Kleberg bluestem leachate affected the seed germination of 'Verde' Kleingrass and blue panicgrass, while buffelgrass leachate affected seed germination of all tested species. Further research is needed to determine if similar results occur under field conditions.

INTRODUCTION

Management of grazing land for game animals in addition to livestock is currently of economic importance in south Texas (Pitman and Holt, 1983). Growing interest exists among south Texas landowners in planting wildlife food plants in mixtures with introduced forage grasses that have low value for wildlife, such as buffelgrass (Cenchrus ciliaris) and Kleberg bluestem (Dichanthium annulatum).

Many plants produce phytotoxic chemicals that inhibit the growth of neighboring plants (Rice, 1979). Knowledge of the allelopathic effects of buffelgrass and Kleberg bluestem on seed germination and growth of wildlife food plants may help landowners in selecting food plants to include in range seeding mixtures with these introduced grasses. Nurdin and Fulbright (1990) found that percent germination of Illinois bundleflower (Desmanthus illinoensis) seeds was lower on substrata moistened with Kleberg bluestem root or buffelgrass leaf leachate than on substrata moistened with distilled water. Buffelgrass root leachate reduced germination of partridge pea (Cassia fasciculata).

Sorghum (Sorghum almum), Kleingrass (Panicum coloratum), and blue panicgrass (P. antidotale) produce seeds that are eaten by bobwhite quail (Colinus virginianus) (Guthery, 1986). The objective of this study was to determine the effects of leachate from Kleberg bluestem and buffelgrass on seed germination of these 3 species.

MATERIALS AND METHODS

Fresh roots and leaves of buffelgrass and Kleberg bluestem were randomly collected from improved pastures 2.5 miles north of Kingsville, Texas. Samples were collected in August and September, 1985. Soil was rinsed from the roots and leaves of both species with tap water and then 7 ounces of each material was soaked in 0.4 gallons of distilled water for 48 hours at 72° F. Leachate of each species and plant part was filtered through 4 layers of cheese cloth and then vacuum filtered through medium-fast filter paper (Whatman No. 541). The filtrate was stored in a refrigerator at 36-39°F for 24 hours before use in experiments.

Water potential of leachate samples was measured before each experiment with a freezing point depression osmometer. Water potential of Kleberg bluestem leaf, Kleberg bluestem root, buffelgrass leaf, and buffelgrass root leachates averaged -0.10, -0.07, -0.17, and -0.11 MPa, respectively. Bell (1974) stated that the results of tests for allelopathy showed that concentrations exceeding 50 milliosmoles (about -0.11 MPa) should be interpreted with care because plant growth may have been reduced by osmotic effects rather than by phytotoxins. The pH of distilled water, Kleberg bluestem leaf, Kleberg bluestem root, buffelgrass leaf, and buffelgrass root leachates averaged 5.89, 5.62, 5.85, 5.92, and 6.29, respectively.

Seeds of blue panicgrass, sorghum, and 'Verde' Kleingrass were obtained from commercial sources. One hundred seeds each of blue panicgrass or 'Verde' Kleingrass, or fifty seeds of sorghum were germinated on substrata moistened with 3.5 ounces of either distilled water or leachate. The substrata consisted of two layers of 4 inch diameter filter paper on a layer of creped cellulose placed in 5 by 5 by 2 inch plastic boxes. For each species and treatment, 4 plastic boxes were arranged in a randomized complete block design within a controlled environment chamber set at alternating temperatures of 59° F for 12 hours (with darkness) and 77° F for 12 hours (with fluorescent lights). Photosynthetic photon flux density averaged 21° mol/yd^2/s. Experiments were conducted twice. The number μ of germinated seeds was recorded every 4 days for 20 days.

The germination rate index (GRI) was calculated as the summation of the germination percentage at each count divided by the total number of days for germination (Maguire, 1962). The corrected germination rate index (CGRI) was obtained by dividing GRI by the final germination percentage and then multiplying by 100 (Hsu et al., 1985; Evetts and Burnside, 1972). Seeds were considered germinated when both the radicle and coleoptile were more than one half the length of the seed (Fulbright et al., 1983). Radicle lengths of 3 randomly selected seedlings in each box were determined at the end of each experiment.

Analysis of variance and Tukey's test were used to compare the effect of treatments on seed germination, radicle length, and corrected germination rate index (Walpole and Meyers, 1978). Percent germination data were subjected to arcsine transformation for analysis. Values presented in the text are untransformed means for all experiments.

RESULTS

Sorghum

Mean percent germination of sorghum seeds on substrata moistened by Buffelgrass leaf or root leachate was lower ($P<0.05$) than that of seeds germinated on substrata moistened with distilled water (Table 1). However, mean percent germination of seeds on substrata moistened with Kleberg bluestem root or leaf leachate was similar ($P>0.05$) to that of seeds on substrata moistened with distilled water. Radicles of seedlings grown on substrata moistened with buffelgrass leaf leachate were shorter ($P<0.05$) than those of seedlings grown on substrata moistened with distilled water and other leachates. No significant ($P>0.05$) difference existed between the

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Table 1. Effects of Kleberg bluestem and buffelgrass leachate on mean percent germination, radicle length (inches) and corrected germination rate index (CGRI) of 3 grasses at 50-77° F (12 hours with darkness, 12 hours with light).

Germination parameter or species	Leachate treatment				
	Control (Distilled water)	Kleberg bluestem Leaf	Kleberg bluestem Root	Buffelgrass Leaf	Buffelgrass Root
Sorghum					
% Germination[1]	80.7a[2]	73.2ab	72.5ab	58.0b	62.7b
Radicle length	3.0a	2.9a	2.3a	0.7b	3.0a
CGRI	16.6a	16.7a	16.6a	13.6b	16.0a
'Verde' Kleingrass					
% Germination	52.1a	40.2b	43.2ab	40.1b	40.6b
Radicle length	1.3a	0.9bc	1.0ab	0.7c	0.9bc
CGRI	14.1a	12.8ab	13.2ab	12.7b	12.5b
Blue Panicgass					
% Germination	75.6a	69.5a	69.4a	64.9a	71.6a
Radicle length	0.9a	0.9ab	0.7abc	0.5c	0.6bc
CGRI	13.9a	12.9b	13.2ab	13.1ab	13.4ab

[1]Percent germination data was transformed using arcsine √% x 0.01 for analysis.
[2]Means in the same row followed by the same letter are not significantly (P>0.05) different according to Tukey's HSD test.

control and other treatments. Mean CGRI of sorghum seeds germinated in buffelgrass leaf leachate was less (P<0.05) than of seeds in the control and other leachates.

'Verde' Kleingrass

Mean percent germination of 'Verde' Kleingrass seeds on substrata moistened by Kleberg bluestem leaf, buffelgrass leaf or root leachate was lower (P<0.05) than that of seeds on substrata moistened with distilled water (Table 1). Buffelgrass leachate reduced percent germination more than Kleberg bluestem leachate. Radicles of 'Verde' Kleingrass seedlings grown on substrata moistened with Kleberg bluestem leaf, buffelgrass leaf, or root leachate were shorter (P<0.05) than radicles of seedlings grown on substrata moistened by distilled water (Table 1).

Mean CGRI of 'Verde' Kleingrass seeds germinated on buffelgrass leaf or root leachate was less (P<0.05) than that of seeds in the control. However, Kleberg bluestem root or leaf leachate did not affect (P>0.05) CGRI of 'Verde' Kleingrass.

Blue panicgrass

There were no significant (P>0.05) differences in mean percent germination of blue panicgrass between the control and treatments (Table 1). Mean radicle lengths of blue panicgrass seedlings grown on substrata moistened by buffelgrass leaf or root leachate were lower (P<0.05) than that for the control. Mean CGRI of blue panicgrass seeds germinated in Kleberg bluestem leaf leachate was less (P<0.05) than that for the control. There were no significant (P>0.05) differences between control and other treatments.

DISCUSSION

The results of this study indicated that Kleberg bluestem leachate may contain chemicals that affect seed germination of 'Verde' Kleingrass, and blue panicgrass, while buffelgrass leachate affects germination of all 3 grasses. Buffelgrass leachate appeared more inhibitory than that of Kleberg bluestem to germination.

Concentrations of leachates used in this study were similar to those used by other investigators (Bokhari, 1978; Rice, 1972). However, the concentration of phytotoxins leached from Kleberg bluestem and buffelgrass in the field is unknown. In field experiments, Hussain et al. (1982) found that buffelgrass inhibited the growth of several forbs and grasses, including blue panicgrass. Further research is needed to determine if results similar to those obtained in this study would occur under field conditions.

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