Influence of Oxadiazon on Peanuts and Weeds[1]

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ABSTRACT

Oxadiazon [2-**tert**-butyl-4-(2, 4-dichloro-5-isopropoxyphenyl)- $\triangle^2$-1,3,4-oxadiazolin-5-one] was applied alone as a preemergence treatment and in combination with dinoseb (2-**sec**-butyl-4,6-dinitrophenol) as a cracking-time treatment to peanuts (**Arachis hypogaea** L.). During the years 1970 to 1972 the experimental area was heavily infested with a mixed population of annual grass and broadleaf weeds. During the years 1973 to 1975, the predominant species present were sicklepod (**Cassia obtusifolia** L.) and Florida beggarweed [**Desmodium tortuosum** (Sw.) D.C.]. Grass control was acceptable with 3.36 kg/ha of oxadiazon in 2 of the 3 years when benefin (**N**-butyl-**N**-ethyl-α, α , α -trifluoro-2, 6-dinitro-**p**-toluidine) was not included. Commercially acceptable control of Florida beggarweed and sicklepod occurred with application of 3.36 kg/ha of oxadiazon. Substantial control was obtained with an application of 1.68 kg/ha. Generally, the addition of 1.68 kg/ha dinoseb to oxadiazon resulted in slightly improved weed control, particularly at lower rates of oxadiazon. Oxadiazon at rates of 6.7 kg/ha or more was phytotoxic to peanuts during the early part of the growing season. This phytotoxicity generally did not result in lower peanut yields. However, treated plants were more compact.

Chemical weed control in peanuts dates from the late 1940's when extensive research with herbicides was begun. Several reviews (4, 7, 8, 9) consider the performance of many herbicides for weed control in peanuts.

Early research largely employed the phenoxy type herbicides, 2, 4-D [(2, 4-dichlorophenoxy) acetic acid] and 2,4,5-T [(2,4,5-trichlorophenoxy) acetic acid] (18, 19, 20). Other phenoxy herbicides later evaluated were sesone [2-(2,4-dichlorophenoxy) ethyl sodium sulfate] (24) and 2,4-DEP [tris [2-(2,4-dichlorophenoxy) ethyl] phosphite] (10). Shaw *et al.* (21), Hauser and Parham (7), and Rud and Chappell (16) showed that dinoseb (2-*sec*-butyl-4,6-dinitrophenol) effectively controlled weeds with no substantial injury to peanuts. However, mixtures of dinoseb with either naptalam N-1-naphthylphalamic acid) (22) or diphenamid (*N,N*-dimethyl-2,2-diphenylacetamide) (25) were generally more effective than dinoseb alone.

Watson and Nation (23) showed the varying tolerance of peanut to dinoseb when applied as a postemergence spray. These workers noted that dinoseb could be used until peanut plant crowns were 3 inches in diameter without causing substantial injury. Research by Hauser and Parham (7) revealed that dinoseb could be used in peanuts without serious injury if applied "at cracking". Applications made later than the "at cracking" stage increased crop injury.

In the 1960's, two dinitroaniline type herbicides, trifluralin (α , α , α -trifluoro-2, 6-dinitro-N, N-dipropyl - *p*- toluidine) and benefin (*N* - butyl - N-ethyl α , α , α -trifluoro 2,6-dinitro-*p*-toluidine), were introduced for weed control in peanuts (11, 12, 14, 15, 17). An additional number of dinitroanilines have been developed or are being developed for weed control in peanuts (5).

Vernolate (*S* - propyl dipropylthiocarbamate) (6) and anachlor [2-chloro-2',6'-diethyl-N- (methoxymethyl acetanilide] (1) have also proved effective in controlling certain weed species such as yellow nutsedge (*Cyperus esculentus* L.) and fall panicum (*Panicum dichotomiflorum* Michx.).

Bannon *et al.* (3) found that preemergence applications of oxadiazon and metribuzin [4-amino-6-*tert*-butyl - 3 - (methylthio) - *as*-triazin -5 (4H) one] were the most effective herbicides evaluated for control of wild poinsettia (*Euphorbia heterophylla* L.) in soybeans. Mason *et al.* (13) reported that preemergence applications of oxadiazon gave 95 to 100% control of hophornbeam copperleaf (*Acalypha ostryaefolia Riddell)* in peanut.

The objectives of field experiments begun in 1970 were to determine the herbicidal performance of oxadiazon and to measure the response of peanuts to the herbicide. The 1973 to 1975 experiments were particularly designed to evaluate the control of Florida beggarweed and sicklepod.

Materials and Methods

Field experiments were conducted during the period 1970 to 1975 on a Dothan fine sandy loam at Headland, Alabama. Soil in the experimental area was turned each winter and a seedbed early April by disking and leveling. early April by disking and leveling. Experiments were located on land planted to peanuts the previous year, however, experimental treatments were rearranged each year.

Treatments were arranged in a randomized complete block with four, six, or seven replications. Plots were four rows wide and 6.1 m in length. All herbicides were applied in 140 to 190 L/ha of diluent with a tractor-mounted compressed air sprayer set to operate at a spraying pressure of 2.1 kg/cm^2. Treatments were made as preemergence or as cracking-time applications. Herbicides were applied to all four rows of the plots; however, two of the rows were cultivated and hand-hoed as necessary to control weeds. Peanut yields were taken only from the cultivated rows.

Areas used for the 1971 to 1973 experiments had moderate to high populations of large crabgrass (**Digitaria sanguinalis** (L.) Scop.), goosegrass (**Eleusine indica** (L.) Gaertn.), crowfootgrass **Dactyloctenium aegyptium** (L.) Richter), sicklepod, tall morningglory (**Ipomoea purpurea** (L.) Roth), smallflower morningglory (**Jacquemontia tamnifolia** (L.) Griseb.), Florida beggarweed, carpetweed (**Mollugo verticillata** L.), Texas panicum (**Panicum texanum** Buckl.), and redroot pigweed (**Amaranthus retroflexus** L.). To permit more precise measurement of the effects of oxadiazon on Florida beggarweed and sicklepod in the

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1973 to 1975 experiments, benefin was applied at 1.25 kg/ha to control grass and small-seeded weeds on all plots including the control plots. Weed density usually ranged from 10 to 30 plants per m^2.

'Florunner' peanuts were planted 6 to 8 cm deep in rows 91 cm apart in April of each year. Enough seed were planted to give 12 to 15 plants per m of row.

Cultural practices required for maximum production of peanuts were employed. 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.

Weed and crop plant counts and the early-season ratings were made approximately 4 weeks after planting. A second rating was made 3 to 6 weeks later.

Rainfall for May, June, and July, respectively, was 4, 15, and 13 cm in 1970; 10, 5, and 29 cm in 1971; 10, 28, and 10 cm in 1972; 26, 8, and 10 cm in 1973; 8, 9, and 29 cm in 1974; and 30, 17, and 21 cm in 1975.

Results

Experiments without benefin pretreatment. Preemergence applications of oxadiazon were effective in reducing the number of annual grass weeds (Table 1). Grass control ratings 4 weeks after peanut emergence indicated at least 80% control at rates as low as 1.68 kg/ha. Ratings made 3 to 6 weeks later revealed that control was less than 80% at the lower rate in 1971 and at all rates in 1972. High levels of control with all rates of application were recorded 3 to 6 weeks later in the 1970 season. This can probably be explained by the lower weed populations in that year.

Table 1. Number of annual grass weeds and percent control in peanuts when treated preemergence with oxadiazon.

Application	Grass count[a]			Percentage grass control[a]					
rate	1970	1971	1970	First ratings			Second ratings		
(kg/ha)	weeds/7.5 m^2	weeds/7.5 m^2	weeds/7.5 m^2	1970	1971	1972	1970	1971	1972
1.68	2 b	32 b	45 b	86 a	97 a	84 a	89 a	22 b	8 b
3.36	0 b	13 c	25 b	100 a	99 a	94 a	99 a	85 a	44 a
5.04	0 b	20 b	8 b	98 a	99 a	99 a	95 a	78 ab	77 a
0	50 a	262 a	113 a	0 b	0 b	0 b	0 b	0 c	0 b

a/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

Table 2. Number of broadleaf weeds and percent control in peanuts when treated preemergence with oxadiazon.

Application	Broadleaf counts[a]			Percentage broadleaf weed control[a]					
rate	1970	1971	1972	First ratings			Second ratings		
(kg/ha)	weeds/7.5 m^2	weeds/7.5 m^2	weeds/7.5 m^2	1970	1971	1972	1970	1971	1972
1.68	120 ab	61 b	36 ab	74 a	86 a	84 b	80 a	23 c	19 bc
3.36	1 b	12 b	37 ab	99 a	91 a	93 ab	99 a	66 a	46 ab
5.04	0 b	3 b	4 b	98 a	95 a	100 a	100 a	68 a	78 a
0	287 a	287 a	76 a	0 b	0 b	0 b	0 b	0 c	0 d

a/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

In 1970, 1971, and 1972, oxadiazon reduced broadleaf weed populations (Table 2). The two higher rates in 1970, all rates in 1971 and the highest rate in 1972 were effective in reducing broadleaf weed populations. Generally, increases in rate of applicaton gave better weed control. Early-season control ratings reflected acceptable control of all broadleaf weeds. Observations made 3 to 6 weeks later revealed that broadleaf weed control was less than 80% in 1971 and 1972 even at the highest rate of application.

Table 3. Peanut plant counts and percent crop injury when treated preemergence with oxadiazon.

Application	Crop plant			Percentage crop injury					
	1970	1971	1972	First ratings			Second ratings		
rate	number/	number/	number/						
(kg/ha)	24.4 m row	24.4 m row	24.4 m row	1970	1971	1972	1970	1971	1972
1.68	370 a	224 a	222 a	3 b	10 b	11 ab	0 a	0 c	0 a
3.36	400 a	245 a	229 a	14 a	16 b	13 a	0 a	3 b	0 a
5.04	310 a	204 a	227 a	23 a	32 a	5 ab	0 a	10 a	0 a
0	350 a	232 a	237 a	0 b	0 c	0 b	0 a	0 c	0 a

c/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

Oxadiazon applied at rates as high as 5.04 kg/ha did not significantly reduce the stand of peanuts in any year (Table 3). Ratings made early in the season revealed substantial phytotoxicity, especially with higher rates of application. Ratings made 3 to 6 weeks later revealed that there was no measurable phytotoxicity in either 1970 or 1972 at any rate of application. However, there was 3 to 10% phytotoxicity with the two higher rates in 1971. Yields of unshelled peanuts were not affected at any rate of application of oxadiazon (Table 4).

Table 4. Yield of peanuts after treatment with oxadiazon applied preemergence.

Application	Yield unshelled peanuts[a]		
rate	1970	1971	1972
(kg/ha)	(kg/ha)	(kg/ha)	(kg/ha)
1.68	2,670 a	3,650 a	2,340 b
3.36	2,650 a	3,530 a	2,940 a
5.04	2,130 a	3,510 a	2,600 a
0	2,890 a	3,440 a	2,800 a

a/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

Experiments with benefin pretreatment. Since benefin was applied to the entire experimental area in 1973 to 1975, data were not taken on grass control. Early-season ratings indicated commercially acceptable (80% or better) control of broadleaf weeds in all years with all rates of applications (Table 5). Ratings made 3 to 6 weeks later in 1973 and 1975 still showed good weed control at

Table 5. Overall broadleaf weed control when treated preemergence with oxadiazon.

Application rate (kg/ha)	Percentage broadleaf weed control[a/] First ratings 1973	First ratings 1974	First ratings 1975	Second ratings 1973	Second ratings 1974	Second ratings 1975
1.68	83 a	96 a	91 a	85 a	49 a	81 a
3.36	95 a	100 a	99 a	94 a	76 a	94 a
5.04	96 a	100 a	97 a	95 a	99 a	93 a
6.72	----	100 a	96 a	----	96 a	93 a
11.20	----	100 a	100 a	----	96 a	100 a
0	0 b	0 b	0 b	0 b	0 c	0 c

a/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

Table 6. Percent control of sicklepod and Florida beggarweed when treated with oxadiazon preemergence.

Application rate (kg/ha)	Percentage Control[a/] Sicklepod First ratings 1974	Sicklepod First ratings 1975	Sicklepod 2nd rating 1975	Florida beggarweed First ratings 1974	Florida beggarweed First ratings 1975	Florida beggarweed Second ratings 1974	Florida beggarweed Second ratings 1975
1.68	28 b	96 a	95 a	94 a	90 a	41 b	80 a
3.36	81 a	100 a	99 a	99 a	100 a	74 a	99 a
5.04	98 a	91 a	66 a	100 a	100 a	99 a	99 a
6.72	83 a	83 a	83 a	100 a	100 a	100 a	100 a
11.2	80 a	100 a	98 a	100 a	90 a	100 a	100 a
0	0 b	0 b	0 b	0 b	0 b	0 c	0 b

a/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

all rates of application. Control was 49 and 76% at 1.68 and 3.36 kg/ha respectively in 1974. Sicklepod and Florida beggarweed control was good at all but the lowest rate of application (Table 6). The lower rates of application gave 28 to 96% control of these two species.

Ratings made early in the season revealed 32 to 83% injury to the crop at 3.36 kg/ha and higher rates in 1974 and 1975 (Table 7). There was no appreciable phytotoxicity to peanuts at 5.04 kg/ha or lower rates in 1973. Injury ratings made later in the season revealed no appreciable, persistent 'phytotoxicity' at any rate in 1973, but in 1974 and 1975 there was 4 to 49% stunting of peanuts, particularly at the two higher rates. 'Phytotoxicity' was characterized by stunting of peanut vine growth. Resulting plants appeared as "a more compact, tight peanut canopy" (2). This stunting of the plants did not affect yields of unshelled peanuts (Table 7).

In 1974 and 1975, the effects of oxadiazon applied as a preemergence treatment followed by dinoseb as a cracking-time treatment were investigated. Overall broadleaf weed control was 92% or greater at the time of the early season ratings at all application rates and 82% or greater at the time of the late season ratings when treated with 3.36 kg/ha or higher rates of oxadiazon followed by a dinoseb treatment at cracking (Table 8). Early season ratings indicated control of both sicklepod and Florida beggarweed. At the end of the season, the 3.36 kg/ha oxadiazon + 1.68 kg/ha dinoseb rate was effective in controlling these weed species.

Peanut stands in 1974 were not affected by any rate of application (Table 9). In 1975, however, stands were reduced at the two higher rates.

Table 7. Percent injury and yield of peanuts treated preemergence with various rates of oxadiazon.

Application rate (kg/ha)	Percentage crop injury[a/] First rating 1973	First rating 1974	First rating 1975	Second rating 1973	Second rating 1974	Second rating 1975	Yield unshelled peanuts[a/b/] 1973 (kg/ha)	1974 (kg/ha)	1975 (kg/ha)
1.68	3 a	14 c	3 d	0 a	0 c	4 e	3730 a	4230 a	4610 a
3.36	0 a	39 b	32 c	0 a	0 c	13 d	3940 a	4230 a	4470 a
5.04	3 a	45 b	43 c	0 a	4 c	16 c	3430 a	3960 a	4850 a
6.72	---	70 a	60 b	---	15 b	32 b	----	4030 a	4640 a
11.2	---	80 a	83 a	---	25 a	49 a	----	3930 a	4500 a
0	0 a	0 d	0 d	0 a	0 c	0 e	3200 a	3980 a	5010 a

a/ Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

b/Yields from weed-free, cultivated rows.

Tazle 8. Overall broadleaf weed, sicklepod, and Florida beggarweed control following a preemergence application of oxadiazon and a cracking time application of dinoseb.

Treatment Herbicide	Rate (kg/ha)	Percentage Control Broadleaf control[a/] First ratings 1974	First ratings 1975	Second ratings 1974	Second ratings 1975	Sicklepod[a/] First ratings 1974	First ratings 1975	Sicklepod Second ratings 1975	Florida beggarweed[a/] Early 1974	Early 1975	Late 1974	Late 1975
Oxadiazon/Dinoseb	1.68+1.68	98 a	92 a	59 b	70 ab	72 a	86 a	69 a	94 a	90 a	46 b	71 a
Oxadiazon/Dinoseb	3.36+1.68	98 a	96 a	87 ab	82 a	82 a	83 a	83 a	100 a	100 a	77 ab	98 a
Oxadiazon/Dinoseb	5.04+1.68	100 a	100 a	95 a	98 a	83 a	100 a	100 a	100 a	100 a	100 a	100 a
Oxadiazon/Dinoseb	6.72+1.68	100 a	100 a	91 a	96 a	67 a	100 a	96 a	100 a	100 a	100 a	99 a
Oxadiazon/Dinoseb	11.2+1.68	100 a	100 a	98 a	97 a	98 a	100 a	95 a	100 a	100 a	100 a	100 a
Control	0	0 b	0 b	0 c	0 b	0 b	0 b	0 b	0 b	0 b	0 b	0 b

a/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

Table 9. Plant count, phytotoxicity, and yield of peanuts treated preemergence with oxadiazon and a cracking time application of dinoseb.

Treatment		Percentage crop injury[a]						Yield	
				First ratings		Second ratings		Unshelled peanuts[a]	
Herbicide	Rate (kg/ha)	Peanut count[a] 1974	1975	1974	1975	1974	1975	1974 (kg/ha)	1975 (kg/ha)
Oxadiazon/Dinoseb	1.68+1.68	81.0 a	63 a	16 d	33 c	0 d	10 c	3930 a	5120 a
Oxadiazon/Dinoseb	3.36+1.68	70.0 ab	58 a	29 d	41 c	3 cd	18 abc	4150 a	4850 a
Oxadiazon/Dinoseb	5.04+1.68	71.1 ab	57 a	54 c	58 b	6 bc	31 b	4000 a	4850 a
Oxadiazon/Dinoseb	6.72+1.68	64.6 b	55 b	60 b	61 b	8 b	27 bc	3900 a	5010 a
Oxadiazon/Dinoseb	11.2+1.68	71.1 ab	50 b	74 a	81 a	25 a	43 a	4990 a	4640 a
Control	0	79.0 ab	71 a	0 e	0 d	0 d	0 e	4980 a	5010 a

a/Means within a column followed by different letters are significantly different at the 5% level according to Duncan's multiple range test.

There was substantial 'phytotoxicity' at all rates of application at the time of the first ratings. At the end of the season there was considerable phytotoxicity at all rates of application in 1975 and at the highest rate in 1974. There was no associated reduction in peanut yields.

Discussion

Herbicides are widely used for control of weeds in peanuts. This has developed primarily because there are no effective alternatives to chemical weed control except hand weeding. Hand weeding is often more expensive than justified by the value of the crop.

Some of the most widely used herbicides in peanuts are benefin, dinitramine and vernolate. Because of the high degree of herbicidal effectiveness, populations of certain susceptible weed species (i.e., large crabgrass, crowfoot grass, and goosegrass) have been substantially reduced. Associated with the reduction of certain weed species has been an increase in populations of certain other weed species, two of the most common are Florida beggarweed and sicklepod.

Results of these experiments show that oxadiazon has activity against a broad spectrum of weed species including Florida beggarweed and sicklepod. Although the data are not conclusive, Florida beggarweed appears to be more susceptible to oxadiazon than sicklepod. This was especially noticeable in some experiments.

Oxadiazon caused transient phytotoxicity (leaf burn) to peanuts especially at the higher rates of application. However this rather marked effect of oxadiazon on peanut foliage was generally not associated with a reduction in crop yield. Aside from a slight burning of foliage in the early season, the most significant effect was a more compact plant canopy (2). In general, acceptable weed control was obtained without use of rates that caused significant crop injury.

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