Eclipta (*Eclipta prostrata* L.) Control in Peanuts (*Arachis hypogaea* L.) with Soil-Applied Herbicides

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ABSTRACT

Field studies were conducted in 1992 through 1994 to determine the most effective eclipta control in peanuts with soil-applied herbicides. Sonalan, Prowl, Treflan or Dual in combination with Pursuit provided greater than 80% control at three of four test locations. Prowl applied preplant incorporated plus the experimental herbicide V-53482 applied preemergence and Frontier applied preplant incorporated or preemergence controlled > 90% eclipta at three of four locations. Herbicide systems which included Cobra and the experimental herbicide, RH-1658, applied preemergence resulted in > 90% control at all locations. Effective eclipta control resulted in up to a five-fold increase in peanut yield over plots with no control.

Keywords: preplant incorporated, preemergence, groundnut, weed control

Eclipta is a herbaceous plant native to Asia (Holm et al., 1977). It is a member of the Aster family and is reported to be a weed in 17 crops in 35 countries around the world (Holm et al., 1977). Its distribution in North America is primarily in the southern U.S., lower Midwest and along the East Coast (Steyermark, 1981).

Eclipta can be an annual or perennial plant, depending on where it grows. In South Africa and India, eclipta grows as an annual and as a perennial. In the Philippines, it flowers all year round and has been known to produce more than 17,000 seeds per plant (Holm et al., 1977). As a seedling, it has small spatulate cotyledons, but as it matures, stems may be prostrate or grow up to 90 cm in height. Eclipta can root at the nodes. As eclipta matures, it can become reddish brown to purplish in color. It may be distinguished by the white flowers, the two-rowed, involveral bracts and the absence of a pappus (Holm et al., 1977).

Eclipta can be a troublesome weed in cotton (*Gossypium hirsutum* L.), peanuts, rice (*Oryza sativa* L.), soybeans [*Glycine max* (L.) Merr.] and various ornamentals (Altom and Murray, 1992; Altom and Murray, 1993; Berchielli-Robertson et al., 1989; Crawford and Leake, 1992; Sharma and Amritphale, 1988; Smith, 1988; Wilcut et al., 1991b; York and Worsham, 1992). It is usually found on poorly drained wet areas, along streams and ditches, in marshes and on the dikes of rice paddies. However, it is also common in lawns and in upland conditions where rainfall is 48 inches or more. Once introduced into a field, eclipta spreads quickly

Accepted 10 Apr 1996. This study was partially funded by the Texas Peanut Producers Board. Kevin Brewer, Michael Dolle and David Sestak provided technical assistance and Doris Yost prepared the manuscript. *Corresponding author.

and becomes a severe weed problem. Melouk et al. (1992) reported that eclipta serves as a host for Sclerotinia blight, caused by the fungus *Sclerotinia minor* Jagger. Sclerotinia blight infects approximately 25% of Oklahoma peanut fields and can reduce yields 25 to 50% (Jackson et al., 1993). Therefore, eclipta can be important both as a weed and a disease host.

In Oklahoma, eclipta infests about 10,000 acre of irrigated peanuts (Melouk et al., 1992) and infestations are frequently observed after heavy rains. Similar observations have been reported in Georgia (Anonymous, 1992). In Texas, the weed has gradually spread south from the Red River area. Eclipta has become a serious problem in central Texas and can now be found in areas of south and east Texas (authors' personal observation).

In the Southeast, eclipta control was found to be more consistent with Lasso or Dual applied preemergence (PRE) when followed with Blazer postemergence (POST) plus Basagran mixtures or a timely POST Paraquat application (Wilcut et al., 1991a). Pursuit applied preplant incorporated (PPI) or PRE provides good control at 0.095 lb ai $acre^{-1}$, but at the registered rate of 0.063 lb ai $acre^{-1}$ control is inconsistent (Wilcut et al., 1991b).

The objectives of this study were to (i) evaluate various soil-applied herbicides for control of eclipta in peanuts, and (ii) determine, whenever possible, the effect of eclipta control on peanut yields.

MATERIALS AND METHODS

Studies were conducted in 1992 through 1994 in producers' fields in Eastland County near Rising Star, TX, and in Wilson County near Floresville, TX, in 1993. The soil in Eastland County was a Windthorst, loamy, fine sand (fine, mixed, thermic Udic Paleustalfs) with less than 1% organic matter. The soil in Wilson County was a Poth, loamy, fine sand (clayey, mixed, hyperthermic Arenic Paleustalfs) with 1% organic matter.

The experimental design was a randomized complete block with treatments replicated three times. Plots consisted of two rows 15 to 25 ft long and spaced on 36 to 38 inch centers. All field plots were naturally infested with high populations of eclipta (2 to 5 plants ft^{-2}). No other broadleaf weeds were present in the test area. Poast was used POST to control Texas panicum (*Panicum texanum* Buckl.) and southern crabgrass [*Digitaria ciliaris* (Retz.) Koel.].

Sprinkler irrigation was applied as needed throughout the growing season. Herbicides were applied in water with a compressed-air bicycle sprayer using Teejet 11002 flat fan nozzles (Spraying Systems Co., Wheaton, IL.) which delivered a spray volume of 20 gal $acre^{-1}$ at 26 psi. PPI herbicides were incorporated immediately to a depth of 2-1/2 inches with a tractor-driven power tiller. PRE herbicides were applied immediately after peanuts were planted. Ground cracking (GC) treatments were applied approximately one week after peanut planting or when peanuts were beginning to emerge. POST treatments were applied 2 to 3 weeks after peanut emergence.

The schedule of events for conducting these studies is listed in Table 1. 'Florunner' peanuts were planted at each test location. Peanuts were not harvested in Eastland County in 1993 because of an early freeze in late October which destroyed the peanut plants. In 1994, peanuts at this location were dug but not

harvested because of 4 wk of continuous rainfall. In Wilson County, peanuts were dug early because of grower concerns about the spread of eclipta seed.

Data collected included visual estimates of crop injury and weed control on a scale of 0% (no control or peanut injury) to 100% (complete control or death of the peanuts) relative to the untreated check. Weed control and peanut injury were usually estimated early-, mid- and late-season during each year of the study. Only late-season ratings taken two to three weeks prior to digging of peanuts are presented.

Peanut yields were determined by digging the pods, air-drying in the field for 4 to 6 days and harvesting individual plots with a combine. Weights were recorded after soil and trash were removed from the samples.

Visual estimates and peanut yields were subjected to an analysis of variance over years and differences between means were determined with Fisher's Protected LSD Test at the 5% level of probability. Visual weed control ratings were subjected to arcsine transformation prior to analysis of variance. Original data are used for presentation.

Table 1. Schedule of events for conducting the eclipta study in peanut.

	Experiment location and years			
	Eastland County			Wilson Co.
Events	1992	1993	1994	1993
Preplant herbicides applied and incorporated	June 10	May 27	June 2	May 18
Peanuts planted	June 10	May 27	June 2	May 18
Preemergence herbicides applied	June 10	May 27	June 2	May 18
Ground cracking herbicides applied	--	June 5	June 9	May 27
POST herbicides applied	June 26	July 20	June 28	June 18
Peanuts dug	Oct 28	--	Oct 31	Sept 20
Peanuts combined	Nov 3	--	--	Sept 24

RESULTS AND DISCUSSION

Eclipta control data were not combined over years because some of the treatments were not at every test location and because of the varying rainfall conditions each year of the study. Peanut yields were not analyzed over years because of different harvest dates between the Eastland and Wilson County studies.

Below average rainfall amounts were received at the Eastland County site early in the growing season in 1992, while in 1993 there was above average rainfall during the early part of the growing season and extremely heavy rainfall at peanut harvest. However, at the Wilson County location in 1993, excessive rainfall was prevalent through the early portion of the growing season with moderate rainfall thereafter. The 1994 season was characterized as below average rainfall early in the growing season with normal to above average rainfall during the latter part of the season.

Eclipta control

Complete control of eclipta was difficult to obtain; however, several herbicides used alone or in combinations provided consistent control. Eclipta was more difficult to control at the Wilson County location because of the excessive amount of rainfall received during the early portion of the growing season.

Sonalan alone effectively controlled (85%) eclipta at only one of four locations (Table 2). The addition of Pursuit to Sonalan improved control over Sonalan alone 12 to 50%. No rate response was evident when the rate of Sonalan was increased. When Pursuit was added to the other dinitroaniline herbicides (Treflan or Prowl), eclipta control was > 85% in seven of ten instances. Jordan et al. (1993) reported poor eclipta control with a dinitroaniline herbicide (Prowl) alone.

V-53482 is an N-phenyl phthalimide experimental herbicide and is currently being evaluated for soil-applied control of several weeds in peanuts (Eastin et al., 1993; Grey et al., 1993; Grichar and Boyd-Robertson, 1992; Zorn et al., 1993). Grey et al. (1993) reported that V-53482 controls morningglory (*Ipomoea* spp.), Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.] and prickly sida (*Sida spinosa* L.). Zorn et al. (1993) and Eastin et al. (1993) found no activity with V-53482 on yellow nutsedge (*Cyperus esculentus* L.) or sicklepod (*obtusifolia* L.).

V-53482 applied alone provided erratic eclipta control (20 to 100%). However, Prowl (PPI) followed by V-53482 (PRE) improved eclipta control 31 to 64% at 2 of 3 locations (Table 1). A rate response with V-53482 was apparent at the Wilson County location.

Pursuit at 0.095 lb ai acre^{-1} applied PPI or PRE controlled eclipta $\geq$ 90% at one of two locations (Table 2). Pursuit at 0.063 lb ai acre^{-1} provided inconsistent control ranging from 27 to 92%. Wilcut et al. (1991b) reported eclipta control with 0.063 lb ai $^{-1}$ of Pursuit ranged from 67 to 75% when applied PPI, PRE or GC. They stated that 0.095 lb ai acre^{-1} of Pursuit was necessary for good control.

While Dual alone controlled eclipta > 85% at three of four locations, the addition of Pursuit to Dual applied PPI improved control 57% in Wilson County (Table 2). Dual plus Pursuit applied PPI controlled eclipta 23% better than Dual plus Pursuit applied PRE in Wilson County.

Excellent season-long control (> 90%) of eclipta at all locations was observed with herbicide systems which included Dual plus Cobra applied GC followed by

Cobra or Cobra plus Butoxone POST or Prowl plus Dual applied PPI followed by Blazer plus Butoxone applied POST. Jordan et al. (1993) found that Dual applied PRE followed by Cobra applied at GC and early postemergence (EPOST), or EPOST plus late postemergence (LPOST) or LPOST controlled eclipta completely. Many growers in the Southwest are reluctant to apply Dual PPI or PRE because of potential peanut injury when planting is closely followed by moderate to heavy rains (authors' personal observation).

The use of a POST treatment of Blazer plus Butoxone following Prowl plus Dual improved eclipta control over Prowl plus Dual applied alone by 23 and 73% in Eastland and Wilson Counties, in 1993. An early study in Virginia, has shown that Dual applied PRE, followed by Blazer plus Basagran applied POST, controlled eclipta 100% (Wilcut et al., 1991b).

Prowl plus Dual (PPI) followed by Pursuit or Cadre applied POST controlled eclipta $\geq$ 88% in Eastland County, but less than 70% in Wilson County (Table 1). However, there was at least a 41% improvement in eclipta control over Prowl plus Dual applied alone at the Wilson County location. Wilcut et al. (1991b) reported POST applications generally provided the least control of broadleaf weeds of any of the application timings with Pursuit. The difference in control of broadleaf weeds was attributed to differential metabolism of Pursuit between tolerant and susceptible species (Cole et al., 1989). They further reported that the amount of Pursuit metabolized varied with site of uptake. Thus, metabolism and tolerance varied with method of application and may explain the observed differences in field efficacy. The activity of other translocated herbicides also has been reported to be influenced by site of application (Baird et al., 1989; Petersen and Swisher, 1985).

RH 1658 controlled > 90% eclipta with no observed rate response (Table 2). Little is known about the chemistry of this herbicide, but it does have good activity against Palmer amaranth (*Amaranthus palmeri* S. Wats) and hophornbeam copperleaf (*Acalypha ostryifolia* Riddell) as well as yellow nutsedge (authors' personal observation).

Frontier, at rates of 1.0 to 1.25 lb ai acre^{-1}, applied PPI or PRE, controlled eclipta $\geq$ 93% at three of four test sites. At the Wilson County location, eclipta control was < 55%. Dual alone controlled eclipta $\geq$ 88% at three of four locations. Jordan et al. (1993) reported Dual applied PRE alone controlled eclipta only 59%. Previous work suggests that chloroacetamide herbicides, applied PRE, may differ in efficacy under certain rainfall conditions. Shrefler et al. (1994) noted that for soils high in organic matter, Lasso and Frontier produced better annual grass control than with Dual when < 0.4 inch of rainfall was received during the first week following herbicide application.

Peanut yield

Only slight peanut injury was observed from any of the herbicidal treatments (data not shown). Peanut yields were reduced up to 58% in Eastland County and 84% in Wilson County when eclipta was not effectively controlled (Table 2). In Eastland County, Sonalan plus Pursuit applied PPI increased yields 136% compared with the untreated check. Even low numbers of eclipta plants can effect peanut yields because the roots of eclipta are very fibrous and can become intertwined with peanut pods (authors' personal observation).

Table 2. Influence of herbicides on eclipta control and peanut yield.

Treatment	Rate	Application timing‡	Eclipta Control† Eastland 1992	Eastland 1993	Eastland 1994	Wilson 1993	Peanut yield Eastland 1992	Wilson 1993
	lb ai acre^{-1}						------lbs acre^{-1}------	
Check			0	0	0	0	1670	270
Sonalan	1.12	PPI	47	37	85	17	3300	290
Sonalan	0.75	PPI	95	87	97	43	3950	630
+Pursuit	+0.063							
Sonalan	1.12	PPI	88	78	100	43	2740	930
+Pursuit	+0.063							
V-53482	0.06	PRE	65	100	-	20	3120	410
Pursuit	0.063	PRE	73	92	-	27	3380	590
Pursuit	0.094	PPI	-	90	-	43	-	970
Pursuit	0.094	PRE	-	100	-	40	-	520
Dual	1.5	PRE	95	88	95	13	3990	320
Dual	1.5	PPI	86	98	-	70	3090	1150
+Pursuit	+0.063							
Dual	1.5	PRE	96	100	100	47	2690	680
+Pursuit	+0.063							
Dual	1.5	CRACK/	-	100	93	98	-	1270
+Cobra/	0.25/							
Cobra	0.2	POST						
Dual	1.5	CRACK/		100	93	95	-	1470
+Cobra/	0.25/							
Cobra	0.2	POST						
+Butoxone	+0.25							
Prowl	0.75	PPI	-	90	97	30	-	680
+Pursuit	+0.063							
Prowl	1.0	PPI	100	87	52	87	2850	700
+Pursuit	+0.063							
Prowl	1.0	PPI	95	72	87	22	2860	270
+Dual	+1.5							
Prowl	1.0	PPI/	100	95	100	95	2370	1380
+Dual/	+1.5/							
Blazer	0.25	POST						
+Butoxone	+0.25							
Prowl	1.0	PPI/	98	88	-	68	2260	990
+Dual/	+1.5/							
Pursuit	0.063	POST						
Prowl	1.0	PPI	96	99	-	63	2380	810
+Dual/	+1.5/							
Cadre	0.032	POST						
Prowl/	1.0/	PPI/	93	100	-	51	3490	790
V-53482	0.06	PRE						
Prowl/	1.0/	PPI/	90	100	-	84	3850	700
V-53482	0.09	PRE						
RH-1658	0.07	PRE	-	100	93	94	-	1020
RH-1658	0.27	PRE	-	100	-	100	-	1740
Frontier	1.0	PRE	-	95	95	53	-	610
Frontier	1.25	PPI	97	100	100	49	3610	410
Frontier	1.25	PRE	93	100	100	40	2690	660
Treflan	0.5	PPI	97	92	-	33	3500	290
+Pursuit	+0.063							
LSD (0.05)			23	20	23	36	1120	530

†Control index: 0=no control; 100=complete control.

‡PPI=preplant incorporated; PRE=preemergence; CRACK=peanut cracking; POST=postemergence.

In Wilson County, RH-1658 at 0.27 lb ai acre^{-1} improved peanut yield over the untreated check by 540%. Ten herbicide treatments resulted in at least a 300% yield increase over the untreated check (Table 2). Since eclipta growth is sometimes limited to lower wet areas of a peanut field, peanut yields can be reduced because of poor soil conditions. Eclipta compounds the poor yield problem in these areas. Variable peanut yields are due in part to field locations. These trials were located in the lower areas of the field where eclipta was usually more uniform. These low areas also held water longer and the waterlogged conditions resulted in variable peanut plant growth.

This research indicates that effective eclipta control in peanut is possible with a proper herbicide program. Two herbicides presently available to growers, a dinitroaniline herbicide in combination with Dual or Pursuit, consistently controlled eclipta. Following soil-applied herbicides with Blazer plus Butoxone controlled many of the escaped eclipta plants. Several herbicides not yet cleared for use in peanuts, Frontier, RH-1658 and Cobra, show the most promise for effective control of eclipta.

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