Effect of Dinitroaniline Herbicides upon Yield and Grade of Five Runner Cultivars[1]

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ABSTRACT

Five runner peanut (*Arachis hypogaea* L.) cultivars were treated with four dinitroaniline herbicide treatments or a postemergence herbicide treatment to determine the effect on pod yield and grade, percentage sound mature kernels + sound splits (SMK+SS). No yield differences due to the dinitroaniline herbicide treatments were noted in the three year study. Southern Runner and GK-7 were higher in yield in one of the three test years, however, no cultivar yield differences were noted in the other two years. Grades were lower with pendimethalin in the three years; grades of trifluralin, ethalfluralin and benefin-treated peanuts were variable from year to year.

Key Words: groundnut, dinitroaniline herbicide, trifluralin, benefin, pendimethalin, ethalfluralin.

The use of dinitroaniline herbicides in the Southwest has been one of the major factors contributing to the increase of peanut yields. The use of herbicides combined with other improved practices has enabled Texas farmers to double peanut yields in the past thirty years (1, 2).

Growers in the Southwest have raised questions concerning the relative tolerance of runner peanuts to dinitroaniline herbicides, especially trifluralin [2,6-dinitro-*N*,*N*-dipropyl-4-(trifluoromethyl)benzenamine] (authors' personal observation). Merkle (17) stated that sporadic injury to runner peanuts from trifluralin was due to the failure to properly incorporate this dinitroaniline herbicide.

Peg injury is more common in certain runner peanuts than it is in spanish peanuts (17). Peg injury has been observed when a concentrated layer of herbicide is covered by a thin layer of non treated soil. The pegs (modified gynophores) grow normally until they enter the zone of concentrated herbicide, but then growth ceases and pods do not develop (17).

Greer *et al.* (11) stated that trifluralin had a narrow margin of safety to spanish peanuts and that proper incorporation, including the correct depth, was very important. Boswell *et al.* (4) stated that in greenhouse studies, lateral root development was inhibited within bands of 0.5 to 1.0 ppm concentration of soil treated with trifluralin, benefin [*N*-butyl-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine], and nitralin [4-(methylsulfonyl)-2,6-dinitro-*N*,*N*-dipropyl aniline]. In general, the effects of trifluralin and nitralin on spanish peanut seedlings were comparable, while benefin required approximately twice the concentration to produce an equal effect. In Brazil, trifluralin controlled certain weeds without damaging peanuts (15, 16), while Guse *et al.* (13) reported that peanuts tolerated benefin better than trifluralin. Buchanan *et al.* (6) found that trifluralin at rates as high as 4.48 kg ha^{-1} did not reduce stands of Florunner, Florigiant, or GK-3 peanuts. However, 2.24 kg ha^{-1} or more reduced the stand of Starr peanuts. Trifluralin at 1.12 kg ha^{-1} or less did not reduce yields of any peanut cultivars.

Brecke and Curry (5) found that ethalfluralin [*N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzenamine] did not cause injury to the peanut crop at any rate or time of application tested. Although it was not stated, it was presumed that runner peanuts were used in the test.

Pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] is a relatively new herbicide; however, no research has been conducted to determine its potential effects on peanut production. In greenhouse studies with soybeans, pendimethalin has been found to decrease nodulation (3, 8, 9), inhibit lateral root formation (8), and injure stem tissue (19). Pendimethalin increases shoot weight and nodulation in other leguminous plants (18).

The significance of early season herbicide injury has been the subject of some debate (10). Visual ratings of crop injury are standard components of herbicide evaluation trials but stunting and developmental responses are more difficult to rate than are other injury symptoms (10). Moderate injury, which the crop appears to outgrow under most conditions, may cause significant yield reduction under unfavorable growing conditions (7). Herbicide injury also reduces canopy growth rendering the crop less competitive with weeds.

The purpose of this study was to compare the effects of dinitroaniline herbicides applied before planting on percentage peanut grade [sound mature kernels (SMK)+ sound splits (SS)] and peanut yield of commonly used runner peanut varieties.

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[4] Agridex contains 83% paraffin base petroleum oil and 17% polyoxyethylated polyol fatty acid ester and polyol fatty acid ester, produced by Helena Chem.2 Co., 5100 Poplar Avenue, Memphis, TN 38137.

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Materiald and Methods

Field studies were conducted during 1988-1990 growing season at the Texas Agricultural Experiment Station located near Yoakum, Texas on a Tremona loamy fine sand (thermic Aquic Arenic Palenstalfs) with less than 1% organic matter and a pH of 7.0 to 7.2. Areas with low weed populations were selected to reduce labor for hand weeding.

Dinitroaniline herbicide treatments included trifluralin at 0.56 kg ha^{-1}, benefin at 1.68 kg ha^{-1}, pendimethalin at 1.12 kg ha^{-1}, and ethalfluralin at 1.25 kg ha^{-1}. A comparison treatment of sethoxydim [2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] at 0.34 kg ha^{-1}, bentazon [3-(1-methylethyl)-(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide] at 1.12 kg ha^{-1}, and 2,4-DB [4-(2,4-dichlorophenoxy)butanoic acid] at 0.34 kg ha^{-1} was also included.

Herbicides were applied in water with a compressed-air bicycle sprayer using Teejet 11002[3] flat fan nozzles which delivered a spray volume of 190 L ha^{-1} at 180 kPa. The dinitroaniline herbicides were applied preplant (PPI) and immediately incorporated to a depth of 6 cm with a tractor-driven power tiller. Sethoxydim, bentazon, and 2,4-DB, were applied postemergence (POST) to the plots as needed to control annual grasses, nutsedge, and broadleaf weeds, respectively. Sethoxydim, bentazon, and 2,4-DB included a non-phytotoxic crop oil[4] at 2.3 L ha^{-1}. POST applications were made when annual grasses and broadleaf weeds were 7 to 15 cm tall while nutsedge was treated when 15 to 20 cm tall.

Florunner, Southern Runner, Okrun, Tamrun 88, and GK-7 peanut cultivars were planted at the rate of 5 seed per 30 cm. Seeding depth was 6 cm and row spacing was 91 cm.

Treatments were arranged in a split-plot randomized complete block design with four replications. The main plot treatments were peanut variety, while subplot treatments were herbicide treatment. Main plots were 10 rows wide, while subplots were two rows wide. Row length was 9.1 m. Peanuts were planted June 17, June 5, and May 31 in 1988, 1989, and 1990, respectively. Peanuts were dug on October 27, 132 days after planting (DAP) in 1988, October 23, 140 DAP in 1989, and October 15, 137 DAP in 1990. Plots were irrigated with a sprinkler system throughout the growing season as needed. Leafspot and insect control was consistent with Extension Service recommendations. Due to low weed numbers in test area, hand weeding was not necessary in the dinitroaniline treated plots.

After digging, the peanuts were allowed to air dry in the field 4 to 6 days. Plots were then threshed by means of a stationary harvester. The pods were dried to 10% moisture and then cleaned of pegs, stems, and inert matter by hand. Grades were determined for a 250 g pod sample from each plot following procedures described by the Federal-State Inspection Service. All data were subjected to analysis of variance and Duncan's Multiple Range Tests.

Results and Discussion

Analysis of data indicated that the year by cultivar and year by herbicide interactions were significant for yield and percentage SMK+SS; therefore, each year is analyzed separately. No cultivar by herbicide or year by cultivar by herbicide interaction were observed.

No visual plant growth reduction was noted with any of the herbicide treatments (data not shown). Yield differences between herbicide treatments were significant only in 1989 (Table 1). In this year the POST treatment produced a 17 to 22% yield reduction compared with the dinitroaniline herbicides. Lower yields in 1989 with post herbicides may be because of early-season competition from weeds due to heavy early summer rains. These rains resulted in an abnormally high number of weeds in the test area and also prevented entry into the field to apply herbicides and hand weed the test area. Grichar and Boswell (12) stated that pod yields were greater in plots treated with a POST herbicide at the earlier stage of growth as compared to plots treated later in the growing season.

Differences in cultivar tolerance to the herbicide treatments evaluated were not apparent during either the 1988 or 1990 growing seasons (Table 1). In 1989, Southern Runner and GK-7 were significantly higher in yield than Okrun and Tamrun 88, regardless of the herbicide applied.

Table 1. Yield of peanut cultivars grown with five herbicide treatments (1988-1990).

	Years			
	1988	1989	1990	Mean
Treatment				
Herbicides:	kg ha^{-1}			
Sethoxydim	1940 a[1]	2840 b	2430 a	2400
Trifluralin	2150 a	3440 a	2360 a	2650
Benefin	1950 a	3650 a	2460 a	2690
Pendimethalin	2000 a	3600 a	2520 a	2710
Ethalfluralin	1980 a	3430 a	2440 a	2620
Cultivars:				
Florunner	2120 a	3470 ab	2240 a	2610
Southern Runner	2270 a	4030 a	2670 a	2990
Okrun	1890 a	2880 b	2580 a	2450
GK-7	1860 a	3850 a	2520 a	2740
Tamrun 88	1880 a	2740 b	2900 a	2510

[1]Means for each parameter within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Peanut grade (percentage SMK+SS) among herbicide treatment varied from year to year (Table 2). Pendimethalin significantly reduced grade when compared with the other herbicide treatments in each of three test years. In 1989, ethalfluralin resulted in significantly higher grade than the other herbicide treatments.

Cultivar grade response was not apparent in 1988, but varied considerably in 1989 and 1990 (Table 2). Southern Runner had significantly lower grade than Tamrun 88 in both 1989 and 1990. When averaged over the three year period, GK-7 and Tamrun 88 each produced a 7% higher grade than Southern Runner. The lower grade with Southern

Table 2. Peanut grade (SMK+SS) of peanut cultivars grown under five herbicide treatments (1988-1990).

	Years			
	1988	1989	1990	Mean
Herbicides:	SMK+SS[1]			
Sethoxydim	68.7 ab[2]	66.4 b	70.8 a	68.6
Trifluralin	69.3 a	67.5 b	70.4 ab	69.1
Benefin	69.2 a	67.2 b	69.6 ab	68.7
Pendimethalin	67.2 b	67.6 b	68.8 b	67.9
Ethalfluralin	67.0 b	69.9 a	70.2 ab	69.0
Cultivars:				
Florunner	67.5 a	67.5 ab	71.3 ab	68.8
Southern Runner	67.3 a	63.9 b	65.8 c	65.7
Okrun	67.9 a	67.1 ab	70.8 ab	68.6
GK-7	70.0 a	70.9 a	69.8 b	70.2
Tamrun 88	68.7 a	69.1 a	72.7 a	70.2

[1]Percentage sound mature kernels plus percentage sound splits.
[2]Means for each parameter within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Runner may be attributed to earlier than normal digging date for that variety (132 to 140 days after planting). Knauft *et al.* (14) reported that Southern Runner produced higher percentage total sound mature kernels (TSMK) than Florunner and Dixie Runner and that TSMK of Southern Runner increased as digging date was delayed.

Conclusion

This work as well as earlier work by Buchanan *et al.* (6) found that trifluralin, at label rates, did not adversely influence peanut grade or yield on runner type peanut cultivars. Buchanan *et al.* (6) also noted that at the highest rate of trifluralin, phytotoxic symptoms were more severe with deep incorporation (13 to 15 cm); however, yields were not significantly reduced.

Since no differences in yield of runner peanuts with the dinitroaniline herbicides were noted, concerns of problems with dinitroaniline herbicide injury may be due to other factors. Greer *et al.* (11) stated that proper incorporation of trifluralin was very important with spanish peanuts. Any type of incorporation equipment which is not properly adjusted can result in uneven herbicide distribution, resulting in concentrated zones within the soil which may inhibit lateral root development (4). Seed placement may also be a contributing factor. Greer *et al.* (11) stated that correct seed placement within the incorporated zone was very important. Peanut seed planted in the upper levels of the incorporation zone generally extend roots through the treated zone. Any factor which causes a slower rate of growth could result in considerable injury.

Lack of trifluralin injury on runner type peanut means that producers could apply trifluralin at a reduced cost compared to the other dinitroaniline herbicides. In addition, with the lack of herbicide injury, producers would not have to change herbicide programs with different peanut cultivars.

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