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Control of Florida Beggarweed and Sicklepod in Peanuts with Dinoseb[1]

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ABSTRACT

Florida beggarweed (**Desmodium tortuosum** (Sw.) DC.) and sicklepod (**Cassia obtusifolia** L.), two of the worst weeds in peanuts grown in the Southeastern states, were most susceptible to dinoseb (the alkanolamine salt of 2-sec-butyl-4, 6-dinitrophenol) applied to seedlings before the true leaves expanded. If either of these weeds was not controlled by the first application of dinoseb, especially at the lowest rate of 0.63 kg/ha, it often survived later applications and became a problem when harvesting the peanuts. Sicklepod growing in soil previously treated with vernolate (S-propyl dipropylthiocarbamate) was more susceptible to low rates of dinoseb than sicklepod growing in soil free of vernolate. A single treatment of dinoseb at 0.63 kg/ha killed seedling Florida beggarweed if the maximum daily temperature exceeded 32C; however, twice that rate was necessary under cool conditions. Repeated treatments with higher rates (such as 1.26 kg/ha) of dinoseb usually were necessary for satisfactory control of sicklepod. However, where dinoseb did not kill the early weeds, repeated treatments suppressed weed growth and reduced the mass of weeds present at harvest. Peaunt plants generally tolerated the repeated dinoseb treatments, although yields trended lower if dinoseb at 1.26 kg/ha was applied after treatment with naptalam (N-1-naphthylphthalamic acid). However, any reduction in yields of peanuts attributable to either naptalam or dinoseb treatments was much less than potential reductions in yield from uncontrolled sicklepod and Florida beggarweed.

Farmers have used dinoseb on more acres than any other herbicide for peanuts grown in the United States. The early research on dinoseb for controlling weeds in peanuts is summarized in the book "Peanuts (Culture and Uses)" (4). Originally, dinoseb was used as a preemergence treatment, with erratic results. However, its principal use in peanuts since 1960 has been as a component of mixtures applied at the ground-cracking stage (GC) of the peanuts, or of the weeds if the weeds emerged first. Watson and Nation (3) found that, although tolerance of peanuts varied to dinoseb applied as a postemergence spray, the herbicide could be effectively and safely used until the peanut plants were 3 inches in diameter. However, early unpublished data from Georgia showed that while dinoseb at 5.0 kg/ha did not affect peanut yields if applied "at cracking", it did reduce both stands and yields if applied seven days later. Hauser and Parham (1) reported that a lower rate of dinoseb (1.7 kg/ha) applied 7 or 14 days after peanuts emerged (and sequentially to cracking-time treatments), always increased crop injury and suggested that peanuts be shielded when dinoseb is applied after the GC stage. In contrast, Rud and Chappell (2) reported that dinoseb, at 3.7 to 10 kg/ha, appplied at growth stages prior to 10 leaves, did not significantly reduce peanut yields.

In recent research, Rud[3] did not reduce peanut yields with five sequential applications of dinoseb as a postemergence treatment with rates of 0.41 or 0.84 kg/ha. Five applications at 1.68 kg/ha reduced the yields of peanuts significantly, but four treatments did not. Preceding the dinoseb treatments, Rud used vernolate as a preplanting incorporated treatment, followed by cultivation on all plots to control weeds.

In the Alabama-Florida-Georgia area, Florida beggarweed and sicklepod are the two most troublesome weeds and are among the 10 most common weeds in peanuts (4). In many fields, these weeds tower over the peanuts at harvest time. Control of these weeds is not consistently satisfactory with currently registered herbicides applied either as (a) preemergence treatments (incorporated or surface applied), (b) mixtures at ground-cracking (which include dinoseb as a component), or (c) postemergence treatments. Consequently, we began experiments in 1970 to study the effects of dinoseb on Florida beggarweed, sicklepod, and peanuts.

Methods and Materials

The experiments were conducted on Tifton loamy sand (at Tifton, Ga.), on a Greenville sandy clay loam (at Plains, Ga.), on a Dothan fine sandy loam (at Headland, Ala.), and on a Chesterfield sandy loam (at Auburn, Ala.). The peanuts were planted about 7 cm. deep. In 1970, peanuts were planted at Tifton on June 20, and in 1971 they were planted on June 4 at Auburn. All other plantings were made between April 10 and May 15.

The experimental design at Tifton and Plains was a randomized block (with four replicates) which was modified to leave a weedy check plot between each pair of adjacent treated plots. Two-row plots, 7m in length, were used. Just before peanuts were harvested, weeds were counted in the check plots on both sides of each treated plot. The average of each pair of check plots was used to compute percentage control for the treatment located between them. The average number of Florida

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[3]Rud, O. E. 1973. Effect of multiple applications of contact herbicides on peanuts. SWSS Proc. 26:119 (Abstract).

Table 1. Control of Florida beggarweed and sicklepod with dinoseb and naptalam treatments at Tifton and Plains, Georgia, 1970-72.

Herbicide[a]	Rate	Times applied[b]	Control of beggarweed at Tifton[c]			Control of sicklepod at Plains[c]		
			1970	1971	Av.	1971	1972	Av.
	kg/ha		%	%	%	%	%	%
Dinoseb	0.63	1	93 c	26 b	59 c	9 de	0 b	5 e
Dinoseb	1.26	1	94 c	41 b	67 bc	8 de	37 b	22 de
Dinoseb	0.63	4-7	99 ab	87 a	93 a	42 bc	18 b	30 cd
Dinoseb	1.26	4-5	100 a	96 a	98 a	88 a	42 b	65 b
Naptalam	2.24	1	50 d	89 a	69 bc	12 de	13 b	12 de
Naptalam + dinoseb	2.24 + 0.63	1 + 1	96 bc	84 a	90 ab	25 cd	36 b	30 cd
Naptalam + dinoseb	2.24 + 1.26	1 + 1	97 b	57 a	77 abc	20 d	8 b	14 de
Naptalam + dinoseb	2.24 + 0.63	1 + 4-7	99 ab	83 a	91 ab	37 bc	41 b	39 bcd
Naptalam + dinoseb	2.24 + 1.26	1 + 4-5	99 ab	97 a	98 a	64 ab	38 b	51 bc
Hand-weeded control	----	---	---	---	---	100 a	100 a	100 a

a/ All plots at Plains received benefin as a preplanting incorporated treatment. At Tifton, in addition to benefin, vernolate was injected at planting.

b/ The first application was made at ground-cracking, 7 days after peanuts were planted. The higher number of applications with repeated treatments were made only in 1970 at Tifton. Four to five treatments were made with both rates in all other studies.

c/ Control figures derived from counts of all beggarweed or sicklepod in treated and paired check plots. Any two means within the same column not followed by the same letter are significantly different at the 5% level.

beggarweed plants in the check plots at Tifton was 2 per m^2 in 1970, and 4 per m^2 in 1971. Sicklepod at Plains averaged 11 and 39 plants per m^2 in 1971 and 1972, respectively. At Auburn and Headland, four-row plots, 6m in length, were used. Treatments were replicated four times and arranged in a randomized block. Two of the four rows were maintained weedfree for yield determination. Density of sicklepod ranged from 4 to 6 plants per m^2 at both Alabama locations. Sicklepod was the only species present at Auburn, but at Headland, Florida beggarweed emerged to a stand of 4 to 6 plants per m^2.

Dinoseb was applied either 1 or more times alone or in combination with naptalam. Naptalam was included alone at GC for a "treated check" comparison. For specific treatments, see Tables 1 and 2. Dinoseb treatments were usually made about a week apart although the intervals varied from 4 to 14 days depending on (a) germination of weeds, (b) rate of dinoseb, and (c) weather conditions. An effort was always made to apply dinoseb when the Florida beggarweed or sicklepod was in the cotyledonary leaf stage—before the true leaves enlarged. To control grass weeds and small-seeded broadleaf weeds at all locations we applied N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine (benefin) on all plots including the checks. At Auburn, dinoseb at 3.4 kg/ha was applied as a preemergence treatment. At Tifton, in addition to benefin, we injected vernolate at planting to control the nutsedge prevalent in the experimental area.

The peanuts were dug, windrowed, and combined a few days after digging. Yield data were subjected to analyses of variance and to Duncan's multiple range test using comparisons at the 5% level of probability.

Table 2. Control of sicklepod and Florida beggarweed with multiple applications of dinoseb at Auburn (1971) and Headland, Alabama (1972-73).

Number of applications	Rate	Control of sicklepod at Auburn[b]	Control of Florida beggarweed and sicklepod at Headland		Av.
		1971[a]	1972	1973	
	kg/ha	%	%	%	%
1	0.63	31 b	25 c	20 e	25
2	0.63	44 ab	48 bc	44 de	45
4	0.63	28 b	74 ab	43 de	48
6	0.63	76 a	60 abc	20 e	52
8	0.63	70 a	99 a	29 de	66
1	0.84	41 b	13 c	25 de	26
2	0.84	36 b	64 abc	54 de	51
4	0.84	53 ab	81 ab	85 ab	73
6	0.84	82 a	86 ab	83 abc	80
8	0.84	91 a	100 a	88 ab	93
1	1.12	--	--	51 de	51
2	1.12	--	--	98 a	98
4	1.12	--	--	96 a	96
6	1.12	--	--	86 ab	86
8	1.12	--	--	98 a	98
Control	----	0 c	0 d	0 f	0

a/ Predominantly sicklepod.

b/ Any two means within the column not followed by the same letter are significantly different at the 5% level.

Weather conditions at Tifton. Within 14 days after peanuts were planted on June 20, 1970, 10.2 cm. of rain fell. Conditions were very wet for the next 8 weeks (total of 44.4 cm. rain), and then a drought lasted until harvest time. High daytime temperatures for 10 days after GC varied from 27 to 36C with an average maximum high of 32C. After the peanuts had been planted

on April 19, 1971 at Tifton, no rain occurred the first week, but 8.7, 2.5, and 6.3 cm. fell during the 2nd, 3rd and 4th weeks, respectively. Maximum air temperatures for 10 days after GC were usually in the mid-20's, but varied from 24 to 32C.

Weather conditions at Plains. Peanuts were planted on May 5, 1971, at Plains, after which rains totaling 3.8, 6.3, 6.3, and 0.6 cm fell during the first four weeks, respectively. High daily temperatures for 2 weeks after GC varied from 19 to 32C, but were usually in the low 20's. In 1972, sustained cooler than usual conditions persisted for about four weeks. For example, the maximum temperature on May 28, 30 days after treatment began, was only 21C. For 10 days after the GC stage, the average maximum temperatures averaged only 27C.

Weather conditions at Auburn and Headland. Rainfall was 10, 5, and 29 cm in May, June, and July in 1971 at Auburn. In 1972 at Headland, rainfall was 10, 28 and 10 cm for the same months. In 1973, rainfall was high, 26 cm, in May but was low, 8 and 10 cm, in June and July, respectively. In the period immediately after the first application of dinoseb in 1971, many days had temperatures in the 30C's. However, there were no 30° days in 1972 and 1973 during the comparable period.

Results

Control of beggarweed — Tifton. Under the hot humid conditions of June 1970, dinoseb applied alone at the cracking stage controlled 93 and 94% of the Florida beggarweed (Table 1). Repeated postemergence treatments with dinoseb increased control to 99 and 100%. The combinations of dinoseb-naptalam produced about the same control as did the same rate of dinoseb applied alone at GC or in repeated treatments. Naptalam applied alone produced 50% control.

The 1971 results demonstrate how weather conditions change the activity of dinoseb and naptalam. With less rainfall, and therefore less leaching, than in 1970, naptalam controlled 89% of the Florida beggarweed which was significantly higher than for single applications of dinoseb. Although normal for the planting season, temperatures were lower than in 1970, which markedly reduced the activity of dinoseb. Except where sequential applications of dinoseb were used, control of beggarweed was not satisfactory with dinoseb applied alone. However, the data averaged over the two years show that either rate of dinoseb, applied sequentially from 4 to 7 times, was equally effective on Florida beggarweed with or without naptalam.

We observed at Tifton that the Florida beggarweed, if not controlled with the first application of dinoseb, usually was not controlled with sequential treatments at the same rate. However, Florida beggarweed that received repeated dinoseb treatments was much smaller and less vigorous at harvest than that treated only once or not treated with dinoseb. The younger the Florida beggarweed plant, the more effective was the action of dinoseb, provided the dinoseb spray thoroughly covered the plant. Florida beggarweed in the seedling stage without expanded true leaves was the most susceptible to dinoseb.

Control of sicklepod — Plains. Only one herbicide treatment in 1971, (dinoseb at 1.26 kg/ha, applied 5 times) approached satisfactory control of sicklepod (Table 1). All other chemical treatments controlled less than 65% of the weed. Naptalam in combination with repeated dinoseb treatments controlled fewer sicklepod plants than repeated treatments of the higher rate of dinoseb. This apparent anomaly was caused by stunting of the peanuts by naptalam thus reducing the competitive capacity of the peanut for suppressing the growth of sicklepod. Under the prolonged cold, dry conditions atfer treatments began in 1972, no herbicide treatment satisfactorily controlled sicklepod.

Table 3. Percent injury and yield of peanuts after treatment with various numbers of applications of dinoseb, Auburn and Headland, Alabama, 1971-1973.

Number of applications	Rate	Percent injury[a/] Auburn 1971	Headland 1972	Headland 1973	Av.	Yield of peanuts[a/] 1971	1972	1973	Av.
		%	%	%	%	kg/ha	kg/ha	kg/ha	kg/ha
1	0.63	0 b	0 a	2 fg	1	2215 ab	4360 a	3212 ab	3300
2	0.63	0 b	0 a	0 g	0	2215 ab	3273 a	3319 a	2936
4	0.63	0 b	0 a	2 fg	1	2381 ab	3567 a	3212 ab	3053
6	0.63	0 b	0 a	2 fg	1	2307 ab	4635 a	2908 ab	3283
8	0.63	13 a	0 a	22 b	12	1649 bc	2806 a	2643 b	2365
1	0.84	0 b	0 a	0 g	0	2051 abc	4390 a	3140 ab	3194
2	0.84	0 b	0 a	0 g	0	2546 ab	3090 a	3252 ab	2962
4	0.84	0 b	0 a	5 defg	2	2663 a	3893 a	3024 ab	3196
6	0.84	0 b	0 a	4 efg	1	2015 abc	3110 a	3232 ab	2785
8	0.84	14 a	0 a	19 bc	11	1483 c	2480 b	2628 b	2215
1	1.12	-	-	0 g	0	----	----	3232 ab	3232
2	1.12	-	-	0 g	0	----	----	3293 ab	3293
4	1.12	-	-	3 efg	3	----	----	3431 a	3431
6	1.12	-	-	12 bcd	12	----	----	2866 ab	2866
8	1.12	-	-	33 a	33	----	----	2724 ab	2724
Control		0 b	0 a	0 g	0	1868 abc	2930 a	3193 ab	2664

a/ Any two means within the column not followed by the same letter are significantly different at the 5% level.

As was true for beggarweed, sicklepod was most susceptible to dinoseb immediately after emergence. After true leaves expanded, sicklepod was very difficult to kill, even when favorable weather followed treatment. However, growth of sicklepod was suppressed by repeated applications of dinoseb, especially at the higher rate. Further, we noted that the sicklepod plants in the beggarweed study at Tifton (and in adjacent fields at Plains), where vernolate had been applied previously, were much more susceptible to dinoseb than in these plots, where vernolate had not been applied.

Control of sicklepod and Florida beggarweed — Auburn and Headland. Dinoseb applied at 0.63 kg/ha six or fewer times did not give acceptable control of sicklepod or Florida beggarweed (Table 2). Eight applications with this rate gave almost complete control in 1972, but only 29% control in 1973. When the rate was increased to 0.84 kg/ha, acceptable control resulted in 1972 and 1973 with only 4 applications. Six or eight applications gave satisfactory control in all years. In 1973, two or more applications with 1.12 kg/ha gave essentially complete control of sicklepod and Florida beggarweed.

All dinoseb treatments controlled some sicklepod and Florida beggarweed. In general, an increase in the rate or the number of applications improved control.

Visible injury ratings made toward the end of the growing season revealed no marked effects on peanut foliage where six or fewer applications had been made (Table 3).

Yield of peanuts. In evaluating the yield data we cannot separate the effects of competition of uncontrolled weeds from possible injury by dinoseb at Tifton and Plains. From Rud's 1973 results we believe that most of the yield differences in our studies, especially at Plains where sicklepod populations were dense, were influenced more by weed competition than by toxicity from dinoseb (especially at the low rate).

At Tifton, highest average yields in 1971 followed a single dinoseb treatment because of low beggarweed stands in these particular plots (Table 4). The yields from this treatment can be considered as equivalent to those from a hand-weeded check plot, because there was essentially no competition between the crop and the beggarweed. Yield differences among the other treatments ranged up to 376 kg/ha. In general, differences averaged over the 2-year period were not statistically significant among treatments that involved (a) repeated applications of dinoseb or (b) any combination of dinoseb with naptalam. The only exception, tending to reduce yields (while offering excellent control of beggarweed), was nap-

Table 4. Yield of peanuts after dinoseb and naptalam treatments at Tifton and Plains, Georgia, 1970-72.

Herbicide[a]	Rate	Times applied[b]	Yield of peanuts at Tifton[c]			Yield of peanuts at Plains[c]		
			1970	1971	Av.	1971	1972	Av.
			kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Dinoseb	0.63	1	1434 a	3578 a	2506 a	1236 d	1845 bc	1540 de
Dinoseb	1.26	1	1434 a	2923 bc	2178 c	1314 d	1519 c	1416 e
Dinoseb	0.63	4-5	1508 a	3110 abc	2309 bc	2635 bc	2579 b	2607 c
Dinoseb	1.26	4-5	1314 a	3205 ab	2259 bc	3030 b	3377 a	3203 b
Naptalam	2.24	1	965 a	3037 bc	2001 d	1401 d	1848 bc	1624 de
Naptalam + dinoseb	2.24 + 0.63	1 + 1	1430 a	3157 abc	2293 bc	1438 d	1270 c	1354 e
Naptalam + dinoseb	2.24 + 1.26	1 + 1	1398 a	3356 ab	2377 ab	1511 d	2013 bc	1762 de
Naptalam + dinoseb	2.24 + 0.63	1 + 4-5	1474 a	3133 abc	2303 bc	2206 c	1719 c	1962 d
Naptalam + dinoseb	2.24 + 1.26	1 + 4-5	1548 a	2694 c	2121 cd	2631 bc	3637 a	3134 b
Hand-weeded control	----	---	----	----	----	3512 a	4145 a	3828 a

a/ All plots at Plains received benefin as a preplanting incorporated treatment. At Tifton, in addition to benefin, vernolate was injected at planting.

b/ The first application was made at ground-cracking, 7 days after peanuts were planted. The higher number of applications with repeated treatments were made only in 1970 at Tifton. Four to five treatments were made with both rates in all other studies.

c/ Any two means within the same column not followed by the same letter are significantly different at the 5% level.

talam followed by repeated applications of dinoseb at 1.26 kg/ha.

Yield differences were greater at Plains than at Tifton (Table 4). The hand-weeded check yielded significantly more than any other treatment. Yields after a single application of the low rate of dinoseb, where only 5% of the sicklepod was controlled, demonstrate the drastic effects of competition from thick stands of sicklepod (about 60% reduction in yields). As compared to single applications of dinoseb, average yields of peanuts were more than doubled where dinoseb at the higher rate was applied repeatedly (with or without naptalam).

Comparative yields at Auburn and Headland reflect only the influence of dinoseb because weeds were controlled by cultivation on plots harvested for yields. Six or fewer applications of dinoseb, except for the highest rate used in 1973, did not reduce peanut yields in any year, regardless of the rate of application (Table 3). Eight applications of either 0.63 or 0.84 kg/ha resulted in significantly lower yields in 1971 or 1972.

Discussion

One of the most meaningful results of these studies to the peanut farmer concerns timing of dinoseb applications. Both Florida beggarweed and sicklepod were more susceptible to dinoseb immediately after emergence than after true leaves began expansion. This finding, in combination with the fact that weeds not controlled early became harvesting problems, emphasizes timeliness of the dinoseb applications. Treatment with the standard registered rate of 3.4 kg/ha of dinoseb at the GC stage (for excellent control of the first broadleaf weeds), followed by 2 to 4 treatments with the lower rates we used, may provide the farmer with a better alternative than the treatments used in these studies.

As expected from past research and wide farm experience, weather conditions markedly affected the activity of dinoseb. Under hot humid conditions, with maximum temperatures over 32°C, a single application of 0.63 kg/ha effectively controlled Florida beggarweed. Under cooler conditions, higher rates or repeated treatments at the lower rate were required. Sicklepod was somewhat more resistant to dinoseb than Florida beggarweed. In these studies, repeated treatments of dinoseb were required for good control of sicklepod. Under cold conditions, even repeated treatments at 1.26 kg/ha were insufficient. However, we have observed good control of sicklepod with 0.63 kg/ha if the field received vernolate as an incorporated treatment before peanuts were planted. Where fields have been treated with vernolate, safety for peanuts may require that dinoseb applied after the ground-cracking stage be limited to 0.63 kg/ha.

Peanut yields indicate a surprising tolerance of this crop to even repeated applications of dinoseb. Based on our experiments at 4 locations over a 4 year period, peanuts will tolerate at least 4 applications of dinoseb at 0.84 kg/ha. It should be emphasized that factors such as temperature, spray coverage, and previous pesticide treatment that affect weed control may also affect the susceptibility of peanuts to dinoseb.

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