Use of F6285 for Weed Control in Peanut: Efficacy and Crop Injury[1,2]

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ABSTRACT

Field studies in 1991 and 1992 at Tifton and Attapulgus, GA evaluated the weed control efficacy and crop safety of F6285 on peanut. Treated peanut were stunted by F6285 and had chlorotic leaflet margins. The degree and persistence of injury varied according to rate of F6285. The lowest rate of F6285 (0.14 kg ai ha^{-1}) produced the aforementioned symptoms early in the season, but peanut recovered by late season with no yield effects ($P \leq 0.05$). F6285 at 0.28 and 0.42 kg ha^{-1} severely injured peanut and reduced yields. Preemergence and vegetative emergence applications of F6285 were equally injurious. F6285 effectively controlled yellow nutsedge at rates as low as 0.14 kg ha^{-1}, but sicklepod was not controlled at rates up to 0.42 kg ha^{-1}. F6285 controlled yellow nutsedge more effectively that standard treatments of metolachlor or imazethapyr, but crop injury from F6285 was greater ($P \leq 0.05$) than from other herbicides.

Key Words: *Arachis hypogaea*, *Cyperus esculentus*, peanut injury, phytotoxicity.

Yellow nutsedge (*Cyperus esculentus* L.) is a serious weed pest of peanut in the United States. Nutsedge spp., which includes yellow nutsedge, is ranked among the ten most common and troublesome weeds of peanut in every peanut producing state (4). Losses from yellow nutsedge include yield reduction from competition, harvest losses, contamination of harvested peanut, and costs of control. Contamination of harvested peanut with yellow nutsedge tubers is of particular concern to the peanut industry. Yellow nutsedge tubers occasionally escape removal during harvest, shelling, blanching, and processing operations, causing liability concerns among manufacturers of confectionery peanut products (2). Even though yellow nutsedge does not appear to be overly competitive (2), the unique nature of losses from harvest contamination makes improved control a high priority.

The major herbicides available for yellow nutsedge control in peanut are alachlor [2-chloro-*N*-(2,6-diethylphenyl)-*N*-(methoxymethyl)acetamide], bentazon [3-(1-methylethyl)-(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide], imazethapyr [(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid], metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-2-(methoxy-1-methylethyl)acetamide], and vernolate (*S*-propyl dipropylcarbamothioate). Alachlor and metolachlor control yellow nutsedge, but not purple nutsedge (*Cyperus rotundus* L.) (2,6,11). Furthermore, some growers are reluctant to use metolachlor due to its perceived injury potential (3,15), even though recent research has shown its safety when used at registered rates (5). Bentazon effectively controls yellow nutsedge postemergence (POST), but provides no residual control. Imazethapyr controls yellow and purple nutsedge preplant incorporated (PPI), preemergence (PRE), and POST (7), but has stringent crop rotation restrictions for its use. Vernolate controls yellow and purple nutsedge, but the duration of control can be reduced due to enhanced microbial degradation (5).

F6285 [2',4'-dichloro-5'-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1*H*-1,2,4-triazol-1-yl)methanesulfonanilide] is an experimental herbicide under development by FMC Corporation for use on soybean. F6285 controls several broadleaf weeds, annual grasses, and perennial sedges (8,12,14). The most effective time to apply F6285 is prior to crop and weed emergence. Uptake is through roots and shoots, with apoplastic movement in plants (13). Its mode of action is disruption of cell membranes.

The objective of the studies reported here were to determine the effectiveness of F6285 for weed control in peanut, particularly yellow nutsedge, and to quantify the phytotoxic effects of F6285 on peanut.

Materials and Methods

General information. Irrigated experiments were conducted in 1991 and 1992 at the Coastal Plain Experiment Station in Tifton, GA and the Attapulgus Research Farm in Attapulgus, GA. The soil type in Tifton was a Tifton loamy sand (thermic Plinthic Kandiudults), composed of 84% sand, 10% silt, and 6% clay with 0.3% organic matter in 1991 and 86% sand, 8% silt, and 6% clay with 0.7% organic matter in 1992. The soil type at Attapulgus was a Lucy loamy sand (thermic Arenic Kandiudults), composed of 84% sand, 10% silt, and 6% clay with 0.7 and 0.9% organic matter in 1991 and 1992, respectively.

Land was moldboard plowed 23 cm deep 2 d before planting at both locations. Plots were 6.1 m long and 1.8 m wide. 'Florunner' peanut was planted with a two-row planter at a seeding rate of 112 kg ha^{-1} in rows 91 cm apart. Cultural and pest management practices were based on recommendations by the Georgia Cooperative Extension Service. Timing of harvest was based on optimum maturity of the nontreated control in each experiment.

Herbicide treatments at Tifton were applied with a tractor-mounted compressed air plot sprayer calibrated to deliver 234 L ha^{-1} at 207 kPa with flat fan nozzle tips. Herbicide treatments at Attapulgus were applied with a CO_2 backpack sprayer calibrated to deliver 234 L ha^{-1} at 207 kPa with flat fan tips. A nonionic surfactant[4] at 0.13% by vol. was included with all paraquat (1,1'-dimethyl-4-4'-bibypyridinium) applications and 0.25% by vol. with F6285 and imazethapyr applied at vegetative emergence (VE).

Data from both experiments and years were subjected to analysis of variance to determine sources of variation and significant interactions. Differences in treatment means were determined using Fisher's Protected Least Significant Difference Test at $P \leq 0.05$.

F6285 phytotoxicity. F6285 phytotoxicity studies were conducted in Tifton. The experimental design was a randomized complete block with four replications using a factorial arrangement of five PRE and four VE treatments. Ethalfluralin [*N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzenamine] at 0.8 kg ai ha^{-1} was applied to the entire experiment PPI. Weeds not controlled by herbicides were removed by hand throughout the season. Plots were planted on 31 May 1991 and 2 June 1992.

[1]Cooperative investigations of the USDA Agric. Res. Ser. and the Univ. of Georgia Agric. Exp. Stn., Tifton. All programs and services of the U.S. Department of Agriculture are offered on a nondiscriminatory basis without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

[2]Mention of a trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the USDA or the University of Georgia and does not imply it approval to the exclusion of other products or vendors that may also be suitable.

[3]Research Agron., USDA-ARS and Agric. Res. Stat., Univ. of Georgia, Coastal Plain Exp. Stn., Tifton, GA 31793-0748.

[4]X-77 (a nonionic surfactant containing alkylaryl-polyoxyethylene glycols, free fatty acids, and isopropanol). Valent U.S.A. Corp., P.O. Box 8025, Walnut Creek, CA 94596-8025.

[5]Indicates two herbicides applied as a tank mixture.

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PRE herbicide treatments were F6285 (0.14, 0.28, and 0.42 kg ai ha^{-1}), metolachlor (2.8 kg ai ha^{-1}), and a nontreated control. Metolachlor was chosen as a standard treatment since it is commonly applied PRE and can be injurious to peanut under certain conditions (3,15). Treatments applied VE were F6285 (0.14 and 0.28 kg ha^{-1}), bentazon (0.6 kg ai ha^{-1}) +[5] paraquat (0.14 kg ai ha^{-1}), and a nontreated control. The standard treatment of bentazon + paraquat is commonly applied at VE for weed control in peanut and can be moderately injurious.

Visual estimations of injury were made 39 and 77 days after emergence (DAE) in 1991, and 49 and 80 DAE in 1992. Peanut canopy width was measured 35 DAE in 1991 and 49 DAE in 1992. Biomass was collected 68 DAE in 1991 and 59 DAE in 1992. Samples were collected from a one-meter section of row, separated into pods and vegetative components, dried at 38 C for 72 hr, and weighed. Yields were measured from the remainder of the plot using a peanut combine.

F6285 efficacy. Efficacy studies were conducted in Attapulgus in fields with extremely heavy natural populations of yellow nutsedge and moderate populations of sicklepod (*Cassia obtusifolia* L.). The experimental design was a randomized complete block using a factorial arrangement of four PRE and four VE herbicide applications with four replications. Plots were planted on 16 May 1991 and 4 May 1992. Pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] at 1.1 kg ai ha^{1} was applied PPI as a blanket treatment across the entire experiment.

PRE herbicides were F6285 (0.14 and 0.28 kg ha^{-1}), metolachlor (2.8 kg ha^{-1}), and a nontreated control. Metolachlor was chosen since it is widely used for yellow nutsedge control in peanut. VE herbicides were F6285 (0.14 and 0.28 kg ha^{-1}), imazethapyr (0.071 kg ai ha^{-1}), and a nontreated control. Imazethapyr is commonly used at VE for yellow nutsedge control.

Visual estimations of yellow nutsedge and sicklepod control were made 30 and 72 DAE each year. Yields were measured from the entire plot with a peanut combine.

Results and Discussion

Rainfall for herbicide activation were optimum both years. In 1991 at the Tifton location, 2.2 cm rainfall occurred 24 hr after PRE application. Similarly, in 1992 2.5 cm of rainfall occurred 48 hr after PRE application. Soil moisture at planting in 1991 was optimum for peanut seed germination. In 1992 at Tifton, the soil was very dry and loose at planting. Soil conditions and subsequent rainfall encountered in 1992 were similar to those correlated with severe metolachlor injury (3).

Analysis of variance of the F6285 phytotoxicity study indicated significant effects of PRE and VE treatments on peanut growth and yield; however, interactions were nonsignificant. In the efficacy study, interactive effects of PRE and VE treatments on weed control were significant.

F6285 phytotoxicity. F6285 stunted peanut and produced interveinal chlorosis in peanut leaflets, especially toward the leaflet margin. PRE applications visually injured peanut in early season both years (Table 1). By late season in 1991 and 1992, peanut treated with 0.14 kg ha^{-1} recovered. PRE applications at 0.42 kg ha^{-1} reduced peanut growth throughout the season. Metolachlor reduced peanut growth, only in 1992 and at the early ratings. VE applications of F6285 reduced peanut growth throughout the season, with little difference between rates. F6285 injury was more severe and persistent than injury from the standard VE treatment of bentazon + paraquat.

Early season peanut canopy width was reduced by both PRE and VE applications of F6285, with the highest rates causing the most inhibition. Metolachlor applied PRE and bentazon + paraquat applied VE reduced canopy width only in 1992.

Gross differences in biomass values between years are due to the earlier sampling date in 1992. However, we feel that the relative treatment effects between years are the same. PRE applications of F6285 reduced vegetative biomass, with progressively greater reductions as rates increased. All VE applications of F6285 reduced vegetative biomass. PRE applications of metolachlor reduced vegetative biomass only in 1992. Bentazon + paraquat had no effect on biomass.

F6285 applied PRE at 0.28 and 0.42 kg ha^{-1} reduced pod biomass, but not at 0.14 kg ha^{-1}. VE applications of F6285 at 0.14 kg ha^{-1} did not reduce pod biomass, but 0.28 kg ha^{-1} was

Table 1. Main effects of selected PRE and VE treatments on peanut growth and yield in weed-free conditions.

		Early season visual injury†		Late season visual injury‡		Canopy width§		Vegetative biomass¶		Pod biomass¶		Total yield	
Herbicide	Rate	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
	kg ai ha^{-1}	%				cm		gm^{-1}				kg ha^{-1}	
PRE# treatment													
none	—	4	3	0	0	69	67	1730	340	86.5	4.0	4420	3650
F6285	0.14	23	11	5	3	58	62	1330	320	71.4	4.9	4290	3400
F6285	0.28	51	24	19	8	40	51	1050	210	39.8	2.2	3640	3180
F6285	0.42	74	58	44	31	26	33	600	110	20.5	0.5	2710	1880
metolachlor	2.8	4	16	0	3	68	57	1470	240	83.3	2.2	4430	3120
LSD (0.05)		9	7	11	6	7	4	300	50	17.0	1.2	580	330
VE# treatment													
None	—	22	18	7	5	60	57	1370	280	66.5	3.6	4240	3400
F6285	0.14	37	23	19	9	46	53	1040	240	59.1	2.5	3610	3030
F6285	0.28	46	38	24	18	43	44	1120	170	52.6	1.5	3470	2430
bent. + para.#	0.6 + 0.14	20	11	5	3	59	61	1410	290	63.2	3.5	4260	3340
LSD (0.05)		8	6	10	5	6	4	270	40	15.2	1.1	520	300

†Early season visual estimations of phytotoxicity were made 39 and 49 DAE in 1991 and 1992, respectively.

‡Late season visual estimations of phytotoxicity were made 77 and 80 DAE in 1991 and 1992, respectively.

§Canopy width measured 35 and 49 DAE in 1991 and 1992, respectively.

¶Foliage and pod biomass measured 68 and 59 DAE in 1991 and 1992, respectively.

#Abbreviations: bent., bentazon; para., paraquat; PRE, preemergence; VE, vegetative emergence.

inhibitory. Metolachlor reduced pod biomass in 1992. Bentazon + paraquat applied VE consistently had no effect on pod biomass.

Peanut yields were reduced both years by PRE applications of F6285 at 0.28 and 0.42 kg ha^{-1}, and VE applications at 0.28 kg ha^{-1}. The standard PRE treatment of metolachlor reduced yield only in 1992, while the standard VE treatment of bentazon + paraquat consistently had no effect on peanut yield.

Vegetative growth estimations and quantitative measurements are in general agreement. All rates at both times of application of F6285 reduced early season growth, as indicated by the subjective visual estimations of injury and the objective measurements of peanut growth parameters. Peanut pod biomass indicated that PRE applications of F6285 at 0.14 kg ha^{-1} had only a temporary effect. However, the obvious stunting and chlorosis from F6285, even at the lowest rate, will likely create concern among growers. Furthermore, severe early stress can delay maturity, hamper other weed control efforts, and, depending on mid-season growing conditions, reduce yields (1,10). Mid-season drought or heat stress could inhibit the ability of peanut to recover from F6285 injury, even at 0.14 kg ha^{-1}.

F6285 efficacy. F6285 effectively controlled yellow nutsedge throughout the season at all rates when applied either PRE or VE (Table 2). Sequential applications were not necessary to control yellow nutsedge. Metolachlor PRE, or imazethapyr VE did not consistently control yellow nutsedge when used alone. Sequential applications of metolachlor and imazethapyr were needed to provide consistent control.

Sicklepod was not controlled by either PRE, VE, or sequential applications of F6285. Sequential applications of metolachlor and imazethapyr controlled sicklepod better than any of the F6285 treatments. However, the level of sicklepod control provided by metolachlor followed by imazethapyr was greater than expected and is usually not adequate for maximum peanut yields, unless additional control measures are used (personal observation).

Despite the high weed density, peanut yields did not consistently reflect the level of yellow nutsedge and sicklepod control provided by the herbicides. Rather, peanut yields were often a reflection of the degree of herbicide injury. Single or sequential applications of F6285 at a total rate >0.28 kg ha^{-1} significantly injured peanut (data not shown) and resulted in low yields. F6285 applied either PRE or VE at 0.14 kg ha^{-1}, or sequential applications of F6285 totalling 0.28 kg ha^{-1} controlled yellow nutsedge and produced acceptable yields.

Both peanut and yellow nutsedge are sensitive to F6285, while sicklepod is somewhat tolerant. The lowest rate of F6285 evaluated in this study (0.14 kg ha^{-1}) consistently controlled yellow nutsedge. However, the lowest rate caused obvious early season stunting and chlorosis of peanut, even though peanut pod biomass and final yield were not reduced. Until the lowest effective rate of F6285 is found that consistently controls yellow nutsedge without early season stunting and chlorosis of peanut, its utility in peanut production is questionable.

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Table 2. Efficacy of F6285 on yellow nutsedge and sicklepod in peanut.

PRE treatment†		VE treatment‡		CYPES-early†‡		CYPES-late†‡		CASOB-early†‡		CASOB-late†‡		Yield	
herbicide	rate	herbicide	rate	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
	kg ai ha^{-1}		kg ai ha^{-1}					%				kg ha^{-1}	
F6285	0.14	F6285	0.14	95	95	95	95	75	79	71	79	2340	3420
		F6285	0.28	95	95	95	95	83	78	80	63	1900	2750
		imazethapyr	0.071	93	94	95	95	86	82	83	86	1780	3040
		nontreated	——	95	93	95	95	77	84	75	83	2340	2780
F6285	0.28	F6285	0.14	95	95	95	95	81	76	77	71	2280	2130
		F6285	0.28	95	95	95	95	85	72	80	63	2110	1910
		imazethapyr	0.071	95	94	95	95	80	76	74	78	2000	2910
		nontreated	——	95	95	95	95	81	78	73	72	1930	2490
metolachlor	2.8	F6285	0.14	94	93	95	94	83	84	75	82	1780	3080
		F6285	0.28	95	95	95	95	81	78	75	77	2450	3430
		imazethapyr	0.071	95	87	95	93	87	89	81	92	1710	2920
		nontreated	——	95	82	95	84	86	79	81	75	1680	2540
nontreated		F6285	0.14	94	95	95	95	80	81	72	83	2110	2430
		F6285	0.28	95	94	95	95	83	85	75	76	1680	3240
		imazethapyr	0.071	75	60	95	84	78	82	72	84	2010	2800
		nontreated	——	0	0	0	0	0	0	0	0	1830	2850
LSD (0.05)				5	6	0	7	10	10	14	16	720	920

†Abbreviations: CASOB, sicklepod; CYPES, yellow nutsedge; PRE, preemergence; VE, vegetative emergence.
‡Early and late efficacy ratings made 30 and 72 DAE both years.

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