Response of Direct-Seeded Guayule to Preemergence Herbicides

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Direct-seeding guayule (*Parthenium argentatum* Gray) in west Texas has been successful; however, seedlings grow slowly and are extremely susceptible to weed competition. An effective preplant or preemergence herbicide is necessary for establishment. The objective of this study was to examine the effects of preemergence herbicides on guayule stand establishment by direct seeding. Experiments were initiated on a Dalby clay in 1991 and 1992 at the Texas Agricultural Experiment Station Guayule Research Site near Fort Stockton, Texas. Conditioned guayule seed (Mexican Bulk) was planted 10 mm deep on raised beds with a Gaspardo SV255 pneumatic planter at 100 seeds/m. The following herbicides were applied immediately after planting: dimethyl 2,3,5,6-tetrachloro-1,4,-benzenedicarboxylate (DCPA) [4.5, 9.0, 11.0 kg ai/ha (hectare)], pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] (0.3, 0.6, 1.1 kg/ha) and prodiamine [N^3,N^3-Di-*n*-propyl-2,4-dinitro-6-(trifluoromethyl)-*m*-phenylenediamine] (0.3, 0.6, 1.1 kg/ha). Herbicides were applied in a 0.5-m band on each bed by using a CO_2-powered backpack sprayer with a single-nozzle boom delivering 300 L/ha at 172 kPa pressure. The lowest rates of all herbicides did not significantly reduce guayule stand density in 1991 when compared to the control. DCPA at 9.0 kg/ha was adequately selective in both studies. Guayule stand reduction varied from only 2% with DCPA at 4.5 kg/ha in 1991, to 71% with 1.1 kg/ha of pendimethalin in 1992. DCPA (4.5 and 9.0 kg/ha) would be recommended for preemergence weed control, depending on soil type, when direct seeding guayule. Based on row spacing recommendations for transplants, at least three established seedlings/m would be required for an acceptable guayule stand. Seeding rate could be reduced and still allow for effective preemergence weed control.

KEY WORDS: Direct seeding, guayule, preemergence herbicides.

A major limiting factor in the commercialization of guayule is the high cost of stand establishment. Production costs could be lowered considerably by the development of direct-seeding techniques. Recently, Foster and Moore (1) have shown that guayule can be successfully direct seeded in west Texas with conditioned seed and precision planting. Seed conditioning improves germination and seedling development over a broad temperature range.

Guayule seedlings grow slowly and produce about 1 cm top growth and 5 cm root growth two weeks after emergence (2). Therefore, there is little competition with weed species. An effective preplant or preemergence herbicide is required for optimum stand establishment by direct seeding.

In 1983, Mihail *et al.* (3) summarized greenhouse and field direct-seeding studies conducted in New Mexico involving 13 preemergence herbicides or herbicide combinations. Only DCPA (dimethyl 1,3,5,6-tetrachloro-1,4,-benzenedicarboxylate) and pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6dinitrobenzenamine] were adequately selective for guayule. However, these studies did not utilize conditioned seed, which can be planted at lower rates *vs.* sowing 300 seed/m on the soil surface.

This study was designed to observe the tolerance of a direct-seeded guayule population established with conditioned seed to DCPA, pendimethalin and prodiamine [N^3,N^3-Di-*n*-propyl-2,4-dinitro-6-(trifluoromethyl)-*m*-phenylenediamine].

EXPERIMENTAL PROCEDURES

Studies were conducted at the Texas Agricultural Experiment Station Guayule Research Site near Fort Stockton, Texas, in 1991 and 1992. The soil type was a Dalby clay (fine, montmorillonitic, thermic Typic Torrert) with 1.7% organic matter and a soil pH of 8.4.

The experimental design was a randomized complete block with four replications. Plots were 6-m wide (six rows spaced 102 cm apart) and 80-m long. Mexican Bulk guayule seed was conditioned by the process outlined by Chandra and Bucks (4) and planted 10-cm deep with a Gaspardo SV255 pneumatic planter (Pordenone, Italy) on August 15, 1991, and June 29, 1992. Germination was 80 and 70%, respectively, in 1991 and 1992.

Herbicide treatments consisted of single rows, 9-m long, treated with DCPA [4.5, 9.0, 11.0 kg/ha (hectare)], pendimethalin (0.3, 0.6, 1.1 kg/ha) and prodiamine (0.3, 0.6, 1.1 kg/ha) immediately after planting. Treatments were applied in a 0.5-m band on each bed by using a CO_2-powered backpack sprayer with a single-nozzle boom (Teejet 8002 fat fan nozzle, Spraying Systems, Wheaton, IL) delivering 300 L/ha at 172 kPa. Herbicides were incorporated with 1 cm of sprinkler-applied water.

Evaluations were conducted by recording the number of guayule seedlings in a 0.5-m band on each bed 60 d after planting. Data were subjected to factorial analysis of variance with herbicides and rate as factors. Treatment means were separated by Fisher's Protected Least Significant Difference at the 5% level of significance.

RESULTS AND DISCUSSION

Guayule seedling density was greater in 1991 than in 1992 (Tables 1 and 2). Seed germination was lower in 1992, which likely affected stand establishment. Favorable environmental conditions (lower air and soil temperatures, less wind) in August 1991 *vs.* in June 1992 promoted uniform sprinkler irrigation and less soil crusting, which enhanced seedling emergence and establishment. Seedlings emerging from the August 1991 planting were not sufficiently hardened, however, and did not survive the 1991–1992 winter. An earlier planting date was selected in 1992.

There was a significant herbicide × rate interaction; therefore, herbicides will be compared within rates. The lower rates of DCPA, pendimethalin and prodiamine had no significant effect on guayule seedling density in 1991 when compared to the control (Table 1). Seedling density in the 9.0 kg/ha DCPA treatment was not significantly different from the control. Guayule populations were

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TABLE 1

Response of Direct-Seeded Guayule to Preemergence Herbicides in 1991

	Herbicide rate[a]		
	Lowest		Highest
Herbicide	1	2	3
		(Seedlings/m)	
DCPA	39a[b]	37ab	30b
Pendimethalin	37a	35b	22c
Prodiamine	37a	29c	32b
Control	40a	40a	40a

[a]Lowest to highest rates (kg/ha): DCPA, 4.5, 9.0, 11.0; pendimethalin, 0.3, 0.6, 1.1; and prodiamine, 0.3, 0.6, 1.1. DCPA, dimethyl 2,3,5,6-tetrachloro-1,4,-benzenedicarboxylate; pendimethalin, *N*-(1-ethylpropyl)-3,4-dimethyl-2,6dinitrobenzenamine; and prodiamine, N^3, N^3-Di-*n*-propyl-2,4-dinitro-6-(trifluoromethyl)*m*-phenylenediamine.

[b]Means within columns followed by the same letter are not significantly different ($P = 0.05$).

reduced at the highest rates for all herbicides. The low and medium rates of DCPA (again in 1992) did not significantly reduce guayule seedling density (Table 2). DCPA at rates of 4.5 and 9.0 kg/ha would be recommended for preemergence weed control when direct-seeding guayule. Recommended rates for other field crops range from 5.0 to 11.8 kg/ha, depending on soil type.

Pendimethalin and prodiamine may be adequately selective on other soil types. Results in 1991 (Table 1) indicated that these chemicals at 0.3 kg/ha were not phytotoxic to guayule seedlings. Prodiamine, which is more persistent than DCPA or pendimethalin, may also offer a broader spectrum of weed control. Mihail *et al.* (3) concluded that the control of 12 weed species in New Mexico was only 60% with DCPA (9.0 kg/ha) and 68% with pendimethalin (1.1 kg/ha). Guayule would not be commercially harvested for 2–3 yr after planting, therefore, soil persistence would be beneficial, especially in controlling cool-season weeds late in the first growing season.

TABLE 2

Response of Direct-Seeded Guayule to Preemergence Herbicides in 1992

	Herbicide rate[a]		
	Lowest		Highest
Herbicide	1	2	3
		(Seedlings/m)	
DCPA	21a[b]	20a	16b
Pendimethalin	14b	12b	7c
Prodiamine	15b	13b	14b
Control	24a	24a	24a

[a]Lowest to highest rates (kg/ha): DCPA, 4.5, 9.0, 11.0; pendimethalin, 0.3, 0.6, 1.1; and prodiamine, 0.3, 0.6, 1.1. Abbreviations as in Table 1.

[b]Means within columns followed by the same letter are not significantly different ($P = 0.05$).

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