Florida Beggarweed *(Desmodium tortuosum)* and Sicklepod *(Senna obtusifolia)* Control in Peanut Using Herbicides Applied Through a Wick-Bar[1]

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ABSTRACT

Tall weeds in peanut fields cause losses other that yield reduction from competition by intercepting fungicides and insecticides, and interfering with harvest efficiency. Studies were conducted at Archer, FL and Tifton, GA in 1994 and 1995 to determine an effective means to selectively control tall Florida beggarweed and sicklepod late season in peanut using herbicides applied with a wick-bar. Herbicides evaluated were glyphosate, paraquat, and dimethylalkylamine salt of endothall (DMAA endothall); each applied at 0, 25, 50, 75, and 100% by volume. Treatments were applied in two passes at opposite directions midseason at both locations. Glyphosate and paraquat, at concentrations as low as 25% by volume, effectively controlled Florida beggarweed and sicklepod at both locations. DMAA endothall did not adequately control Florida beggarweed or sicklepod at either location, regardless of rate. Peanut yields were not increased by weed control from any herbicide applied with a wick-bar. The only benefits from late-season Florida beggarweed and sicklepod control with a wick-bar appear to be improved fungicide deposition and more efficient mechanical harvest.

Key Words: *Arachis hypogaea* L., rope-wick, weed control.

Broadleaf weed management in peanut is generally based on the use of preplant or preemergence herbicides to provide short-term control or suppression, followed by timely applications of an array of postemergence herbicides. Rarely are either application groupings effective when used alone. Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.] and sicklepod [*Senna obtusifolia* (L.) Irwin and Barneby] are examples of broadleaf weeds that occasionally escape early season control and require follow-up control efforts mid- to late season. There are options available to control these weeds with mid- and late season herbicides, including chlorimuron {2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid} for Florida beggarweed control and 2,4-DB [4-(2,4-dichlorophenoxy)butanoic acid] for sicklepod control. Midseason control with either herbicide is often substandard due to the large size of the weeds at the time of treatment. Tall weeds, such as Florida beggarweed and sicklepod, over-top the peanut canopy generally around midseason and then logarithmically increase in height until senescence or harvest (Cardina and Brecke, 1991; Barbour and Bridges, 1995). By late season, these weeds can be 60 to 120 cm taller than the peanut canopy (unpubl. data).

Controlling large dicot weeds such as Florida beggarweed and sicklepod at mid- or late season does not directly improve peanut yield. Usually, these weeds already have been present long enough to reduce peanut yield by competition. Hauser *et al.* (1975, 1982) showed that allowing Florida beggarweed and sicklepod to compete with peanut for at least 70 d reduced peanut yields. From this it can be extrapolated that removing Florida beggarweed and sicklepod after 70 d of competition did not negate yield losses resulting from competition.

Tall weeds in peanut cause additional indirect losses other than yield reduction from competition. Royal *et al.* (1997) showed that Florida beggarweed, sicklepod, and cocklebur (*Xanthium strumarium* L.) intercepted significant amounts of chlorothalonil (tetrachloroisophthalonitrile) applied to peanut for early leaf spot (*Cercospora arachidicola* Hori.) and late leaf spot [*Cercosporidium personatum* (Berk. and Curt.) Deighton] control, causing corresponding increases in leafspot. Similarly, tall weeds prevent peanut from being dug and inverted efficiently (Wilcut *et al.*, 1994). Large weeds with woody roots and stems also cause excessive wear on peanut combines at harvest. These losses can be minimized by controlling tall weeds at mid- or late season.

Glyphosate [*N*-(phosphonomethyl)glycine] is a nonselective herbicide that can be applied selectively to weeds taller than the crop using specialized equipment, including recirculating sprayers and wipe-on devices (Ross and Lembi, 1985). A recirculating sprayer directs a horizontal stream of herbicide solution above the crop canopy that is either intercepted by tall weeds or collected and recirculated into the spray tank. Glyphosate applied through a recirculating sprayer is an effective means of controlling tall Florida beggarweed and sicklepod in peanut (Hauser and Buchanan, 1978).

A wipe-on applicator is simpler in concept and design than a recirculating sprayer and is more widely used. The wipe-on applicator is generally a nonpressurized system that uses an array of wick devices to wipe the herbicide solution on tall weeds without contact with the crop. A wick-bar herbicide applicator is a type of wipe-on applicator made from PVC pipe, filled with a herbicide solution and saturates a series of overlapping wicks. The wick-bar is usually mounted on the front of a tractor

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or high-clearance sprayer. By adjusting the height of a wick-bar, herbicides are selectively applied to the upper portion of tall weeds with nominal contact with the crop.

An inherent disadvantage of a wipe-on applicator is the need to apply the herbicide to both sides of a tall weed for optimum efficacy, resulting in two applications in opposite directions. Despite the additional cost of application, a wipe-on applicator is a practical, cost effective means of controlling tall weeds since the herbicide is applied precisely to a weed and without wasteful applications where weeds are not present. The amount of herbicide solution applied is dependent on weed density; i.e. greater weed density results in more contact with the herbicide saturated wipers and more herbicide used. Glyphosate is currently the only herbicide registered to be applied with a wipe-on applicator. However, no herbicides are currently registered for use on peanut with a wipe-on applicator, including glyphosate (Anonymous, 1998).

Given the unique nature of losses that tall weeds cause in peanut production and inconsistent efficacy from currently registered herbicides in controlling tall weeds, there is a need to devise new means of control to minimize losses. Therefore, studies were initiated in 1994 to evaluate several herbicides and herbicide concentrations applied with a wick-bar to control tall Florida beggarweed and sicklepod in peanut.

Materials and Methods

Field studies were conducted in 1994 and 1995 at the Coastal Plain Experiment Station near Tifton, GA and on the Archer Farm near Gainesville, FL. The soil at Tifton was a Tifton loamy sand (thermic Plinthic Kandiudults); pH 6.5, 92% sand, 2% silt, and 6% clay with 0.5% organic matter in 1994 and pH 6.4, 86% sand, 8% silt, and 6% clay with 0.9% organic matter in 1995. The soil at Gainesville in both years was an Arrendondo fine sand (hyperthermic Grossarenic Paleudults); pH 6.4, 86% sand, 10% silt, and 4% clay with 0.5% organic matter.

Plots were two rows wide × 6.1 m long. Row spacing was 91 cm at Georgia and 76 cm at Florida. The cultivars were Georgia Runner and Sunrunner in Georgia and Florida, respectively. These cultivars are among the most commonly planted cultivars in the southeastern U. S. Peanut were seeded in Georgia on 3 May 1994 and 28 April 1995. Peanuts were seeded in Florida on 3 May 1994 and 16 May 1995.

The entire experimental area was treated with a preplant incorporated application of ethalfluralin [*N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)-benzenamine] at 0.8 kg ai/ha to control annual grasses and small-seeded dicot weeds. Bentazon [3-(1-methylethyl)-1(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide] at 1.1 kg ai/ha plus Agridex (a crop oil concentrate containing 83% paraffin base petroleum oil and 17% polyoxyethylated polyol fatty acid and polyolfatty acid ester) (Helena Chemical Co., Memphis, TN) adjuvant at 1.0% by volume was applied as needed to control yellow nutsedge (*Cyperus esculentus* L.). Plots were cultivated with a sweep cultivator twice as needed, leaving the remaining dicot weeds in the row. Cultural, insect, and disease management practices were based on recommendations by the Georgia and Florida Coop. Ext. Serv.

The experimental design was a split-plot with treatments replicated four times. Main plots were herbicides applied through a wick-bar; glyphosate (Roundup®, 480 g ai/L, Monsanto Co., St. Louis, MO), paraquat (Starfire®, 180 g ai/L, Zeneca Ag Products, Wilmington, DE), (1,1'-dimethyl-4,4'-bipyridinium ion), and the dimethylalkylamine salt of endothall (Hydrothol 191®, 240 g ai/L, Elf Atochem North America, Inc., Philadelphia, PA) (DMAAendothall) [7-oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid]. Subplots were herbicide concentrations in the wick-bar applicator; 0, 25, 50, 75, and 100% by volume.

Treatments were applied with a custom made wick-bar applicator made from PVC pipe 10.1 cm in diameter and 1.8 m in length. Wicks were set in the PVC pipe with grommets and o-rings to control the flow of herbicide solution through the wicks. One wick-bar applicator was prepared for each herbicide to prevent contamination among herbicides. Within a given herbicide, the most dilute rates were applied first to minimize contamination of concentrations. The wick-bar applicator was mounted on the front of a tractor on a hydraulically controlled frame to allow adjustment according to weed and crop height. Wick-bar height was adjusted to achieve maximum coverage of the weeds and minimum contact with the peanut canopy.

Florida beggarweed was present at both locations during both years. Sicklepod was present in Florida in 1994 and in Georgia in 1995. Florida beggarweed and sicklepod densities were heavy (11 to 44 plants/m^2) at both locations during both years. In Georgia, treatments were applied 71 and 87 d after emergence (DAE) in 1994 and 1995, respectively. Treatments were applied in Florida 84 and 67 DAE in 1994 and 1995, respectively. These application timings correspond with R6 to R7 stage of peanut growth, which is generally the beginning of peanut maturity (Boote, 1982). At the time of treatment, Florida beggarweed and sicklepod were 30 to 60 cm taller than the peanut canopy. All herbicide treatments were applied with two consecutive passes, in opposite directions, at a ground speed of 3.2 km/hr.

Parameters measured were visual estimates of weed control and peanut injury, and yield. Weed control ratings were made in Georgia 32 and 16 d after treatment (DAT) in 1994 and 1995, respectively, and weed control ratings were made in Florida 49 and 42 DAT in 1994 and 1995, respectively. Estimations of weed control and peanut injury were based on the nontreated control in each main-plot (0 = no control or injury, 100 = complete control or injury). Yields were measured by digging, inverting, windrow curing, and combining peanut using commercial two-row implements. Yield samples from both locations were cleaned mechanically to remove all foreign material, and yields from both locations are reported as clean, farmers stock peanut.

All data were subjected to analysis of variance and regression analysis, where $^+$, *, and ** indicate $P \leq 0.10$, 0.05, and 0.001, respectively. The regression analysis was based on the principles outlined by Draper and Smith (1981) using

$$\bar{Y} = a + bx \qquad \text{[Eq. 1]}$$

where Y = parameter being measured, a = intercept, b = slope, and x = X - X or midpoint of herbicide rate range. Significant treatment by year and treatment by location interactions prevented data being pooled. Therefore, data are presented separately for each year and location.

Results and Discussion

Florida Beggarweed Control. Glyphosate and paraquat at concentrations between 25% and 50% by volume controlled Florida beggarweed > 85% at both locations both years (Figs. 1 and 2). Efficacy was similar for paraquat and glyphosate. Concentrations greater than 50% by volume of either herbicide did not improve weed control. DMAA endothall did not effectively control Florida beggarweed, regardless of concentration. However, overall Florida beggarweed control with DMAA endothall was better in 1995 than in 1994. The viscous nature of DMAA endothall delayed saturation of the wicks, resulting in very poor efficacy in 1994. Modifications in the experimental protocol were made in 1995 to allow more time for DMAA endothall to saturate the wicks and control of Florida beggarweed was better in 1995 than in 1994. Even with improved performance in 1995, DMAA endothall applied with a wick-bar applicator did not control Florida beggarweed as well as either glyphosate or paraquat.

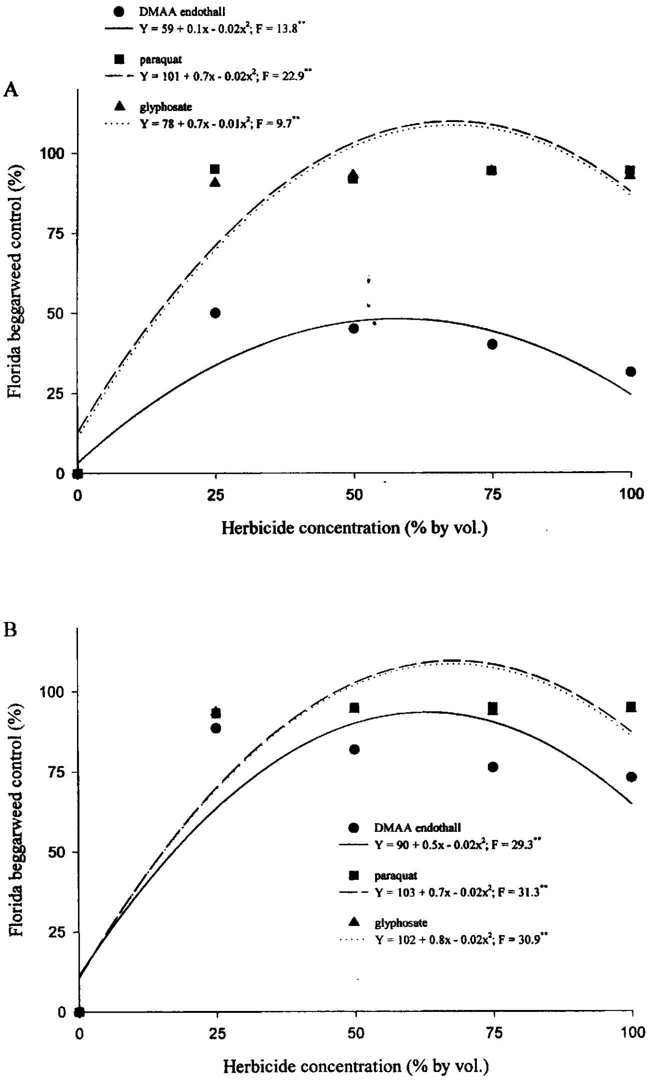

Fig. 1. Efficacy of herbicides applied through a wick-bar for Florida beggarweed control at Tifton, GA; A = 1994, B = 1995; x = X - $\bar{X}$, according to Draper and Smith (1981).

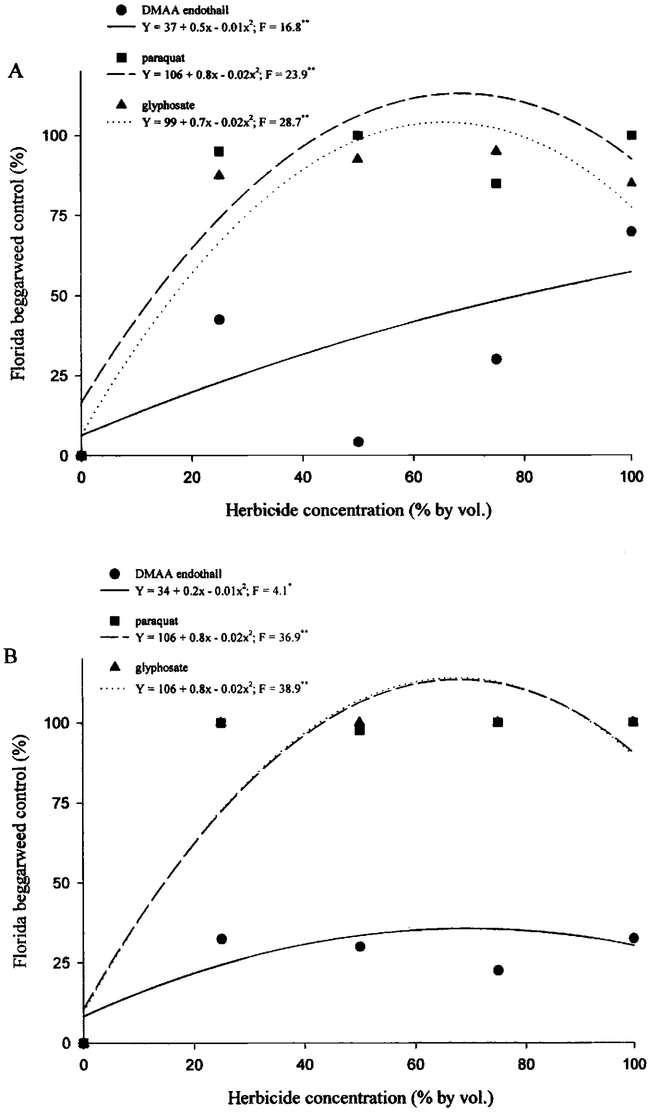

Fig. 2. Efficacy of herbicides applied through a wick-bar for Florida beggarweed control at Archer, FL; A = 1994, B = 1995; x = X - $\bar{X}$, according to Draper and Smith (1981).

Sicklepod Control. Sicklepod was effectively controlled (> 85%) by glyphosate and paraquat applied through a wick-bar applicator at Florida in 1994 (Fig. 3A) and Georgia in 1995 (Fig. 3B). Predicted response of sicklepod to either glyphosate or paraquat showed that the most effective concentration was approximately 50% by volume. This rate response is similar to that observed with Florida beggarweed (Figs. 1 and 2). DMAA endothall applied with a wick-bar applicator did not effectively control sicklepod at Florida in 1994 (Fig. 3A). However, sicklepod control improved in 1995 at Georgia with DMAA endothall (Fig. 3B). Improved sicklepod control with DMAA endothall was consistent with the improved Florida beggarweed control in 1995 (Figs. 1 and 2). Although efficacy was superior with paraquat and glyphosate, allowing more time for DMAA endothall to saturate the wicks improved sicklepod control.

Visual Peanut Injury. Paraquat was the most inju-

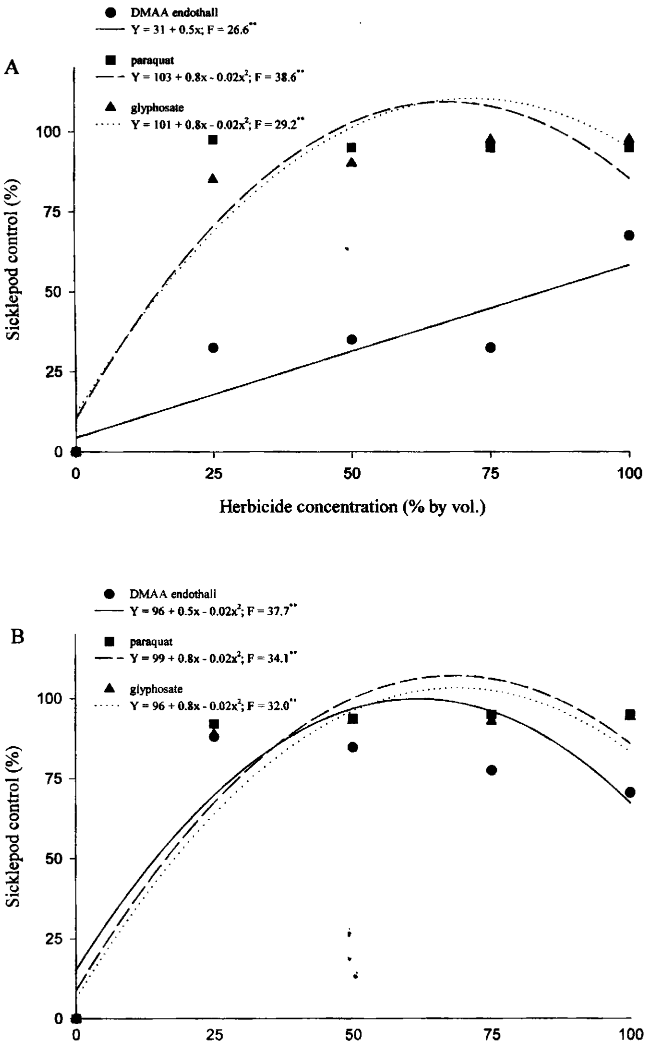

Fig. 3. Efficacy of herbicides applied through a wick-bar for sicklepod control; A = Archer, FL (1994), B = Tifton, GA (1995); x = X - $\bar{X}$, according to Draper and Smith (1981).

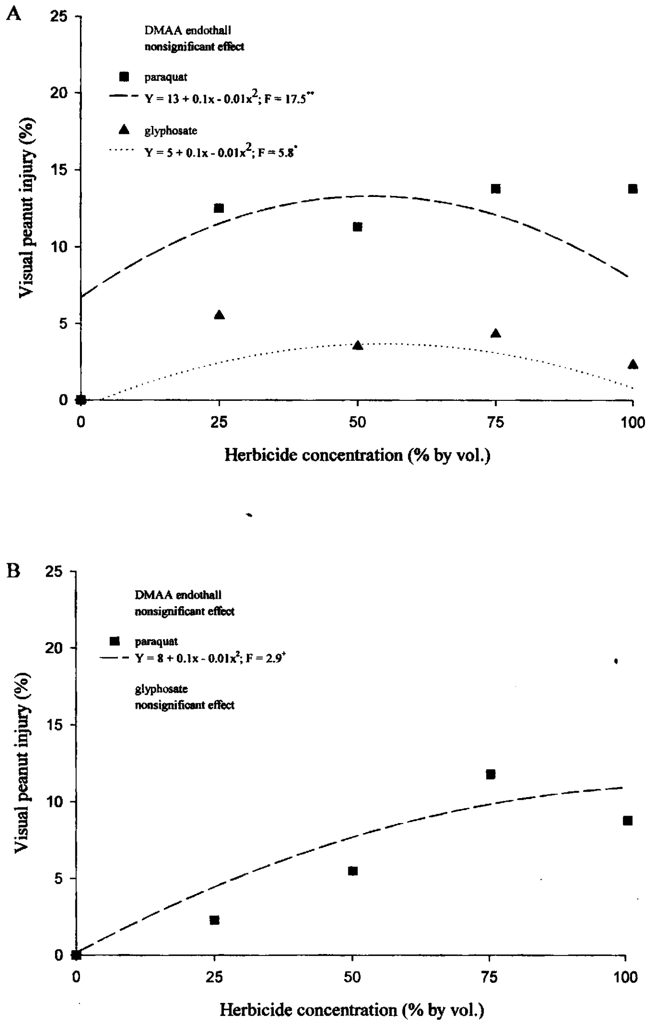

Fig. 4. Visual injury of peanut from herbicides applied through a wick-bar at Tifton, GA; A = 1994; B = 1995; x = X - $\bar{X}$, according to Draper and Smith (1981) (+ = $P \leq 0.10$).

rious herbicide applied through a wick-bar in Georgia both years (Fig. 4). However, glyphosate was more injurious at Florida (Fig. 5). Glyphosate, a systemic herbicide, stunted peanut growth. Injury from paraquat, a contact herbicide, was expressed as necrotic spots, which developed rapidly but did not appear to produce long-lasting effects. The difference in injury ratings between the two locations was likely due to the time differential for injury symptom development between glyphosate and paraquat, and visual injury ratings made 3 to 4 wk later at the Florida location than in Georgia. DMAA endothall did not injure peanut since little dripped due to the viscosity of the herbicide solutions.

Peanut Yield. Peanut yields were not improved by weed control with any of the herbicides applied with a wick-bar device (Fig. 6). In Georgia, the predicted yield response from weed control with a wick-bar applicator showed yield reduction with increasing rates of glyphosate. In contrast, peanut yields showed little response to weed control with paraquat and no response to weed control with DMAA endothall. Similarly, peanut yield response from weed control with a wick-bar applicator could not be predicted at the Florida location (data not shown). The inability to regress herbicides and rates with peanut yields is further evidence that peanut yields do not directly respond to late-season weed control. The lack of positive yield response to Florida beggarweed and sicklepod control with a wick-bar applicator is consistent with results of Hauser *et al.* (1975) that showed early season weed control is necessary for optimum peanut yields and late-season control will not necessarily increase yields.

In these trials, glyphosate and paraquat applied with a wick-bar applicator were equally effective in controlling Florida beggarweed and sicklepod at concentrations between 25% and 50% by volume. In areas outside the research plots, we observed that paraquat at 25% by volume effectively controlled other tall weeds treated late in the season; common ragweed (*Ambrosia artemisiifolia* L.), bristly starbur (*Acanthospermum hispidum* DC.), and hairy indigo (*Indigofera hirsuta* L.) (unpubl. data). Clearly, several tall weed species can be

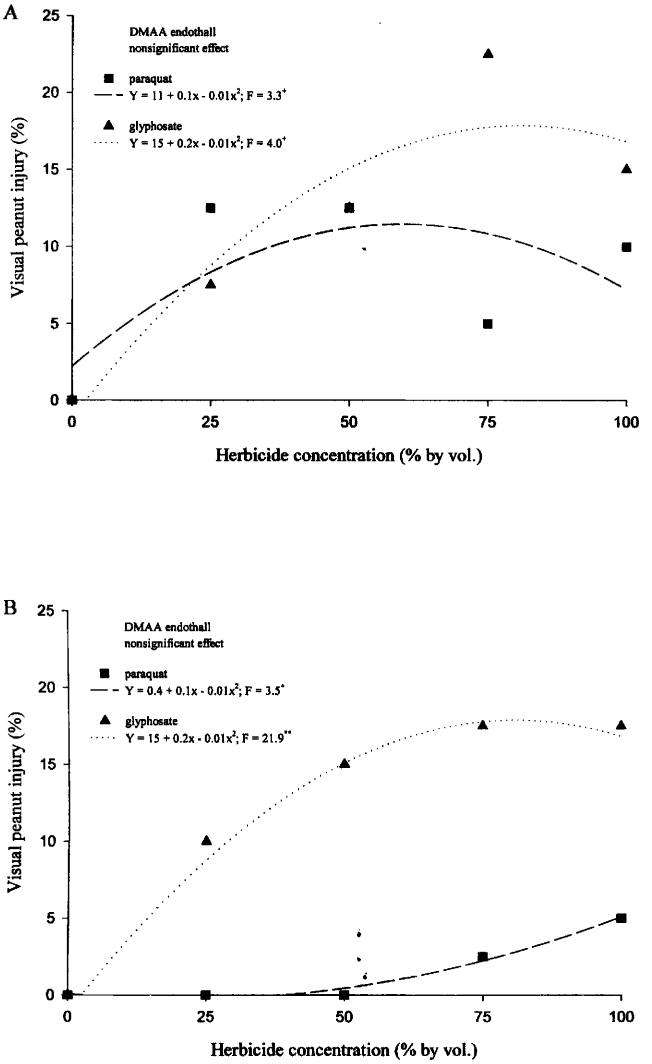

Fig. 5. Visual injury of peanut from herbicides applied through a wick-bar at Archer, FL; A = 1994; B = 1995; x = X - X̄, according to Draper and Smith (1981) (+ = P ≤ 0.10).

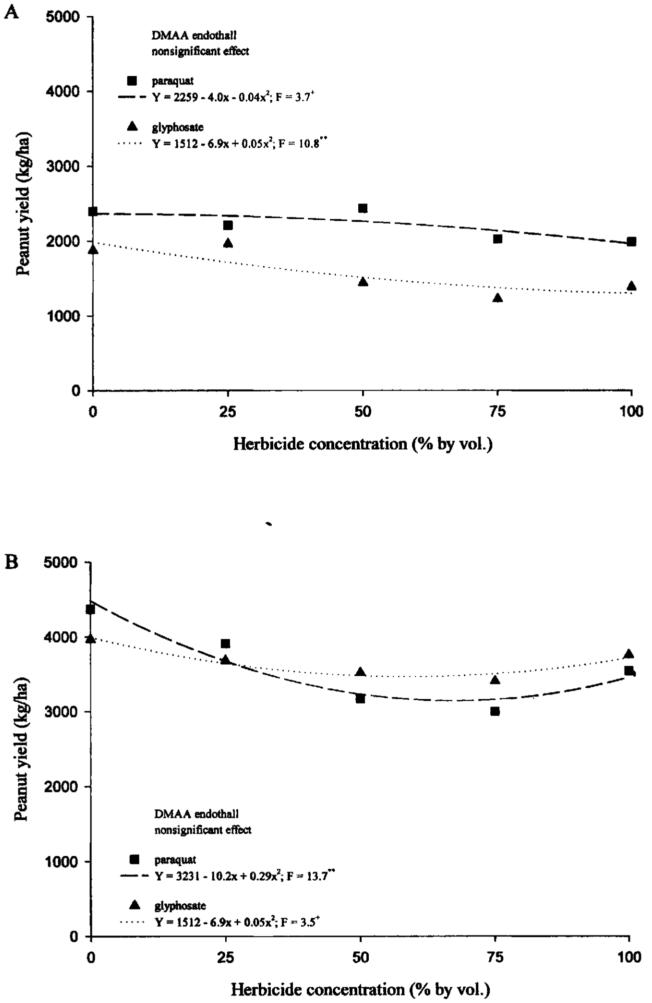

Fig. 6. Peanut yield response to weed control with herbicides applied through a wick-bar at Tifton, GA; A = 1994, B = 1995; x = X - X̄, according to Draper and Smith (1981) (+ = P ≤ 0.10).

effectively controlled late season in peanut with either paraquat or glyphosate applied with a wick-bar applicator.

This alternative weed management practice has two disadvantages. First, the application procedure is slow and tedious. Ground speed was 3.2 km/hr, with the herbicide applied twice in opposite directions. Conventional postemergence herbicide applications can be made as fast as 10 km/hr. Excessive field operations at mid- and late season can injure peanut vines, enhancing disease development. Furthermore, cost of operation for a wick-bar applicator is more than twice that of conventional pesticide applications due to the slower ground speed and numbers of applications. This may relegate herbicides applied with a wick-bar applicator to a control option in small areas with intense weed pressure.

The second disadvantage is lack of yield response from weeds controlled in late season. The weeds in our trials were controlled with a wick-bar from 67 to 87 DAE. At this stage of development, peanut was beginning to mature (Boote, 1982). Hauser *et al.* (1975, 1982) reported peanut yield reduction from interference if Florida beggarweed and sicklepod were allowed to compete with peanut until late in the season. By the time the weeds were controlled in our trials, yield reduction from weed competition had been inflicted.

There are advantages offered to controlling weeds late season in peanut with a wick-bar applicator. Despite the higher costs of application with a wick-bar, herbicide costs are inexpensive. In 1996, we treated a peanut field (0.2 ha) outside the research site in Georgia with paraquat (25% by volume) applied with the same wick-bar device evaluated in these trials. The field was infested with Florida beggarweed at approximately 22 plants/m², which were taller than the peanut canopy. This treatment effectively (> 90%) controlled Florida beggarweed. Based on the amount of herbicide used, weed density, area treated, and local cost of paraquat, the herbicide cost was estimated to be $1.97/ha. In contrast, chlorimuron, a currently registered option for Florida beggarweed control, cost $3.24/ha in 1996 (G. E. MacDonald, pers. commun.).

Another advantage of weed control with a wick-bar applicator is consistent efficacy. Glyphosate and paraquat applied through a wick-bar consistently and effectively controlled tall Florida beggarweed and sicklepod at concentrations as low as 25% by volume. Controlling these weeds should allow for more effective fungicide applications for the remainder of the season (Royal *et al.*, 1997) and easier harvesting (Wilcut *et al.*, 1994). While fungicide deposition and harvest efficiency were not directly measured in our studies, it is logical that effective control of these weeds with glyphosate or paraquat applied through a wick-bar will improve these facets of peanut production.

Given the lack of measurable yield response, neither glyphosate nor paraquat applied through a wick-bar should be the primary means of managing Florida beggarweed or sicklepod in peanut. Rather, it is strictly a salvage weed control practice with the object being to improve fungicide deposition and improve harvest efficiency.

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