Pre-emergence Herbicides for Seeding Range Grasses[1]

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Highlight

Three herbicides were evaluated for use in seeding range grasses. Propazine, applied as a pre-emergence at rates up to 3.0 lb/acre, controlled broadleaf weeds and crabgrass but had no apparent retarding effect on the germination and growth of switchgrass and Old World bluestems. Siduron applied at 1.5 lb active ingredient/acre controlled large crabgrass and had no apparent retarding effect on switchgrass, big bluestem, and indiangrass. Sideoats grama was harmed by all pre-emergence herbicides tested. Norea applied at 2 lb/acre retarded germination and seedling establishment of those species tested. None of the herbicides tested has been cleared for use on grazing lands.

Range grass seeding in the Great Plains has a history of a limited probability for success. A survey of grass plantings from 1960 to 1962 revealed that 18% of these were failures (Great Plains 6 Technical Committee, 1966). Seedbed preparation has been studied extensively (Launchbaugh and Anderson, 1963; Burnham, 1955; and Cooper, 1957) and it is generally agreed that seeding into a stubble mulch using double disk banded openers and press wheels offers the best chance for success.

Starter fertilizers have been tried and a small degree of improvement in stand establishment was occasionally noted (Cosper and Alsayegh, 1964; Welch et al., 1962). Bryan and McMurphy (1968) found that the addition of fertilizer did not enhance stand establishment. In their study weedy grasses present during the first year of establishment reduced second year forage yield by 28 to 70%. Weed control during establishment was considered mandatory before any benefits might be obtained from starter fertilizers. Arnold and Santelmann (1966) tested 4amino-3,5,6-trichloropicolinic acid (picloram) and 2,4-dichlorophenoxyacetic acid (2,4-D) for pre-emergence treatment of four native grasses and reported no germination from the picloram treated plots. Seven months after application Klomp and Hull (1968) found no residual effect from 4 lb of 1-(2-methylcyclohexyl)-3-phenylurea (siduron)/acre using crested wheatgrass (*Agropyron desertorum*) for bioassay.

Pre-emergence herbicides for use at the time of seeding have long been available for many cultivated crops. The purpose of these studies was to evaluate some promising herbicides in rangeland grass seeding for their selectivity as pre-emergence treatments to permit the seeded grasses to grow and to control the weedy species.

Materials and Methods

The herbicides tested were 2-chloro-4, 6-*bis*(isopropylamino)-s-triazine (propazine); 3-hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea (norea), and 1-(2-methylcyclohexyl)-3-phenylurea (siduron). Grasses used in the tests included experimental blends of the Old World bluestems (*Bothriochloa* spp.) not yet released as cultivars (Harlan et al., 1964). These included *B. ischaemum* var. *ischaemum* (S-Blend and M-Blend), *B. ischaemum* var. *indica* (L-Blend, LL-Blend, B-Blend, T-Blend, and H-Blend), *B. intermedia* var. *montana* (I-Blend and J-Blend). Other grasses in the tests were King Ranch bluestem (*B. ischaemum*), Caucasian bluestem (*B. caucasica*), 'Kaw' Big bluestem (*Andropogon gerardi*), 'Woodward' sand bluestem (*A. hallii*), indiangrass (*Sorghastrum nutans*), 'Caddo' switchgrass (*Panicum virgatum*), sideoats grama (*Bouteloua curtipendula*), and weeping lovegrass (*Eragrostis curvula*).

Three separate field tests, two at Stillwater and one at Muskogee, Oklahoma, were conducted using the same basic experimental design. The grass drill planted five species at a time which made it inconvenient to randomize the species; therefore, each species was an individual experiment involving a randomized complete block design with five replications. A single plot was one row wide by 18 ft long. Treatments involved different herbicides and rates of application. Herbicides were applied immediately after seeding using a small compressed air sprayer. A known amount of herbicide in one gallon of water was applied to a measured plot area.

Grass stands were evaluated by sampling an eight foot row length of each plot. An eight foot stick marked in 4-inch units was used, and a single plant in a 4-inch unit was considered successful for the unit. Percent stand as reported refers to the percentage of these 4-inch units occupied by at least one plant and is actually a frequency of occurrence in a 4-inch unit of row.

The two field tests at Stillwater were planted on an abandoned field in early secondary succession characterized by prairie threeawn (*Aristida oligantha*) the lesser amounts of broomsedge (*Andropogon virginicus*). The Muskogee test site was a cultivated field. Seedbed preparation for each of the three tests involved plowing and harrowing to produce a clean firm seedbed.

Stillwater 1967.—These plots were

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seeded June 6, 1967, on a moderately eroded Renfro-Kirkland soil. This upland soil has a 2–5% slope and a clay subsoil which limits water infiltration, thus making it a claypan prairie range site. Precipitation was timely, above average, and totaled 16 inches for the period from May 1 through August 31. Stand evaluation readings were taken August 25, 1967.

Stillwater 1968.—These plots were seeded June 19, 1968, on a Kirkland silt loam soil. This upland soil has a 1–3% slope with a clay subsoil which restricts infiltration rate making it a claypan prairie range site. Precipitation was timely but below average in August. The May 1 through August 31 rainfall totaled 12 inches. Stand evaluation readings were made on August 20, 1968.

Muskogee 1968.—Grass seeding was accomplished on June 11, 1968, at the Eastern Oklahoma Pasture Station, Muskogee, on a Taloka silt loam soil. This is a loamy prairie range site. Moisture conditions were excellent with 17 inches of precipitation from May 1 through August 31. Stand evaluation readings were made July 22, 1968.

Results and Discussion

The data on stand establishment are summarized in Tables 1, 2, and 3. From the standpoint of grass seedling survival propazine was the most promising pre-emergence herbicide in the 1967 tests. Norea at 2 lb/acre significantly reduced the stand of the various grasses tested and was not included in subsequent tests. Siduron was applied at such high rates in 1967 that a soil sterilant effect was achieved. Nothing grew in those plots throughout the season. Greenhouse studies (data not shown) indicated that lower rates of siduron might have promise on the native species but not for the Old World bluestems.

Old World bluestems and switchgrass.—Propazine at rates up to 3 lb/acre permitted good stand establishment of the Old World bluestems. In only 3 of the 22 separate experiments were there significant reductions in stand, but in two experiments significant improvements in stand were noted. Siduron at the lowest rate, 1.5 lb/acre, often caused significant reductions in the stand of Old World bluestems.

Switchgrass stands were not reduced by propazine at rates up to 3 lb/acre. The low rate (1.5 lb/acre) of siduron caused no significant stand reduction, but higher rates of siduron significantly reduced the stands of switchgrass.

Big bluestem.—Siduron at 1.5 lb/acre produced no significant reductions of big bluestem stands. Higher rates of siduron and all rates of propazine did on occasion reduce the stand of big bluestem.

Indiangrass.—Siduron at rates up to 4.5 lb/acre produced no significant reductions of Indiangrass, but propazine caused significant reductions in the 1967 tests and at 3 lb/acre at Muskogee in 1968.

Sideoats grama, weeping lovegrass, and sand bluestem.—Sideoats grama was sensitive to all herbicides, suffering significant stand reductions from nearly every treatment. Weeping lovegrass stands were significantly reduced by 2 lb of propazine/acre. Sand bluestem survived both propazine and siduron treatments with no significant stand reductions (Table 2). Considerable variation occurred in the limited tests with weeping lovegrass and sand bluestem. Therefore, it is believed that more information is needed about weeping lovegrass, sand bluestem, and sideoats grama to determine their resistance to these pre-emergence herbicides.

Table 1. Stand establishment (%) of different grasses as affected by pre-emergent herbicides. Stillwater, 1967.

Species	Herbicide and Rate (lb/acre)						
	Check	Propazine		Norea		Siduron	
		1	2	1	2	8	12
S-Blend	45	23	76@	23	18*	1*	0*
M-Blend	40	32	40	9 *	1*	0*	0*
L-Blend	92	95	78	66*	18*	0*	0*
LL-Blend	39	52	34	14	3*	0*	0*
King Ranch bluestem	38	34	24	5*	0*	0*	0*
Big bluestem	34	14*	9*	10*	3*	1*	0*
Switchgrass	89	83	73	33*	4*	0*	0*
Indiangrass	42	21*	3*	12*	3*	1*	1*
Sideoats grama	73	28*	14*	45	30*	1*	1*
Weeping lovegrass	51	40	26*	22*	7*	0*	1*

* Indicates a significant stand reduction (P = .05) from the check.
@ Indicates a significant stand improvement (P = .05) from the check.

Table 2. Stand establishment (%) of different grasses as affected by pre-emergent herbicides. Stillwater, 1968.

Species	Herbicide and Rate (lb/acre)						
	Check	Propazine			Siduron		
		1.0	2.0	3.0	1.5	3.0	4.5
S-Blend	47	37	48	47	11*	3*	0*
M-Blend	100	96	97	98	63*	13*	12*
L-Blend	94	93	98	98	90	63*	48*
LL-Blend	98	87	98	98	57*	29*	11*
H-Blend	98	97	98	100	85*	30*	11*
I-Blend	99	98	98	98	84	28*	43*
J-Blend	84	50*	76	77	21*	3*	0*
T-Blend	76	72	65	52*	12*	2*	1*
King Ranch bluestem	37	25	33	41	5*	2*	2*
Caucasian bluestem	83	76	70	78	7*	0*	2*
Big bluestem	28	34	49@	46	57@	38	21
Switchgrass	82	85	83	84	79	29*	34*
Indiangrass	28	23	22	23	26	15	16
Sideoats grama	90	64*	41*	18*	67*	35*	18*
Sand bluestem	20	25	13	14	33	16	23

* Indicates a significant stand reduction (P = .05) from the check.
@ Indicates a significant stand improvement (P = .05) from the check.

Table 3. Stand establishment (%) of different grasses as affected by pre-emergent herbicides. Muskogee, 1968.

Species	Check	Herbicide and Rate (lb/acre)					
		Propazine			Siduron		
		1.0	2.0	3.0	1.5	3.0	4.5
M-Blend	99	100	98	98	62*	13*	14*
L-Blend	47	78	80@	88@	19	0*	1*
LL-Blend	93	98	92	94	57*	17*	5*
H-Blend	91	95	98	89	38*	8*	13*
I-Blend	86	94	93	83	8*	2*	3*
T-Blend	78	78	88	83	1*	0*	0*
B-Blend	82	87	72*	81	11*	3*	6*
Big bluestem	43	28*	26*	28*	40	28*	28*
Indiangrass	63	45	57	24*	56	48	60
Sideoats grama	60	3*	6*	3*	25*	16*	6*

* Indicates a significant stand reduction (P = .05) from the check.
@ Indicates a significant stand improvement (P = .05) from the check.

Weed control from 2 lb of propazine/acre has been described as completely controlling some broadleaf species but not completely adequate on annual grasses (Santelmann and Davies, 1965). Weeds in their tests were carpetweed (*Mollugo verticillata*), pigweed spp. (*Amaranthus retroflexus* and *A. hybridus*), foxtail millet (*Setaria italica*) and large crabgrass (*Digitaria sanguinalis*).

Weedy grasses were no problem in the tests at Stillwater, but the test near Muskogee was heavily infested with large crabgrass. While complete control of large crabgrass was not achieved with propazine, the level of control was a tremendous asset to establishment of healthy seedlings. No forage yields were taken, but a visible improvement in plant vigor was noted in the propazine treated plots. At Muskogee all propazine treatments gave complete control of the broadleaf species encountered, pigweed spp. and carpetweed (data not shown). Venice mallow (*Hibiscus trionum*) was present in the Stillwater plots and complete control was achieved with propazine.

In contrast with propazine, siduron was an effective chemical for large crabgrass control, but allowed many broadleaf weeds, pigweed spp. and carpetweed, to survive. In fact, a bad infestation of the above broadleaf weeds would have necessitated 2,4-D for their control because siduron was not effective at the low rate.

These herbicides have not been cleared for use of grazing lands, and their major value at present would be in establishment of small plots for research purposes. Crabgrass control has been a dominant problem in the establishment of our variety test plots for yield, and propazine and siduron were effective in reducing crabgrass competition.

LITERATURE CITED

ARNOLD, W. R., AND P. W. SANTELMANN. 1966. The response of native grasses and forbs to picloram. Weeds 14: 74–76.

BRYAN, G. G., AND W. E. MCMURPHY. 1968. Competition and fertilization as influences on grass seedlings. J. Range Manage. 21:98–101.

BURNHAM, D. R. 1955. Reseeding abandoned cropland or depleted range areas. N. Mex. Agr. Exp. Sta. Bull. 395. 13 p.

COOPER, H. W. 1957. Some plant materials and improved techniques used in soil and water conservation in the Great Plains. J. Soil and Water Conserv. 12:163–168.

COSPER, H. R., AND A. Y. ALSAYEGH. 1964. Can fertilizers aid in establishing grass on native ranges. S. Dak. Farm & Home J. 15 (1) 3–5.

GREAT PLAINS 6 TECHNICAL COMMITTEE. 1966. A stand establishment survey of grass plantings in the Great Plains. Great Plains Council Report No. 23. Univ. Nebr., Agr. Exp. Sta. 60 p.

KLOMP, G. J., AND A. C. HULL, JR. 1968. Herbicidal residues on crested wheatgrass. Weed Sci. 16:315–317.

LAUNCHBAUGH, J .L., AND K. L. ANDERSON. 1963. Grass reseeding investigations at Hayes and Manhattan, Kansas. Kans. Agr. Exp. Sta. Tech. Bull. 128. 22 p.

SANTELMANN, P. W., AND F. F. DAVIES. 1965. Weed control research in grain sorghums, Progress report: 1962–1964. Okla. Agr. Exp. Sta. Processed Series 514. 17 p.

WELCH, N. H., E. BURNETT, AND E. B. HUDSPETH. 1962. Effect of fertilizer on seedling emergence and growth of several grass species. J. Range Manage. 15:94–98.

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