DPX-PE350 for Weed Control in Peanut (*Arachis hypogaea* L.)

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ABSTRACT

Field experiments were conducted in 1991 and 1992 in Georgia to determine the efficacy of DPX-PE350 when applied either preplant incorporated (PPI), preemergence (PRE), and early postemergence (EPOST) at rates of 40, 80, or 120 g ae ha^{-1} for weed control in peanut. Species evaluated included coffee senna [*Cassia occidentalis* (L.)], Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.], prickly sida (*Sida spinosa* L.), smallflower morningglory [*Jacquemontia tamnifolia* (L.) Griseb.], sicklepod (*Cassia obtusifolia* L.), and yellow nutsedge (*Cyperus esculentus* L.). Sicklepod was controlled better with either PPI or PRE applications than with EPOST. Coffee senna control was more consistent with DPX-PE350 applied EPOST. DPX-PE350 controlled prickly sida and smallflower morningglory regardless of application method and rate. DPX-PE350 did not control Florida beggarweed when soil applied. PPI applications were more injurious to peanut than PRE or EPOST applications. Peanut yields tended to decrease as DPX-PE350 rates increased.

Key Words: Acifluorfen, bentazon, paraquat, pendimethalin, 2,4-DB, application method, *Cassia obtusifolia, Cassia occidentalis, Cyperus esculentus, Desmodium tortuosum, Jacquemontia tamnifolia, Sida spinosa.*

Coffee senna, Florida beggarweed, yellow and purple nutsedge, sicklepod, and smallflower morningglory are among the most troublesome broadleaf weeds in the southeastern peanut production area (12). Currently, herbicides applied to the soil at planting do not adequately control these weeds, and postemergence applied (POST) herbicides often are necessary to provide season-long control. Although combinations of paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) and bentazon [3-(1-methylethyl))-(1*H*)-2,1,3-ben-zothiadiazon-4(3*H*)-one 2,2-dioxide] provide POST control, neither herbicide provides residual control and additional POST applications are often necessary for season-long control (12). A soil-applied herbicide that controls these weeds throughout the season may reduce trips across the field and herbicide load in the environment.

DPX-PE350 [sodium 2-chloro-6-(4,5-dimethoxy-pyrimidin-2-ylthio] is currently being evaluated for soil-applied and POST control of annual broadleaf weeds in cotton (*Gossypium hirsutum* L.)(9). DPX-PE350 is a new herbicide similar to the sulfonylurea and imidazolinone herbicide families. This herbicide controls numerous broadleaf weeds (1, 2, 4, 6, 7, 8), some of which are among the most prevalent and difficult weeds to control in peanut (*Arachis hypogaea* L.) (12). DPX-PE350 provided season long control of pitted morningglory (*Ipomoea lacunosa* L.), entireleaf morningglory (*Ipomoea integriuscula* var. *integriuscula* Gray), and prickly sida when soil-applied or POST (4). Additionally, DPX-PE350 provided sicklepod control when applied PPI or PRE, but was ineffective when applied POST (3, 5).

Therefore, field experiments were conducted with the following objectives: a) to determine the feasibility of using DPX-PE350 applied PPI, PRE, or EPOST for weed control in peanut, b) to determine peanut tolerance of DPX-PE350, and c) to compare weed control and peanut yield with DPX-PE350 when compared to a commercial standard weed management system.

Materials and Methods

Efficacy study. Experiment I was conducted in 1991 and 1992 at the Coastal Plain Experiment Station at Tifton, GA on a Tifton loamy sand (Plinthic Paleudults) with 0.9% organic matter and pH 5.6. The experiment was also conducted in 1992 at Midville, GA on a Dothan loamy sand (Typic Kandiudults) with 0.7% organic matter and pH 5.8. Peanut cv. Florunner was planted May 14, 1991 and April 29, 1992 at Tifton and May 8, 1992 at Midville. Peanut seeds were planted at 112 kg ha^{-1}, 5 cm deep in a well-prepared flat seedbed using conventional equipment. Individual plots were two rows, spaced 91 cm apart and 6.1 m long.

Each test area was treated with pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] applied PPI at 1.12 kg ai ha^{-1}. DPX-PE350 was applied at 40, 80, and 120 g ha^{-1} in a factorial treatment arrangement with three methods of application which included PPI, PRE, and EPOST applications. Additional treatments included pendimethalin PPI, and pendimethalin PPI followed by (fb) paraquat at 0.14 kg ai ha^{-1} plus bentazon at 0.28 kg ae ha^{-1} applied EPOST fb a POST application of paraquat plus bentazon at 0.56 kg ai ha^{-1} plus 2,4-DB at 0.28 kg ae ha^{-1} (referred to as the "commercial standard"). PPI herbicides were applied with a CO_2-pressurized tractor-mounted sprayer calibrated to deliver 187 L ha^{-1} using 11002LP nozzles at 140 kPa and incorporated 8 cm deep with a vertical-action tiller. PRE, EPOST, and POST herbicide applications were made with a CO_2-pressurized backpack sprayer at the same spray volume and pressure as was used to apply PPI herbicides. Weed densities ranged from 2 to 15 plants per m^2 for each species and broadleaf weeds were in the cotyledon to one-leaf and cotyledon to six-leaf stage at the time of EPOST and POST applications, respectively. Yellow nutsedge was 15 to 20 cm and 20 to 30 cm tall when herbicides were applied EPOST and POST, respectively. A nonionic surfactant[3] at 0.25% (v/v) was included with all EPOST and POST applications.

The experimental design was a randomized complete block, and treatments were replicated three times. Visual estimates of percent weed control on a scale of 0% to 100% where 0% = no control and 100% = complete control were recorded in early August at Midville in 1992 and in mid-August and early September at Tifton in 1991 and 1992, respectively. Peanut injury was visually estimated approximately 3 weeks after EPOST treatment. Foliar chlorosis, stunting, and reduction in plant population were parameters used in making the visual estimates. Peanuts were harvested mechanically at maturity using conventional harvesting equipment.

Tolerance study. Planting and herbicide application procedures at Midville were identical to the efficacy studies. Pendimethalin at 1.12 kg ha^{-1} was applied PPI over the entire test area. DPX-PE350 was applied at 45 and 60 g ha^{-1} in a factorial treatment arrangement with three timings or methods of application including PPI, EPOST, and POST. Additional treatments included imazethapyr [(+)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid] at 70 g ae ha^{-1} plus paraquat at 0.14 kg ha^{-1} applied at EPOST and paraquat plus bentazon at 0.56 kg ha^{-1}, plus 2,4-DB at 0.28 kg ha^{-1} applied POST. A nonionic surfactant[3] at 0.25% (v/v) was included with all EPOST and POST applications. The experimental design was a randomized complete block with three replications.

Visual estimates of percent peanut injury were recorded approximately 3 weeks after the final herbicide application of a given treatment and at the end of the season for the parameters described in the efficacy studies.

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[2]Spraying Systems Co., Wheaton, IL 60187.

[3]X-77 Spreader (mixture of alkylarylpolyoxyethylene glycols, free fatty acids, isopropanol). Valent USA Corp., North California Blvd., Walnut Creek, CA 94596.

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Peanuts were mechanically harvested at maturity with commercial equipment customized for small plot research.

Statistical analysis. Data for the efficacy studies were subjected to analysis of variance with basic partitioning for a four by three (DPX-PE350 rate by application method) factorial treatment arrangement. Data for DPX-PE350 rates within a method of application and methods of application within each rate of DPX-PE350 were subjected to analysis of variance for the factorial arrangement of treatments. Additional analysis was performed to include pendimethalin PPI and the commercial standard. Data for the tolerance study were subjected to analysis of variance for a three by three (DPX-PE350 rate by application method or timing) factorial treatment arrangement. Additional analysis was performed that included combinations of imazethapyr plus paraquat EPOST and paraquat plus bentazon plus 2,4-DB POST. Means of significant main effects and interactions were separated by Fisher's Protected LSD.

Results and Discussion

Weed control. Prickly sida and smallflower morningglory were controlled at least 91% by all DPX-PE350-containing treatments, with no response to either rate or method of application detectable. This control was equivalent to the commercial standard of paraquat plus bentazon EPOST fb paraquat plus bentazon plus 2,4-DB POST (data not shown). Other research has shown good control of prickly sida with soil applications of DPX-PE350 (3). Previous work demonstrated that smallflower morningglory was susceptible to 45 or 110 g ha^{-1} of DPX-PE350 at the six-leaf stage or smaller (4, 5), and DPX-PE350 at 56, 110, or 170 g ha^{-1} controlled at least 92% of prickly sida when applied at the one- to two-leaf stage (7). Imazethapyr, which was registered for use in peanut in May 1991, also provides residual control of these two species (12). No other currently- registered herbicide in peanut provides residual control of these two weed species.

The interaction of treatment by location was significant for coffee senna control. In general, coffee senna control was lower at Tifton in 1991 than at Midville, with control at Midville being at least 93% regardless of the rate or method of DPX-PE350 application. The better coffee senna control at this location was attributed to irrigation of 3 cm the day after PRE application (data not shown). Control at Tifton in 1991 with DPX-PE350 at 40 g ha^{-1} applied EPOST exceeded control with the same rate applied PPI or PRE (Table 1). Additionally, PRE control was 17% higher than control with a PPI application when DPX-PE350 was applied at 40 g ha^{-1}. Coffee senna control increased with increased rate of DPX-PE350 application PPI, but not with PRE or EPOST applications. DPX-PE350 at 40 g ha^{-1} or more PRE or EPOST or 80 g ha^{-1} or more PPI controlled coffee senna equivalent to the commercial standard.

There was a significant location by treatment interaction for sicklepod control. Consequently, sicklepod control is discussed by location. Unlike coffee senna, DPX-PE350 controlled sicklepod better either as a PPI or PRE application than as an EPOST application at Tifton in both years.

Sicklepod control at Tifton in 1991 with PPI applications was at least 96% with the two higher rates of DPX-PE350 compared to 73% control with 40 g ha^{-1}. At Tifton in 1992, sicklepod control was at least 93% with all PPI and PRE applications. In 1992, the test was irrigated with 3 cm of water immediately after PRE herbicide application to insure germination in the dry soil. This irrigation may have accounted for the better control seen at Tifton in 1992 than in 1991. Control from PPI applications at Tifton in 1992 or with PRE applications at both locations was not influenced by rate of application. Sicklepod control at both locations was equivalent as PPI and PRE applications.

EPOST sicklepod control was less than 30% with all rates of DPX-PE350. Previous research indicated DPX-PE350 soil-applied controlled sicklepod whereas POST applications were less effective (2, 3). However, poor control of sicklepod

Table 1. Influence of DPX-PE350 application rate and method for coffee senna and sicklepod control. Experiment I.

DPX-PE350 rate	Method of application											
	Coffee senna				Sicklepod							
	Tifton 91				Tifton 91				Tifton 92			
	PPI	PRE	EPOST	LSD[a]	PPI	PRE	EPOST	LSD	PPI	PRE	EPOST	LSD
g ha^{-1}	%											
40	56	73	86	22	73	69	0	18	93	100	0	16
80	86	81	100	NS	96	63	29	28	100	100	16	9
120	95	93	95	NS	97	86	22	12	93	94	0	23
LSD[b]	5	NS	NS		17	NS	12		NS	NS	9	
LSD (Rate X Method)		19				16				16		
Additional treatments[c]												
Pend. PPI		0				0				0		
Pend. PPI fb												
par. + bent. EPOST												
par. + bent. + 2,4-DB												
POST		90				76				66		
LSD (any 2 means)		19				16				16		

[a]For comparison of means within a rate of DPX-PE350.

[b]For comparison of means with in a method of application.

[c]Abbreviations for herbicides: pend., pendimethalin; par., paraquat; bent., bentazon.

with DPX-PE350 soil-applied in cotton also has been reported (9). At Tifton in 1991, DPX-PE350 applied PPI at the two higher rates controlled sicklepod better than the commercial standard. At Tifton in 1992, all PPI and PRE DPX-PE350 applications controlled sicklepod better than the commercial standard. No currently- registered herbicide in peanut controls sicklepod as a soil application (12). Registration of DPX-PE350 in peanut may reduce current management inputs in peanut for sicklepod control.

Florida beggarweed control was essentially the reverse of sicklepod, with DPX-PE350 being more effective when applied EPOST than when soil-applied (Table 2). PRE applications provided better control than PPI applications; however, control was 26% or less with either application method. EPOST applications controlled Florida beggarweed similarly at all rates and control ranged from 53 to 60%. This level of control was comparable to the commercial standard. Dowler (2) reported Florida beggarweed control with DPX-PE350 applied POST. DPX-PE350 provides burn-down control of Florida beggarweed but has marginal soil activity as evidenced by lack of control with PPI and PRE applications (5). Subsequently, later germinating Florida beggarweed escaped control.

Yellow nutsedge control with all rates of DPX-PE350 applied either PPI, PRE, or POST was similar to the commercial standard. Generally, only suppression of yellow nutsedge was noted. The population of yellow nutsedge was not uniform at this location resulting in variability in the control ratings. Vidrine *et al.* (11) reported good control of yellow nutsedge in cotton with POST applications of DPX-PE350. Other research has shown suppression of yellow nutsedge (Wilcut, unpublished data).

Peanut tolerance study. A significant treatment by location interaction was observed for peanut injury. Increasing the DPX-PE350 rate applied PPI increased visual peanut injury at Tifton in 1991 (Table 3). Injury was ≤13% with the two lower rates, but increased to 35% with 120 g ha^{-1}. Injury from PPI applications ranged from 8 to 44% at the other two locations; however, injury was not affected by DPX-PE350 rate. Numerically though, injury was commercially unacceptable (>30%) with the two higher rates soil-applied. When DPX-PE350 was applied at 120 g ha^{-1}, injury from PPI applications was greater at two of three locations when compared with PRE or EPOST applications. The peanut at Tifton and Midville in 1992 were irrigated within 24 h of PRE application and may have contributed to the higher injury observed at these two locations. Jordan *et al.* (7) reported greater cotton injury from DPX-PE350 soil-applied compared to POST applications. However, they reported greater injury was higher with PRE compared to PPI applications. Injury with the commercial standard was 7% at Tifton in 1991 and 1992 and 15% at Midville in 1992.

Talbert *et al.* (10) reported 32 to 52% injury of spanish peanut 'Spanco' four weeks after either PRE or POST application of DPX-PE350 at 50 to 100 g ha^{-1}. Peanut were irrigated within one day of PRE application and this may have contributed to the high injury. Additionally, cultivar selection may explain the difference in peanut response to POST applications.

Pooled over locations and regardless of the method of application, peanut yield decreased as the DPX-PE350 rate increased. Although yield reductions were significant only with PPI applications (Table 4). Yields were similar with all methods of DPX-PE350 applied at 40 or 80 g ha^{-1}. Yield with DPX-PE350 at 40 g ha^{-1} PPI exceeded yield of peanuts treated with 80 or 120 g ha^{-1} PPI. Additionally, yield was lower with the 120 g ha^{-1} rate applied PPI than with the same rate applied PRE or EPOST. The lower yield with this rate of DPX-PE350 was most likely a result of injury. Injury of peanut at all three locations with this treatment was between

Table 2. Influence of DPX-PE350 application rate and method for Florida beggarweed and yellow nutsedge control. Experiment 1[a].

DPX-PE350 rate	Florida beggarweed PPI	PRE	EPOST	LSD[a]	Yellow nutsedge PPI	PRE	EPOST	LSD
g ha^{-1}	%							
40	0	16	60	11	74	44	81	NS
80	0	17	58	19	63	54	70	NS
120	0	26	53	22	59	60	75	NS
LSD[c]	NS	NS	NS		NS	NS	NS	
LSD (Rate X Method)		13				28		
Additional treatments[d]								
Pend. PPI		0					0	
Pend. PPI fb par. + bent. EPOST par. + bent. + 2,4-DB POST		55					59	
LSD (any 2 means)		13					28	

[a]Data are from location 2.
[b]For comparison of means within rate of DPX-PE350.
[c]For comparison of means within a method of application.
[d]Abbreviations for herbicides: pend., pendimethalin; par., paraquat; bent., bentazon.

Table 3. Influence of DPX-PE350 application rate and method on peanut injury. Experiment I, 1991-1992.

DPX-PE350 rate	Method of application											
	Tifton 1991				Tifton 1992				Midville 1992			
	PPI	PRE	EPOST	LSD[a]	PPI	PRE	EPOST	LSD	PPI	PRE	EPOST	LSD
g ha^{-1}	%											
40	0	3	6	NS	15	0	2	NS	8	7	5	NS
80	8	8	13	NS	31	22	18	NS	37	10	10	NS
120	32	14	6	16	37	27	24	NS	44	12	12	26
LSD[b]	12	NS	6		NS	NS	17		NS	NS	NS	
LSD (Rate X Method)		9				NS				21		
Additional treatments[c]												
Pend.[c] PPI		0				0				0		
Pend. PPI												
par. + bent. EPOST												
par. + bent. + 2,4-DB												
POST		7				7				15		
LSD (any 2 means)		9				NS				21		

[a]For comparison of means within a rate of DPX-PE350.
[b]For comparison of means within a method of application.
[d]Abbreviations for herbicides: pend., pendimethalin; par., paraquat; bent., bentazon.

32 and 44%.

DPX-PE350 at 40 g ha^{-1} provided yields equivalent to the commercial standard regardless of the method of application (Table 4). With the exception of DPX-PE350 at 120 g ha^{-1} PPI, peanut yield with all combinations of DPX-PE350 rates and methods of application and the commercial standard exceeded yield when pendimethalin was the only herbicide applied.

Table 4. Influence of DPX-PE350 application rate and method on peanut yield. Experiment 1.

DPX-PE350 rate	Method of application			
	PPI	PRE	EPOST	LSD[a]
g ha^{-1}	kg ha^{-1}			
40	3840	3880	3810	NS
80	3260	3420	3440	NS
120	2960	3310	3360	300
LSD[b]	490	NS	NS	
LSD (Rate X Method)		460		
Additional treatments[d]				
Pend. PPI		2690		
Pend. PPI fb				
par. + bent. EPOST				
par. + bent. + 2,4-DB				
POST		4270		
LSD (any 2 means)		460		

[a]For comparison of means within a rate a DPX-PE350.
[b]For comparison of means within a method of application.
[d]Abbreviations for herbicides: pend., pendimethalin; par., paraquat; bent., bentazon.

Table 5. Inluence of DPX-PE350 application rate and method on peanut tolerance. Experiment 2[a].

DPX-PE350 rate	Application method	Injury[b] Early	Late	Yield
g ha^{-1}		%		kg ha^{-1}
45	PPI	12	5	6170
60	PPI	19	8	5930
45	EPOST	13	7	6040
60	EPOST	15	5	5990
45	MPOST	7	6	5940
60	MPOST	8	5	5160
LSD (0.05)				
within rates and across methods or timings		NS	NS	NS
within methods or timings across rates		NS	NS	NS
LSD (Rate X Method/Timing)		NS	NS	NS
Additional treatments[c]				
Pend. PPI fb imaz. + par. EPOST		10	3	5880
Pend. PPI fb par. + bent. + 2,4-DB POST		7	6	6600
LSD (any 2 means)		NS	NS	810

[a]Early ratings were taken three weeks after the final herbcide application of a given treatment. Late ratings were taken at the end of the season.
[b]Abbreviations for herbicides: pend., pendimethalin; imaz., imazethapyr; par., paraquat; bent., bentazon.

In the tolerance study there was no difference in injury 4 weeks after treatment or at the end of the season regardless of the rate or method of DPX-PE350 application (Table 5). Additionally, DPX-PE350 had no adverse effect on yield at the rates applied in this experiment. Injury and peanut yield from DPX-PE350-treated peanuts were similar to the applications consisting of imazethapyr plus paraquat or bentazon plus paraquat plus 2,4-DB. These results are in agreement with those from the efficacy studies which showed only minor injury when DPX-PE350 was applied at 40 or 80 g ha^{-1}.

Summary

These data indicated that soil applications of DPX-PE350 can provide better sicklepod control than the commercial standard. Currently, no other soil-applied peanut herbicide controls sicklepod. Sicklepod control with either PPI or PRE applications was more effective than EPOST applications. Conversely, coffee senna and Florida beggarweed control was more consistent with EPOST application. Although Florida beggarweed control was only 60% with EPOST applications, this control equaled that of the commercial standard. DPX-PE350 controlled prickly sida and smallflower morningglory regardless of application method or rate. Soil applications followed by rain or irrigation may result in unacceptable injury, especially when the rate is $\geq$80 g ha^{-1}. These data also indicated that increased weed control with DPX-PE350 rates above 40 g ha^{-1} did not increase peanut yield possibly due to greater peanut injury with the higher rates.

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