INTERFERENCE AND DISTANCE OF INFLUENCE OF UNICORN-PLANT (PROBOSCIDEA LOUISIANICA) WITH COTTON (GOSSYPIUM HIRSUTUM)

By

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Introduction

Each of two parts of this thesis is a separate manuscript to be submitted for publication in Weed Science, the journal of the Weed Science Society of America.

PART I

INTERFERENCE OF UNICORN-PLANT (*PROBOSCIDEA LOUISIANICA*) WITH COTTON (*GOSSYPIUM HIRSUTUM*)

Interference of Unicorn-plant (*Proboscidea louisianica*)
with Cotton (*Gossypium hirsutum*)

Abstract. The relationship between cotton (*Gossypium hirsutum* L. 'Westburn M') and full-season interference from unicorn-plant [*Proboscidea louisianica* (Mill.) Thell. #[1] PROLO] density (0 to 32 weeds/10 m row) was measured in field experiments in three environments. Regression models tested were linear for all paramenters using unicorn-plant density as the dependent variable and curvilinear with a quadratic term added to the regression equation. Also tested for the same data was a simple linear model using $\log_{10}$ transformations of weed density. The latter regression analysis resulted in the best "fit". As unicorn-plant density (expressed in $\log_{10}$ units) doubled a corresponding lint yield reduction occurred ranging from 83 to 146 kg/ha. Weed measurements on an individual plant basis were not reliable indicators of competition. Weed biomass, percent ground cover, and number of seed capsules/plot generally increased with increasing weed densities. In the three environments, densities of 2, 4, and 8 weeds/10 m row produced significant cotton plant height reductions; but did not deleteriously influence with mechanical cotton harvest. Maximum lint yield losses ranged from 59.0 to 73.7% in the three environments. Unicorn-plant interference did affect a number of cotton fiber properties including length, uniformity, and fineness; but not strength.

Additional index words. Competition, weed density, lint yield, weed biomass, cotton fiber properties, cotton height, PROLO.

INTRODUCTION

Unicorn-plant [Proboscidea louisianica (Mill.) Thell.], also known as "devilsclaw and ram'shorn", is a member of the tropical family Martyniaceae. It and six other species of this genus are native to the United States (11). Unicorn-plant is easily recognized at all life stages, especially the reproductive. The seed capsule has a conspicuous curved beak that hardens at maturity and splits into a pair of claw-like hooks from which are derived its many common names. The mature plant is a robust, annual broadleaf covered entirely by secretory trichomes that give it a viscid appearance. Distributed throughout the southern United States as far north as Nebraska the species is principally found in the southwestern regions of the United States (10, 11, 15). As reported in the 1984 Beltwide Cotton Prod. Conference, Res. Proc., unicorn-plant was not considered to be one of the 25 major weeds that decrease cotton yields or infest cotton acres (20); nor is it listed as one of the 10 most common weeds in the southern states (14). Nevertheless, in the cotton growing areas of Oklahoma and West Texas, unicorn-plant is considered a troublesome weed. Cooley et al. (10) has documented an 83% cotton yield reduction in West Texas when the species was present in large numbers. Its claw-like seed capsules interfere with mechanical harvest and damage ginning equipment; and for those reasons, substantial efforts are made to control this weed prior to harvest. Control is difficult because this weed exhibits a poor response to preplant incorporated and preemergence herbicides commonly used in the area. Also, after unicorn-plant attains a height of 10 cm or more, the efficacy of postemergence applied herbicides rapidly declines (19).

Competition of numerous weed species with cotton has been inves-

tigated by other scientists and has been reported to depend on such factors as a weed's unique morphology (4, 5, 7, 8, 12, 16), phenology (3), and its differential response to environmental factors such as light (1, 2, 13, 16), temperature (1, 16), moisture, and nutrients (13). Weeds were reported to be most competitive when they germinated simultaneously with the crop (3) and were allowed to form a leaf canopy over the cotton stand (8,13).

Sensitivity of cotton lint yields to various weed densities and species has been well documented for several annual and perennial weeds (3, 4, 5, 6, 7, 8, 12, 17). Competition from sicklepod (Cassia obtusifolia L. #[1] CASOB) and tall morningglory [Ipomoea purpurea (L.) Roth #[1] PBHPU] caused yield reductions at densities as low as eight weeds/7.3 m row. These decreases varied between two locations and ranged from 10 to 40% and from 10 to 75% for sicklepod and tall morningglory, respectively (4). In a similar study, eight common cocklebur (Xanthium strumarium L. #[1] XANTH) plants/7.3 m row reduced lint yield 20 to 40%; while higher densities resulted in even greater yield reductions (5). Sicklepod was described by Buchanan et al. (6) to be about 1.3 times more competitive than redroot pigweed Amaranthus retroflexus L. #[1] AMARE). Chandler (8) reported that full-season competition of spurred anoda [Anoda cristata (L.) Schlecht. #[1] ANVCR], velvetleaf (Abutilon theophrasti Medic. #[1] ABUTH), and prickly sida (Sida spinosa L. #[1] SIDSP) at 8, 16, and 64 plants/12 m row, respectively, caused significant seed cotton yield reductions. Tall morningglory was highly competitive and resulted in a yield decrease as great as 88% with a density 32 weeds/15 m of row (12).

Parameters other than lint yield such as crop height (4, 5, 6, 8,

12, 17, 18), stem diameter (4, 5, 6), weed weight (7, 12, 17, 18), weed density (4, 5, 6, 12, 17, 18), and leaf area (2, 9, 13, 16) have been used to predict the degree of competition. These characteristics; however, have not been determined to be consistently affected by most annual weed species. Cotton fiber properties (i.e., fiber length, strength, micronaire, and uniformity) has likewise been investigated (4, 5, 6, 7, 12) and in the majority of cases, has not been affected, regardless of the weed density.

Limited data are available that demonstrate the competitive relationship of unicorn-plant with cotton. Therefore, the objectives of this research were to determine the effects of full season interference of selected unicorn-plant densities on cotton by measuring and correlating weed biomass, percent weed ground cover, and the number of unicorn-plant seed capsules, cotton plant height, lint yield, and fiber properties.

MATERIALS AND METHODS

Experiments were conducted during 1983 and 1984 on a Teller fine sandy loam (Udic Argiustolls) in north central Oklahoma near Perkins and in 1984 on a Tipton silt loam (Pachic Argiustolls) in southwest Oklahoma near Tipton. Soil fertility requirements were adjusted annually according to state extension soil test recommendations for cotton. These tests also determined the soil pH to be 7.1 and 7.6 at the Perkins and Tipton locations, respectively.

Westburn M, a stormproof stripper-harvested cultivar was planted with a conventional planter in 91 cm rows at Perkins and 101 cm rows at

Tipton. The final cotton stand was approximately 10 plants/m row. The planting dates for both weed and crop were June 17, June 6, and May 31 for Perkins in 1983 and 1984, and for Tipton in 1984, respectively. The experiments were arranged in a randomized complete block design with four replications. The seven treatments applied 0, 1, 2, 4, 8, 16 and 32 weeds/10 m row. Prior to the time of planting, locally collected weed seed were prepared by manually removing the leathery outer seed coat, according to the procedure described by Thilsted et al. (20). In 1983, in a four row cotton plot, approximately, eight weed seed/hill were hand planted about 1 cm deep. The hills were 3 cm to the south side of each of the two center cotton rows. About 2 weeks after weed and crop emergence, the unicorn-plant seedlings were hand thinned to one/hill. The outside single row of each plot when combined with the outside single row of the adjacent plot to functioned as a two row border between the two weed-infested center rows. A possibility existed that both of the center cotton rows were not subject to equal amounts of weed interference when only the two center rows were infested with weeds; therefore, in 1984, at both locations, the weed seed were hand planted 3 cm to the south side of the three north rows of each plot. The single outer row of each plot combined with the outside rows of adjacent plots to serve as border rows; but, measurements were taken form the center rows only.

Plots were maintained free of indigenous weds by hand removal throughout the growing season. At Perkins in 1983, fluometuron [1,1-dimethyl-3-(α,α,α-trifluoro-m-tolyl)urea] was applied preemergence to the border rows between weed plots and to the 3 m alleys between replications. However, at Perkins and Tipton in 1984, no herbicide applica-

tions were made. Irrigation water was available and applied when required to maintain the cotton in an actively growing condition.

While insecticide applications were not required for pest control in cotton at Perkins in 1983 or 1984, chlophenamidine [N'-(4-chloro-o-tolyl-N,N-dimethyl-formamadine] plus permethrin [(3-phenoxyphenyl) methyl 3-(2,2 dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate] were applied twice in 1984 at Tipton for control of cotton bollworm [Heliothis zea (Boddie)] and tobacco budworm [H. virescens (F.)]. State extension entomology field scout recommendations were the basis for those applications. However, at Perkins in 1983 and 1984, insecticides were applied to control pests infesting the unicorn-plant stands. In 1983, Bacillus thuringiensis Berliner was applied in late July for control of the Heliothis complex that was feeding on the immature weed seed capsules. Cyfluthrin [cyano(4-fluoro-3-phenoxy-phenyl)methyl-3-(2,2-dichloroethenyl)-2,2-dimethyl-cyclopro-panecarbo-xylate] plus the fungicide, cupric hydroxide, was applied in late July of 1984 to control the Heliothis complex as well as bacterial blight (caused by Pseudomonas spp.).

At the time of cotton leaf senescence and approximately 25% boll opening, heights of six cotton plants/plot were measured from the soil surface to the terminal bud of the main stem. The diameter of individual weed canopy and the number of seed capsules/plant were also measured for four unicorn-plants chosen at random. The diameter of the weed canopy was transformed into percent weed ground cover/plot and the number of seed capsules/plant were reported on a plot basis, as well. Total weed dry biomass/plot was determined 7 and 8 weeks prior to cotton harvest in 1983 and 1984, respectively. At the time of weed removal,

all unicorn-plants from the two center rows were clipped at the soil surface and weighed. A composite sample was removed from the weed biomass of each plot, weighed, and dried in forage driers at 49 C for 5 to 7 days. Percent moisture was estimated from all those samples and all biomass measurements were adjusted to an oven dried basis. Weed biomass/plot was divided bny the number of weeds/plot and the weight of individual weeds were derived.

In 1983, cotton fiber properties were sampled using two techniques and comparisons were made between the two sampling procedures. The first method involved sampling immediately prior to cotton harvest. One fully developed boll was removed from the center portion of 15 plants selected at random from the two center cotton rows in each plot. The second sampling method was a composite from each plot of mechanically stripped cotton. Lint from both procedures was subjected to fiber quality measurements by personnel in the Oklahoma State University Cotton Quality Res. Lab. Measurements consisted of: (a) 2.5% and 50% span fiber lengths made on the digital fibrograph, in inches and converted to mm; (b) uniformity index, a ratio calculated by dividing 50% span length by 2.5% span length and expressing the results as a ratio; (c) fiber strength, measured on the stelometer in grams force/tex and converted to millimeters/tex; and (d) micronaire, fiber fineness, based on readings from the micronaire instrument, in standard units. No significant differences in fiber properties could be detected between the two sampling methods with analysis of variance (0.05 probability level). Therefore, in 1984, only the 15 boll sampling technique was employed.

Cotton bolls were allowed to open and dry naturally. In early December of both years, it was harvested from the two center rows in

each plot with a one row brush-type cotton stripper. However, in 1984, the south row of the two center rows was designated as row A; while, the north row was designated as row B. The two rows were harvested and weighed separately. Snapped cotton weights were converted using lint percentage estimates obtained from the 15 boll samples that were collected for measurements of fiber properties. The resulting lint yields were analyzed and compared and no significant differences in final cotton lint yields were detected between the weights of the two center rows. Therefore, further analyses concerning lint yields were performed on combined weights from those two center rows.

To determine the effects of unicorn-plant density on total weed dry biomass, weed dry weight/plant, the diameter of an individual weed canopy, percent ground cover, and number of seed capsules/plot (and per plant) as well as on cotton lint yields, plant height, and fiber properties, data were initially combined over three environments and subjected to analyses of variance. Those analyses of variance resulted in significant environment by treatment interactions for all parameters measured, except fiber properties. Therefore, all traits in each environment, except fiber properties, were analyzed and reported individually. Regression analyses were based on actual plot measurements rather than on treatment means. Simple linear regression analyses were conducted and data from all parameters except fiber properties were plotted against unicorn-plant density. However, further analyses revealed that the addition of a quadratic term to the linear equation improved the fit of the regression line to the data and consistently resulted in higher coefficients of determination (r^2). To simplify explanation, it is preferable to use linear regression models rather than

curvilinear models to explain the data. Therefore, linear equations were calculated for each parameter by using the $\log_{10}$ transformation of the number of unicorn-plants/plot as the predictor variable rather than the unicorn-plant density. The number one was substituted for zero in the $\log_{10}$ transformations resulting in values which initiated at zero on the graph and not at a negative number. The linear equations using $\log_{10}$ transformations fit the data and the resulting coefficients of determination were comparable to those of the curvilinear equations.

RESULTS AND DISCUSSION

Individual unicorn-plant dry weights ranged from 0.30 to 0.80 kg/weed at Perkins 1983; 0.09 to 0.69 kg/weed at Perkins in 1984; and 0.14 to 0.50 kg/weed at Tipton in 1984 (Table 1). At Perkins, in 1983, individual unicorn-plant weights did not significantly differ among treatments except between the densities of 1 and 4 weeds/10 m row vs 32 weeds at the highest density of 32 weeds/10 m row, the point at which intraspecific competition occurred. At Perkins in 1984, intraspecific competition occurred because individual unicorn-plants weighed significantly more at the lower densities (i.e., 1, 2, and 4 weeds/10 m row) than at the higher densities of 16 and 32 unicorn-plants/10 m row. Though significant differences were detected at Tipton in 1984, they were not related to increasing weed densities; and therefore, did not substantiate the possibililty of intraspecific competition. Unicorn-plant dry biomass/plot generally increased with successive unicorn-plant density in each environment. During both years at Perkins, the weed dry biomass/plot resulted in densities 1=2, 4=8, and 16=32 plants/10 m row.

The density of 4 weed/10 row at Perkins in 1983 was also not different from 1 and 2 weeds/10 m row. In the Tipton environment, densities of 1, 2, and 4 weeds/10 m row were equal; but different from the densities of 8, 16, and 32 weeds; which were equal.

The diameters of unicorn-plant foliage canopy were not reliable indicators of intraspecific competition (Table 1). They did not differ significantly among treatments at Perkins in 1983. At Perkins in 1984, weed canopy diameters were significantly smaller at the densities of 16 and 32 weeds than at 1 or 8 weeds/10 m row, but not at 2 of 4 weeds/10 m row. At Tipton in 1984, the lowest weed density, 1 weed/10 m row, had a smaller weed canopy diameter than did 8 weeds/10 m row. None of the other treatments were significantly different. Unicorn-plant percent ground cover/plot progressively increased at each higher weed density; though, the increases were not significant in every case. At Perkins in both years, an overlapping leaf canopy was responsible for an estimated percent ground cover of greater than 100% at the highest weed density. At Tipton the percent ground cover attained only 38% at the highest level of infestation. In all three environments, the 32-weed density provided significantly more ground cover than did the other treatments. The 16-weed density had more than the densities of 1 and 4, in every case; and more than 8 at Tipton, in 1984. In no instance did the 1 through 4-weed densities differ significantly for this parameter.

The only significant differences in number of seed capsules/-individual unicorn-plant occurred between the treatmentsof 2 vs. 32 weeds/10 m row at Perkins in 1983 (Table 1). At that location in 1984, intraspecific competition was initially indicated at the density of 16 weeds/10 m row and further shown at 32 weeds/10 m row. At Tipton in

1984, the only significant differences in seed capsule production/weed occurred between 1 and 2 plants/10 m row. Even in 1983, significant differences in the number of seed capsules/plot were exhibited between the densities of 1, 2, and 4, 4 vs. 8, 8 vs. 16, and 16 vs. 32 weeds/10 m of row at Perkins. In 1984, differences in the number of seed capsules/plot were detected with a progression toward more seed capsules at higher weed densities at Perkins and Tipton.

Regression analyses of individual unicorn-plant parameters did not result in a good fit with the regression equations tested. The coefficients of determination were basically poor (r^2 = 0.54 and less) and were highly variable between environments. Therefore, those analyses were not shown. Regression analysis of the corresponding weed parameters on a plot basis did exhibit good fits (r^2 = 0.64 and higher) and the analyses were shown (Table 1). Analyses revealed that with the doubling of each the unicorn-plant density (expressed in $\log_{10}$ units which are approximately three times that of nonlog-transformed density), there was an increase in the whole plot production of unicorn-plant biomass of 3.9, 1.1, and 2.1 kg/plot at Perkins in 1983, in 1984, and at Tipton, in 1984, respectively. Coefficients of determination (r^2) ranged from 0.64 to 0.81. Regressions also showed that by doubling the weed density (expressed in $\log_{10}$ units), the percent ground cover increased 21, 23, and 7%/plot while there was an increase of 117, 157, and 444 seed capsules/plot at Perkins in 1983, in 1984, and at Tipton in 1984, respectively. Coefficients of determination ranged from 0.67 to 0.84 for the percent ground cover and from 0.76 to 0.84 for the seed capsules.

Cotton plant heights at each of the three environments generally

decreased with increasing weed densities (Table 2). Cotton plant heights ranged from 49.5, 57.4, and 39.4 cm in the weed-free plots to 39.4, 32.9, and 28.5 cm in the plots with the highest weed densities, at the respective environments of Perkins, in 1983, in 1984, and at Tipton, in 1984. These height reductions were 20.4, 42.7, and 27.7%, respectively; but they did not appear to detrimentally influence mechanical harvest procedures. At Perkins in 1983, in 1984 and at Tipton, in 1984, a density of 8, 4, and 2 unicorn-plants/10 m row were required for significant reductions in cotton height to be noted. Generally, these data correspond with trends reported by others. Rushing et al. (17) reported that buffalobur (Solanum rostratum Dumal #[1] SOLCU) reduced cotton heights from 75 to 57 cm and from 52 to 46 cm at two locations; but those reductions were only significant at the first location for the densities of 16, 32, and 64 weeds at the second. They obtained similar results for tumble pigweed (18).

In the weed-free treatments, lint yields were greatest at Tipton, in 1984, and lowest at Perkins, in the same year. Cotton lint yields based on checks were reduced 73.0, 65.0, and 49.0% in treatments containing the highest unicorn-plant densities (32 weeds/10 m row) at Perkins in 1983, in 1984, and at Tipton, in 1984, respectively, when compared to weed free cotton. Damage thresholds, the density at which yield reductions are first detected, occurred at the densities of 1, 4, and 16 weeds/10 m row for the above respective locations. Regression analyses showed that as unicorn-plant densities doubled, (expressed as $\log_{10}$ units), lint yield reductions of 85, 83, and 146 kg/ha would be expected at Perkins in 1983, in 1984, and at Tipton in 1984, respectively. Coefficients of determination values ranged from 0.68 to 0.89.

Linear relationships could also be demonstrated when lint yield data are plotted against weed parameters (not shown). Lint yield/plot vs. dry unicorn-plant weight/plot revealed that there was a 0.004, 0.353, and 0.128 kg yield reduction for each additional kg of dry weed weight/plot at Perkins in 1983, in 1984, and at Tipton in 1984, respectiely. Coefficients of determination ranged from 0.76 to 0.87. Regression analyses also demonstrated that lint yields would be reduced 0.006, 0.137, and 0.004 kg/plot with each additional percent ground cover increase/plot for Perkins 1983, 1984, and Tipton, 1984, respectively. Correlation coefficients were 0.67 to 0.84.

Combined analyses of variances were conducted for fiber properties measured on the hand collected prior to harvest (Table 3). Environment by treatment interactions were not significant at the 0.05 probability level, for any fiber property; therefore, data were presented averaged over the three environments. No significant differences among treatments were noted for stelometer and these data are not included in the table. Micronaire exhibited significant differences between the weed-free vs. the 32 weeds/10 m row density. Uniformity index showed differences for the 0, 1, and 4-weed densities vs. the 32 weed-density. 2.5% span length had significant differences between 2 weeds/10 m row compared to 16 and 32 weeds/10 m row. 50% span length demonstrated significant differences after 8 unicorn-plants/10 m row and also between the 16 vs. 32 weed densities. These data were not subjected to linear regression.

Unicorn-plant damages harvesting equipment; and consequently, weeds were removed prior to cotton harvest. Because the weeds were handharvested; it was not possible to measure the effects of unicorn-

plant on harvesting efficiency; nor was it possible to study cotton grades among treatments because the differential lack of foreign matter among plots had been nullified by the weed harvest prior to cotton harvest.

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Table 1. Relationship of unicorn-plant densities to weed parameters on a whole plot and individual plant basis.[a]

Treatment	Dry weight of weed biomass						Ground cover						Number of seed capsules					
	Individual plant			Whole plot			Diameter per plant			Percent ground cover			Seed capsules/ plant			Seed capsules/ plot		
	Perkins		Tipton	Perkins		Tipton	Perkins		Tipton	Perkins		Tipton	Perkins		Tipton	Perkins		Tipton
Unicorn-plant densities	1983	1984	1984	1983	1984	1984	1983	1984	1984	1983	1984	1984	1983	1984	1984	1983	1984	1984
(plants/10 m row)	(kg/plant)			(kg/plot)			(cm)						(cm)					
0																		
1	0.8 a	0.7 a	0.2 b	1.5 c	1.4 c	.4 b	114 a	141 ab	52 b	3 d	9 d	1 d	22 ab	38 a	21 b	44 d	76 d	42 c
2	0.5 ab	0.4 b	0.3 ab	2.4 c	1.6 c	1.26	104 a	126 ab	66 ab	5 cd	14 d	3 d	28 a	35 a	35 a	112 d	140 cd	140 de
4	0.7 a	0.4 b	0.3 ab	5.4 bc	3.4 b	2.6 b	127 a	127 ab	64 ab	18 cd	28 cd	6 d	26 ab	35 a	44 a	208 d	280 c	352 d
8	0.5 ab	0.3 bc	0.5 a	8.7 b	4.6 b	8.0 a	124 a	135 a	71 a	36 bc	57 bc	13 c	27 ab	32 a	42 a	432 c	512 b	672 c
16	0.5 ab	0.2 bc	0.3 b	15.9 a	6.0 a	9.1 a	123 a	114 b	59 ab	58 b	78 b	21 b	23 ab	22 b	46 a	736 b	704 ab	1472 b
32	0.3 b	0.1 c	0.1 b	19.4 a	6.0 a	9.3 a	111 a	100 b	55 ab	113 a	127 a	38 a	20 b	12 c	36 a	1280 a	768 a	2304 a
CV(%)	50	30	68	37	36	47	17	12	17	65	61	28	25	20	29	41	37	25

Regression equations:

Whole plot weight	$Y = -4.67 + 12.9 \log_{10} X$ ($r^2 = 0.81$)	$Y = .111 + 3.5 \log_{10} X$ ($r^2 = .64$)	$Y = -2.21 + 6.9 \log_{10} X$ ($r^2 = .71$)
Percent ground cover	$Y = 33.8 + 69.2 \log_{10} X$ ($r^2 = .69$)	$Y = -29.5 + 77.6 \log_{10} X$ ($r^2 = .67$)	$Y = -10.6 + 23.3 \log_{10} X$ ($r^2 = .84$)
Seed capsules/plot	$Y = -175 + 389 \log_{10} X$ ($r^2 = .79$)	$Y = -134 + 523 \log_{10} X$ ($r^2 = .76$)	$Y = -730 + 1480 \log_{10} X$ ($r^2 = .84$)

[a]Means within a column followed by the same letter are not significantly different at the 0.05 probability level using LSD.

Table 2. Relationship of unicorn-plant density to cotton plant height and lint yield.[a]

Unicorn-plant density			Cotton plant height			Cotton lint yield		
	Area basis		Perkins		Tipton	Perkins		Tipton
Row basis	Perkins	Tipton	1983	1984	1984	1983	1984	1984
(plants/10 m row)	— (plants/ha) —		——— (cm) ———			——— (kg/ha) ———		
0	0	0	49.5 a	57.4 a	39.4 a	757 a	689 a	1196 ab
1	1100	1000	49.5 a	57.6 ab	36.3 ab	596 b	672 a	1345 a
2	2200	2000	48.0 ab	51.3 ab	34.3 b	493 bc	638 a	1153 ab
4	4400	4000	44.3 abc	46.9 bc	36.2 ab	485 bc	518 b	1186 ab
8	8800	7900	41.9 bc	40.5 cd	33.8 bc	381 cd	368 c	798 ab
16	17600	15800	40.8 c	33.7 c	29.6 c	299 de	306 cd	538 b
32	35200	31700	39.4 c	32.9 d	28.5 d	199 d	242 d	490 b
CV(%)								

Resgression Equations:	Cotton plant height	(Perkins 1983)	$Y = 50.5 - 6.7 \log_{10} X$ ($r^2 = .47$)
		(Perkins 1984)	$Y = 58.1 - 14.5 \log_{10} X$ ($r^2 = .77$)
		(Tipton 1984)	$Y = 39.0 - 5.5 \log_{10} X$ ($r^2 = .58$)
	Lint yield	(Perkins 1983)	$Y = 7140 - 283 \log_{10} X$ ($r^2 = .81$)
		(Perkins 1984)	$Y = 7420 - 278 \log_{10} X$ ($r^2 = .86$)
		(Tipton 1984)	$Y = 1400 - 485 \log_{10} X$ ($r^2 = .68$)

[a]Means within a column followed by the same letter are not significantly different at the 0.05 probability level using LSD.

Table 3. Relationship of Unicorn-plant to cotton fiber properties pooled over three environments.[a]

Unicorn-plant density	Micronaire	Uniformity index	2.5% Span length	50% Span length
(plants/10 m of row)	(units)	(ratio)	(mm)	(mm)
0	4.4 a	46 a	25.82 a	11.92 a
1	4.4 a	46 a	25.78 ab	11.82 a
2	4.3 a	45 a	25.97 a	11.81 a
4	4.3 a	46 a	25.83 ab	11.84 a
8	4.4 a	45 a	25.39 ab	11.48 b
16	4.2 ab	45 a	25.26 ab	11.43 b
32	4.06	44 b	25.25 b	11.06 c
CV(%)	7	4	3	4

[a]Means within a column followed by the same letter are not significantly different at the 0.05 probability level using LSD.

PART II

UNICORN-PLANT DISTANCE OF INFLUENCE (*PROBOSCIDEA LOUISIANICA*) WITH COTTON (*GOSSYPIUM HIRSUTUM*)

Unicorn-plant Distance-of-Influence

(Proboscidea louisianica) with

Cotton (Gossypium hirsutum)

Abstract. The distance of influence of an individual unicorn-plant [Proboscidea louisianica (Mill.) Thell. # PROLO] on cotton (Gossypium hirsutum L. 'Westburn M') was determined in field experiments conducted in two environments. Cotton leaf, stem, boll, and combined above ground dry weights were recorded from four 25-cm intervals down the row from the weed. The distance-of-influence for unicorn-plant generally extended up to 50 cm for biomass cotton of each plant part and the whole plant biomass. In 1983 at the final cotton harvest, percent boll weight reductions were 64, 56, and 11% for the sampling intervals of 0 to 25, 25 to 50, and 50 to 75 cm from the weed, respectively; while in 1984, the reductions were 48, 30, 15, and 0% for the intervals 0 to 25, 25 to 50, 50 to 75,and 75 to 100 cm from the unicorn-plant, respectively.

Additional index words. Competition, weed biomass, sphere-of-influence, boll production, PROLO.

INTRODUCTION

Unicorn-plant [Proboscidea louisianica (Mill.) Thell. # PROLO] also commonly known as "devilsclaw and ram'shorn", belongs to the tropical family Martyniaceae. It is one of seven species in the genus native to North America (7). Unicorn-plant is easily recognized in all life stages. Its cotyledons are large, fleshy, and are colored magenta on the lower surface. As a mature plant, it is a viscid, robust, annual broadleaf that presents a pubescent appearance because of secretory glandular trichomes which cover its surface. Palmate, heart shaped leaves are supported by hollow stems that split at maturity. Subsequently, the plant lies prostrate, the leaves quickly decompose, and the seed capsules are exposed. Its woody seed capsules are curved, longer than they are wide, and composed of three compartments. The seed capsules divide into two parts to release the seed that are contained in their central compartment. Each half of the seed pod recurves to form a claw-like appendage that serves as an excellent seed dispersal mechanism.

Unicorn-plant is distributed throughout the southern United States; but is principally found in the southwest. It has been semi domesticated and the capsules are used by southwestern Indians in basketry and pickling (11). Unicorn-plant is not considered a weed pest throughout its geographical distribution; however, it is a troublesome weed in the cotton growing areas of Oklahoma and West Texas. It is difficult to control. Normal preplant incorporated herbicide treatments are ineffective and surface applied preemergence treatments are often only partially effective. Further,the use of some herbicides or herbicide rates is restricted because of soil pH, texture, and organic matter content.

While postemergence herbicide applications are effective, efficacy is substantially diminished when unicorn-plant seedlings attain a height of 10 cm or more (13). High levels of control are necessary because the claw-like seed pods interfere with mechanical harvesting. Cooley et al. (6) in West Texas reported as much as an 83% cotton lint yield reduction when unicorn-plant was present.

Numerous scientists have reported on the competitive relationship between various weed species and crops (1, 5, 9, 12). The competitive ability of each weed species depends upon its unique morphology (1), phenology (5, 9), and its differential response to such environmental factors as light (1, 12), temperature (13), nutrients (5,), and moisture (1, 12,). Black (1) reported that slight differences in plant height early in the season can be responsible for large changes in final crop yields. Hagwood (9) stated that weed growth and crop yield reductions are highly dependent on soil moisture content. Patterson (12) reported that shading is a highly effective growth inhibitor and that it is able to delay and reduce the development of reproductive plant parts.

Currently, data from these studies and others are being integrated so that simulation models can be developed to predict crop growth response to weed growth. In such models, it is important to recognize that each weed possesses unique characteristics that enable it to compete; but also, that each weed affects the response of a specific crop in a different manner.

One type of competition experiment measures the density of weed infestation at which a crop yield reduction occurrs. In cotton, Crowley and Buchanan (10) reported that 32 tall morningglory [Ipomoea purpurea (L.) Roth # RBHPU] plants/15 m row reduced cotton yields as much as

88%. Buchanan and Burns (4) reported that eight common cocklebur (Xanthium strumarium L. # XANST) plants/7.3 m row and 48 redroot pigweed (Amaranthus retroflexus L. # AMARE) plants/7.3 m row caused up to 70% and 90% yield reductions, respectively. It was also reported at two locations that densities as low as eight sicklepod (Cassia obtusifolia L. # CASOB) and eight tall morningglory plants/7.3 m row were responsible for 10 to 40% and for 10 to 75% cotton yield reductions, repectively (3).

Competition studies that measure the effects of density of weed species require large amounts of time and space. Therefore, Johnson and Coble (10) designed an efficient "microplot" experiment that conserved time and space as well as permitted the study of multi species complexes. Their method does not indicate yield reductions, but does assess the ability of a weed species to compete with a particular crop.

Both the large plot and microplot concepts were modified and the result was a competition study that measured the spatial influence of a weed species. In essence, this modification determined the distance from a weed that it interfered with crop production. Bridges and Chandler (2) reported that the sphere of influence of unicorn-plant in cotton was approximatedly 1 m and that wild-okra [Abelmoschus esculentis (L.) Moench] exerted its influence up to 2 m from the plant in a stand of cotton.

The objectives of this research were to determine: 1) additional information on the distance-of-influence of unicorn-plant on cotton production; and 2) the effect of cotton interference on unicorn-plant growth and the weed's competitive ability.

MATERIALS AND METHODS

Experiments were conducted in 1983 and 1984 on a Teller fine sandy loam (Udic Argiustolls) in north central Oklahoma near Perkins. Soil fertility was adjusted annually according to soil test results from the state soil test laboratory. Soil pH was 7.1. Westburn M, a stormproof-stripper harvested cotton cultivar, was planted with a conventional planter in row spacings that were 91 cm. The final cotton stand each year was approximately 10 plants/10 m row. Planting dates were June 17 and June 6, and the growing seasons were 181 and 165, days in 1983 and 1984, respectively.

Locally collected intact unicorn-plant seed had approximately 3% germination. Therefore, to improve germination, the leathery outer seed coat was manually removed prior to planting according to procedures described by Thilsted et al. (14). Immediately following cotton planting, approximately eight unicorn-plant seed were planted about 1 cm deep directly in the cotton row at uniformly spaced distances of 3 meters. One week after crop and weed emergence, the unicorn-plant stands were thinned to one plant/hill; and subsequently, the center of each plot was spaced 3 m apart at the location of weed emergence. Although unicorn-plant germination was substantially improved by removing the seed coat, it remained erratic on an individual plot basis. To compensate for this variable emergence of both unicorn-plant and cotton, the three main treatments: cotto-with-weed, cotton-no-weed, and weed-no-cotton, were not assigned to plots until weed and crop plants were established. Thus, the experimental design was completely randomized with a factorial arrangement of treatments with four replications/treatment. Two weed-free cotton rows functioned as border

rows between weed infested rows. A border of 0.75 and 0.5 m of linear cotton row between individual plots was used in 1983 and 1984, (Figure 1). Each plot was symmetrically divided into subtreatments of 25-cm intervals that initiated at the plot's midpoint and extended along the row of cotton on either side of the center of the plot (Figure 2). In 1983, there were three 25-cm intervals in each plot: 0 to 25, 25 to 50, and 50 to 75 cm. In 1984, each plot contained four 25-cm intervals which were 0 to 25, 25 to 50, 50 to 75, and 75 to 100 cm. Three weeks after cotton and unicorn-plant emergence, the three main treatments were hand harvested by clipping the crop and the weed at ground level. This procedure was then repeated every 3 weeks throughout the growing season. In 1983, harvest dates were 3, 6, 9, and 12 weeks after crop and weed emergence and at crop maturity. In 1984, the harvest dates were 3, 6, 9, 12, and 15 weeks after emergence and at crop maturity. The harvested cotton biomass from each 25-cm interval was combined with the cotton biomass from the corresponding 25-cm interval on the other side of the weed. Ultimately, both the crop and the weed were anatomically partitioned into leaf, stem, and reproductive parts and those parts oven dried in forage driers at 49 C for 5 to 7 days and weighed in grams.

In 1984, alachlor [2-chloro-2,'6'-diethyl-N-(methoxymethyl) acetanilide] was applied postemergence over-the-top at 2.2 kg/ha to control late emerging broadleaf and grassy weeds. Indigenous weeds that emerged in 1983 and those that escaped herbicide treatments in 1984 were removed by hand from the plots.

Insecticide applications for control of cotton insect pests were not required at Perkins in either year; although it was necessary to

control insect pests that infested unicorn-plant stands. In 1983, Bacillus thuringiensis Berliner was applied in late July to control the Heliothis complex that was feeding on immature unicorn-plant seed capsules. In 1984, a tank mix of the insecticide, cyfluthrin [cyano(4-fluoro-3-phenoxyphenyl)methyl-3-(2,2-dichloro ethenyl)2,2,dimethyl-cyclo-propanecarboxylate] plus the fungicide, cupric hydroxide, was applied in late July to control the Heliothis complex as well as bacterial blight (caused by Pseudomonas spp.). Irrigation water was applied with overhead sprinkler systems when necessary to maintain plant growth.

In the weed-free treatments cotton biomass was harvested by 25-sampling intervals; but the cotton weights were from the intervals averaged to obtain mean weights based on 12 and 16 observations, in 1983 and 1984, respectively. Cotton biomass weights from both treatments and both years were subjected to analysis of variance (0.05 probability level) to detect differences between the main treatment, cotton-no-weed, and each of the sampling intervals from the weed-infested treatment: 0 to 25, 25 to 50, 50 to 75, and 75 to 100 cm, respectively. Tests were also conducted to detect differences among 25-cm intervals within the main treatment, cotton-with-weed. Unicorn-plant biomass was subjected to analysis to ascertain variance between the weed biomass weights when grown with cotton and without cotton.

RESULTS AND DISCUSSION

Throughout the 1983 growing season, no significant differences were detected in cotton leaf weights between the weed-free (control) treat-

ments and the weed-infested treatments for any sampling interval (Figure 3). In 1984, no significant differences in cotton leaf weights occurred during the first two harvest dates, 3 and 6 weeks. At 9 and 12 weeks, weed interference significantly reduced leaf weights up to 50 cm from the unicorn-plant. This is indicated because leaf biomass from the third and fourth (50 to 75 and 75 to 100 cm) sampling intervals within weedy treatments did not significantly differ from the weed-free treatments; but leaf biomass in the intervals 0 to 25 and 25 to 50 cm did differ. Within weed-infested treatments, the differences were noted in leaf biomass between the intervals 0 to 25, 50 to 75, and 75 to 100 cm, at 9-week harvest date; but at 12 weeks, differences among leaf weights from the sampling intervals were not significant. Cotton leaves were not present at the time of final cotton harvest, in 1984.

Within weedy treatments, at the 3 week harvest date, in 1983, significant differences in stem weights were detected among the intervals 0 to 25 and 75 to 100 cm (Figure 4). However, except for the final cotton harvest, no significant differences were detected when cotton stem weights from the weed-free treatments were compared to stem weights from sampling intervals of weed-infested treatments. At the time of final cotton harvest in 1983, unicorn-plant exerted its influence on stem production up to a distance of 25 cm. In 1984 for the harvest dates of 3, 6, and 15 weeks, there were no significant differences in cotton stem weights of weedy treatments when compared to weed-free treatments. However, within the 25-cm sampling intervals of weedy treatments, unicorn-plant significantly reduced cotton stem weights the intervals e25 to 50 and 75 to 100 cm; 25 to 50, 50 to 75, and 75 to 100 cm; 0 to 25 and 50 to 75 cm; and 25 to 50 and 75 to 100 cm for the harvest dates

of 6, 9, and 12 weeks, and the final cotton harvest, respectively. Generally, no significant distinction could be made in stem weights from the interval farthest from the weed, 75 to 100 cm, and stem weights of weed-free treatments for the entire 1984 growing season.

In 1983, unicorn-plant exerted its influence on boll weights up to 25 cm at 12 weeks (Figure 6). At final cotton harvest, the distance of influence was increased to 50 cm and percent cotton boll reductions at the end of the 1983 growing season were 64, 56, and 11% for the sampling intervals 0 to 25, 25 to 50, and 50 to 75 cm away from the unicorn-plant, respectively. In 1984, there were no significant differences in boll weights between the weed-infested and weed-free treatments during the first 6 weeks; nevertheless, after 6 weeks, boll weights were significantly reduced up to 75 cm from the unicorn-plant. Percent boll weight reductions were 48, 30, 15, and 0% for the intervals 0 to 25, 25 to 50, 50 to 75, and 75 to 100 cm, respectively. Cotton yield has been reported by others (4, 5, 6, 9) to be a more sensitive indicator of weed interference than parameters such as leaf area index, cotton heights, and cotton stem diameters. In general, cotton boll weight increased over time, while, cotton leaf weight decreased and stem weight fluctuated. No cotton reproductive parts were present at the 3 week harvest date in either year. The onset of cotton boll production coincided with physiological maturity and subsequent decline of unicorn-plant in both years; however, cotton boll reductions remained indicative of weed interference.

There were no significant differences in above ground (i.e.,combined leaf, stem, and boll weights) cotton plant biomass for the first 9 weeks of the growing season in 1983 (Figure 6). At the 12

week harvest date, unicorn-plant was found to exert its influence on above ground cotton biomass up to 25 cm; even though no significant differences were detected among sampling intervals within the weed-infested treatments. At the time of final cotton harvest, the distance of influence extended up to 50 cm. This was determined by comparing differences between above ground cotton biomass of the weed-free treatments to the sampling intervals of the weedy treatments as well as by comparing differences among the intervals in the weed-infested treatments. Above ground cotton biomass production from 50 to 75 cm was not influenced by the presence of unicorn-plant and could not be statistically distinguished from biomass in the weed-free treatments. In 1984, no differences in above ground biomass were detected up to 6 weeks after crop and weed emergence. Throughout the remainder of the growing season, unicorn-plant exerted its influence up to 50 cm on cotton biomass. The bove ground biomass in the two intervals farthest from the weed, 75 to 100 cm, responded as though no unicorn-plnat was present. Within the weed-infested treatments, differences in above ground biomass were ascertained to occur among the intervals of 0 to 25, 25 to 50, and 75 to 100 cm; 25 to 50 and 75 to 100 cm; 0 to 25, 25 to 50, and 75 to 100 cm; and 25 to 50 and 75 to 100 cm, for the 9, 12, 15 weeks, and final cotton harvest, respectively.

In general, unicorn-plant leaf, stem, seed pod, and total plant biomass increase over time (Table 1). In 1983, at the 6 week harvest date significant differences in biomass were first detected between the treatments, weed no cotton and weed with cotton, stems, seed capsules, and whole unicorn-plant biomass and at 9 weeks for leaves. In 1984, significant differences were first reported at 6 weeks for leaves and

whole unicorn-plant biomass and at 12 weeks for seed pod biomass. No significant differences were found among stem biomass at any time during the 1984 growing season. Even when no statistical differences are detected among biomass weights, practical differences (3 fold or greater) can be observed among weights of weed biomass for all plant parts. No weeds were present at the 15 week harvest dates in 1983. No seed capsule biomass was collected at the 3 weed in 1983 or 1984, and no leaf biomass was collected at the harvest interval in 1984.

The distance-of-influence of the unicorn-plant on cotton production was not distinctly delineated for any plant part during the first 6 weeks of the growing season in either year, with the exception of boll weights in 1984. At 9 and 12 weeks, differences could be detected for biomass of most plant parts between the two sampling intervals of 25 to 50 and 50 to 75 cm in 1983 and 1984. Therefore, it is concluded that the distance of influence is generally extended up to 50 cm. In spite of this fact, some biomass reductions did occurr farther from the weed than 50 cm; but these were generally insignificant. In 1983 at the time of final cotton harvest, percent reductions in leaf biomass between the intervals 0 to 25 and 25 to 50 cm were: 40 and 38%, respectively; while 1984, the reductions were 24 and 23%, respectively. Percent stem biomass reductions in the two intervals closest to the weed were 52 and 49% in 1983, and 43 and 36% in 1984. Percent above ground biomass reductions in 1983 were 57 and 49% for the intervals 0 to 25 and 25 to 50 cm, respectively; and in 1984 were 49 to 27%, respectively, for the same intervals. Boll weight reductions were mentioned previously.

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Table 1. Unicorn-plant dry weights of weed with and with and without cotton.[a]

Unicorn-plant with and without cotton		Dry weights							
		Leaf biomass[b]		Stem biomass		Seed capsule biomass[c]		Total biomass[d]	
		1983	1984	1983	1984	1983	1984	1983	1984
	(week after emergence)	(g)							
Weed + crop	3	3.2 a	17.0 a	4.2 a	0.7 a	-	-	4.3 a	2.4 a
Weed no crop	3	9.5 a	3.2 a	2.7 a	0.5 a	-	-	6.1 a	1.8 a
Weed + crop	6	11.8 a	49.3 a	15.8 a	18.0 a	13.8 a	16.7 a	25.4 a	27.5 a
Weed no crop	6	26.9 a	69.2 b	82.0 b	25.5 a	68.8 b	22.1 a	59.2 b	38.0 b
Weed + crop	9	37.4 a	117.3 a	17.8 a	156.5 a	55.1 a	122.0 a	36.8 a	131.9 a
Weed no crop	9	121.5 b	159.5 a	47.4 b	98.8 a	149.7 b	197.8 a	106.2 b	152.0 a
Weed + crop	12	55.6 a	105.5 a	16.5 a	53.8 a	50.0 a	285.8 a	43.2 a	148.3 a
Weed no crop	12	195.4 b	225.0 b	51.9 b	77.3 a	258.9 b	511.5 b	138.8 b	271.2 b
Weed + crop	15	-	84.0 a	-	60.0 a	-	307.8 a	-	150.6 a
Weed no crop	15	-	181.0 b	-	72.0 a	-	575.0 a	-	176.0 a
Weed + crop	Harv	48.8 a	-	24.8 a	45.5 a	121.1 a	286.5 a	64.9 a	166.0 a
Weed no crop	Harv	115.8 a	-	53.2 b	56.8 a	303.9 b	446.5 a	157.6 a	251.6 b

[a]Values within a column followed by the same letter are not significantly different at the 0.05 probability level using the LSD method of comparison.
[b]Leaves were not present at the final harvest date in 1984.
[c]Seed capsule were not present at the 3 week harvest date in either year.
[d]Total biomass represents the combined weights of leaf, stem, and seed capsule biomass.

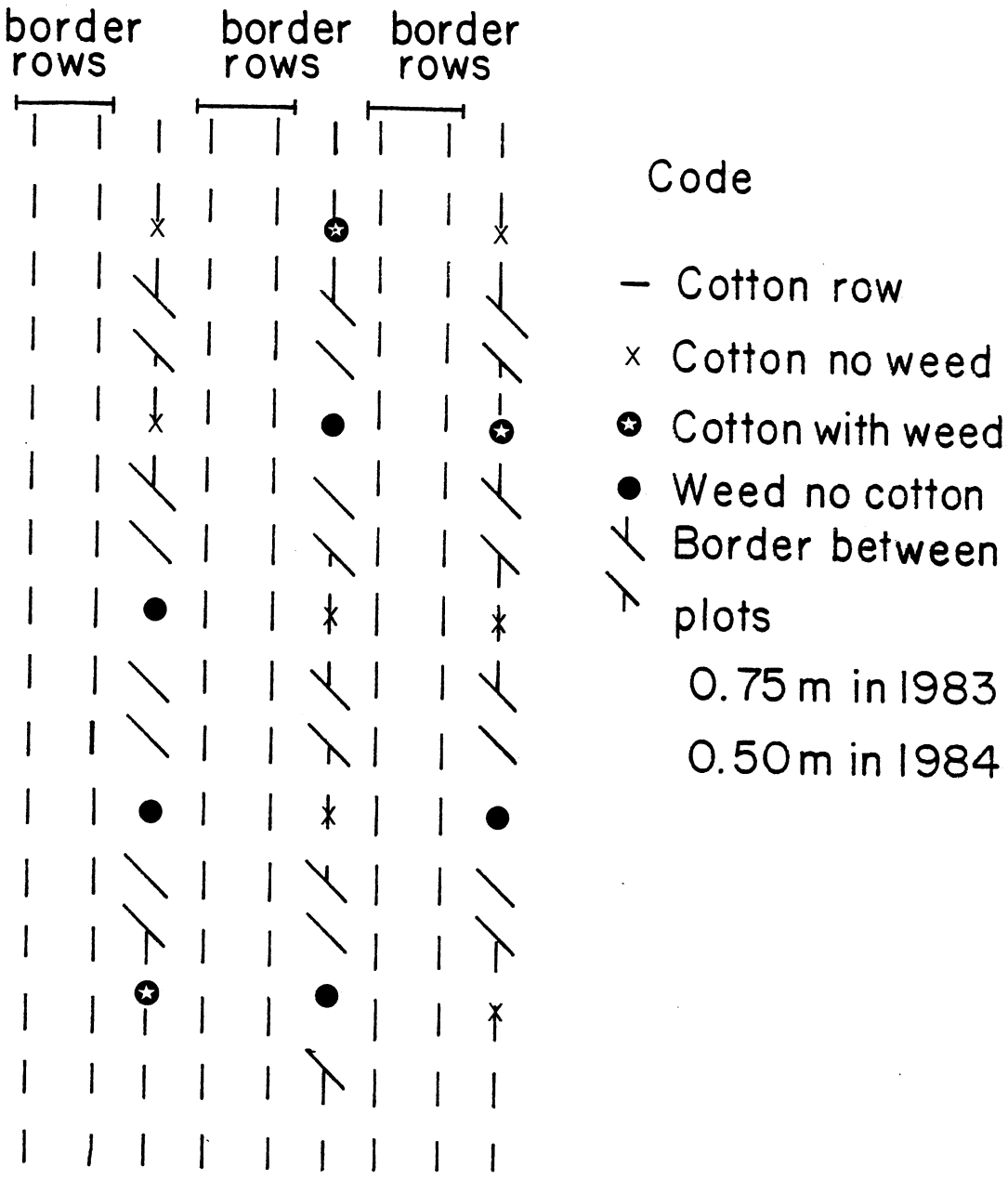

Figure 1. Field layout for distance of influence study.

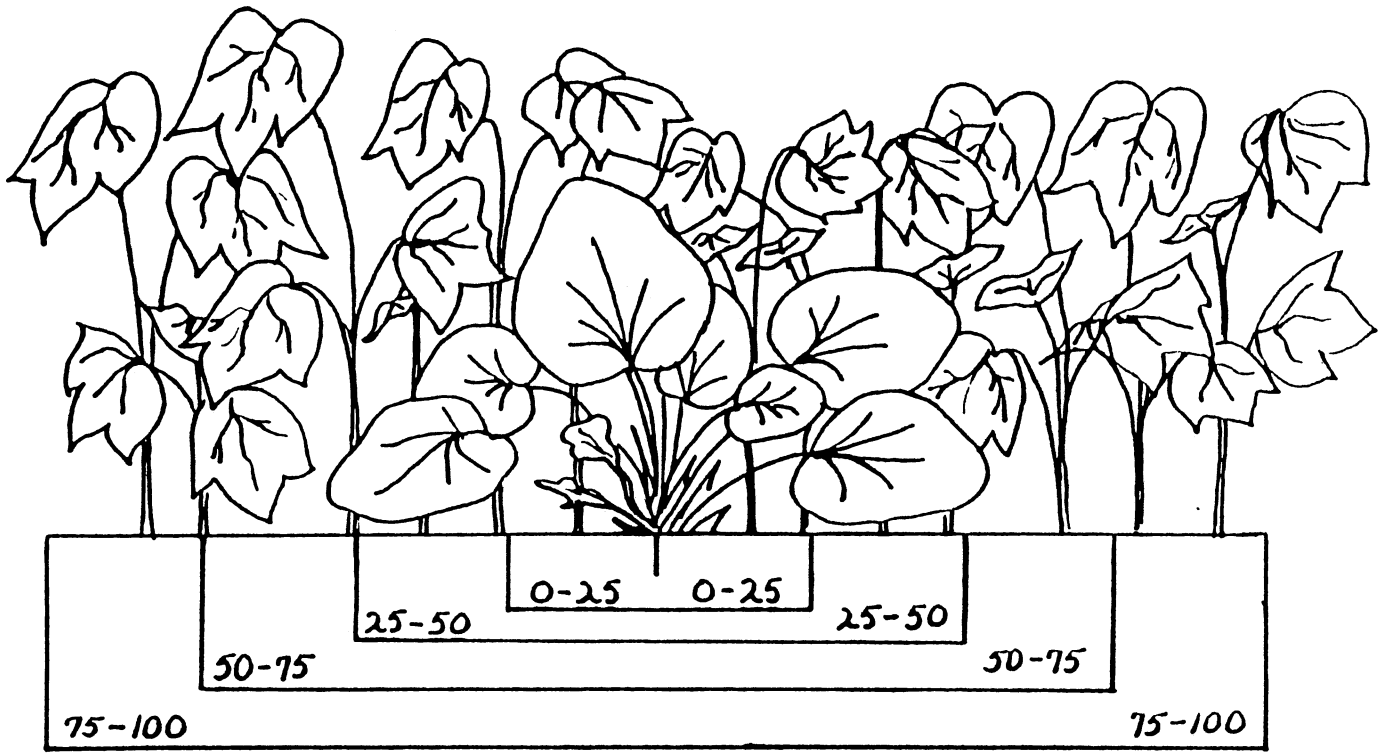

Figure 2. Individual plot design and harvest intervals for distance of influence.

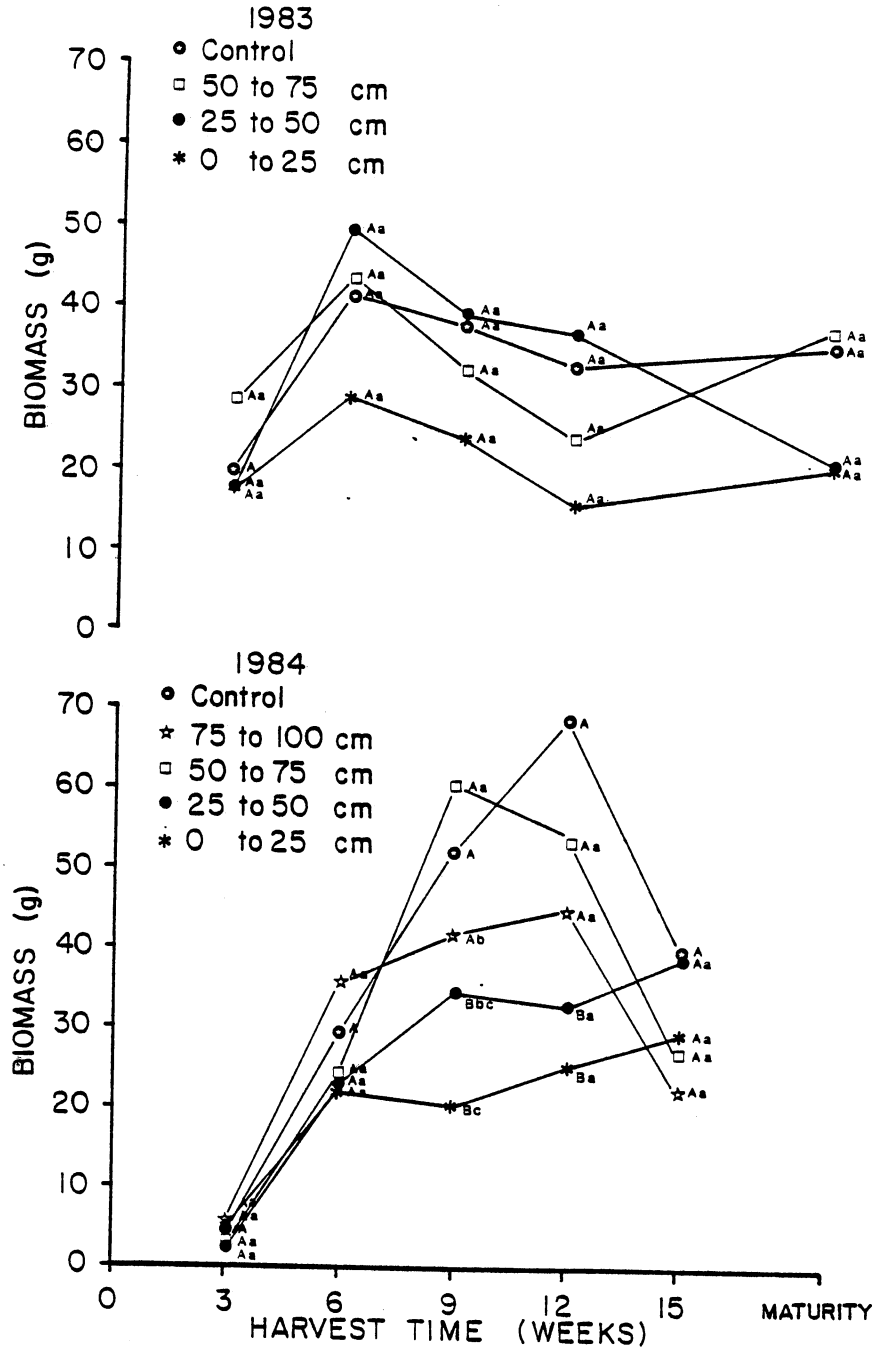

Figure 3. Distance of influence of unicorn-plant on cotton dry biomass production. Lower case letters make comparisons among 25 cm sampling intervals within weed-infested treatments at a single harvest time. Upper case letters make comparisons between the weed-free treatment and each of the intervals of a weed-infested treatment at a single harvest time (P = 0.05).

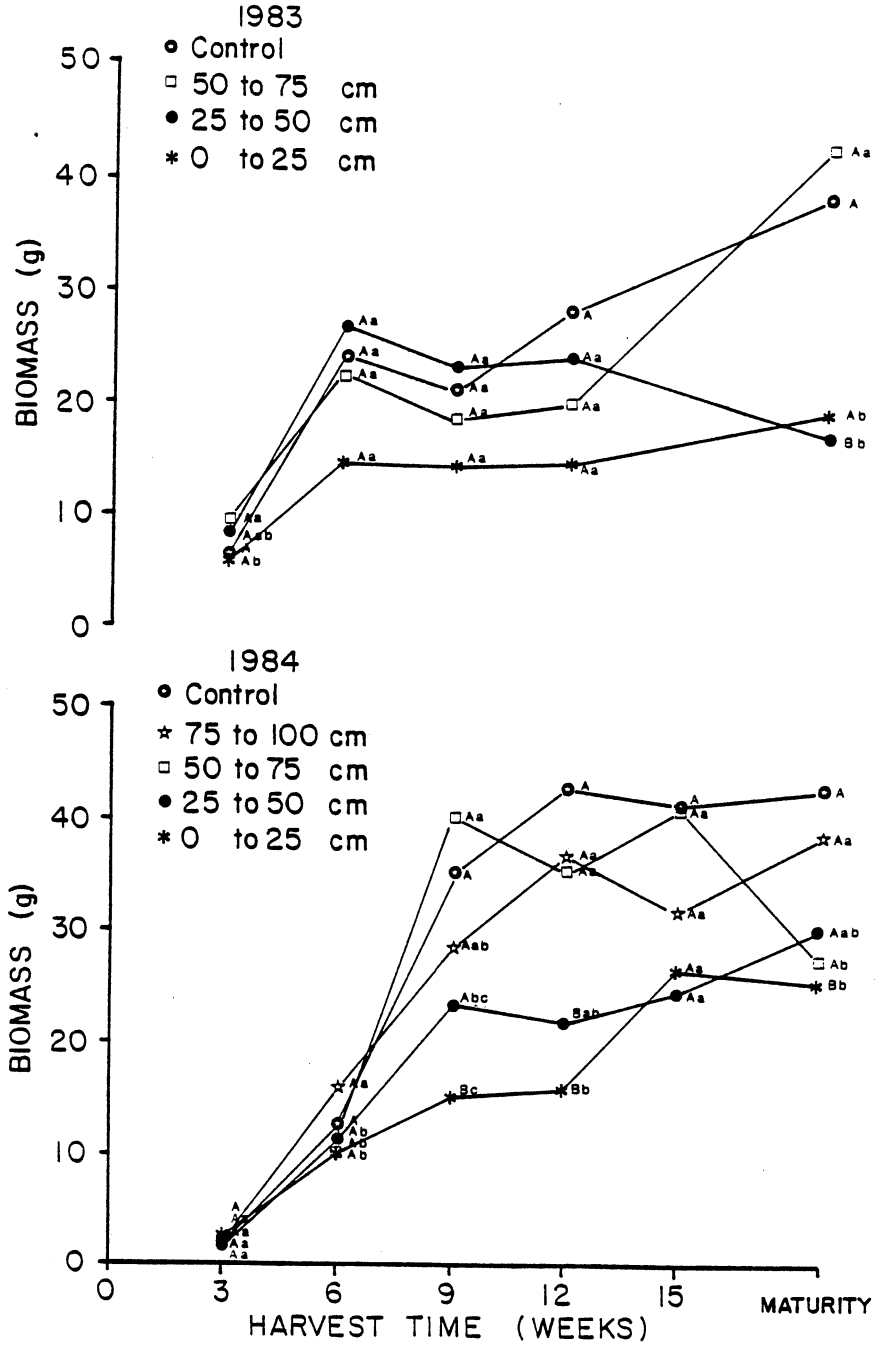

Figure 4. Distance of influence of unicorn-plant on cotton stem dry biomass production. Lower case letters make comparisons among 25 cm sampling intervals within weed-infested treatments at a single harvest time. Upper case letters make comparisons between the weed-free treatment and each of the intervals of a weed-infested treatment at a single harvest time (P = 0.05).

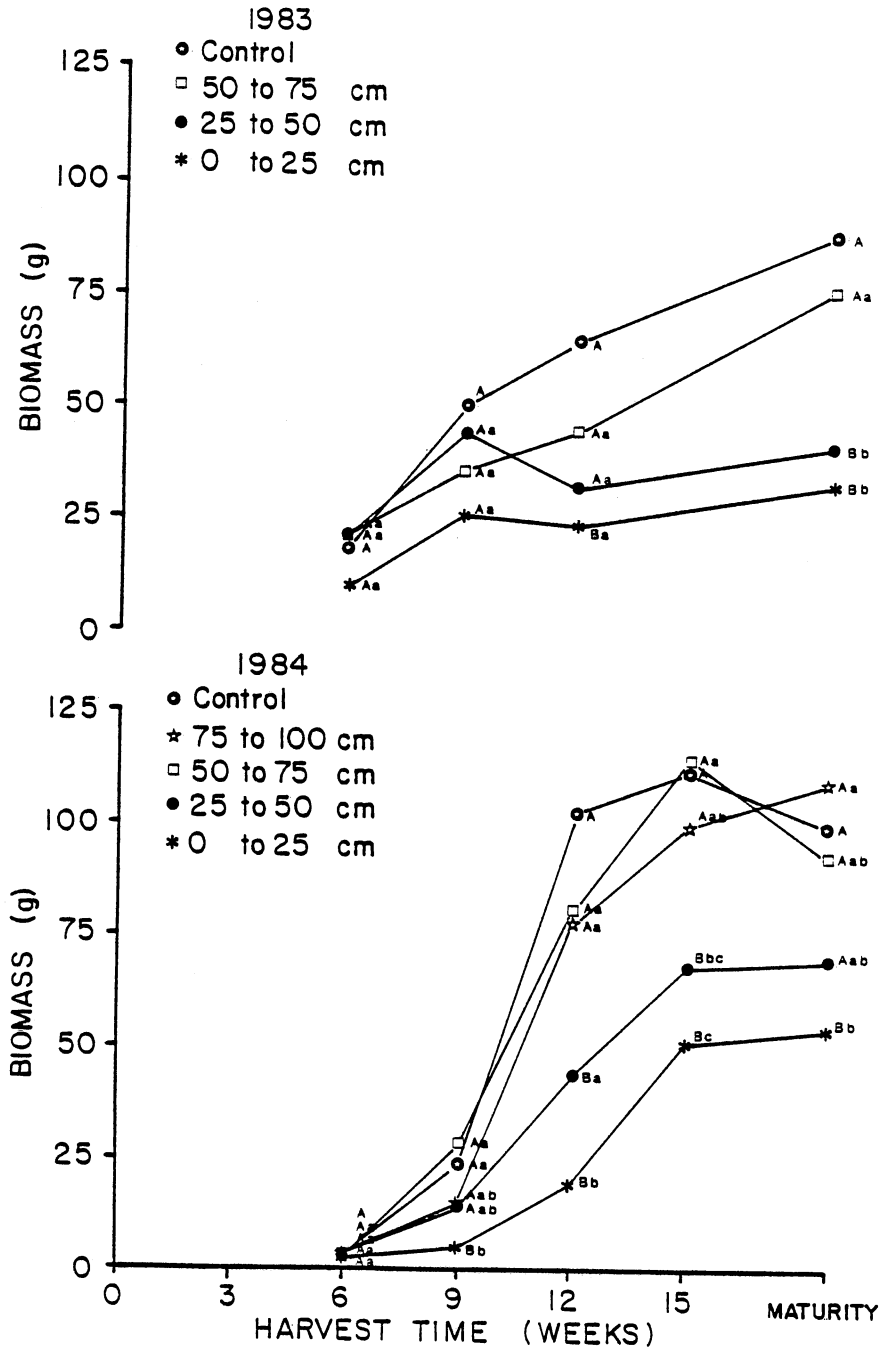

Figure 5. Distance of influence of unicorn-plant on cotton boll weight production. Lower case letters make comparisons among 25 cm sampling intervals within weed-infested treatments at a single harvest time. Upper case letters make comparisons between the weed-free treatment and each of the intervals of a weed-infested treatment at a single harvest time (P = 0.05).

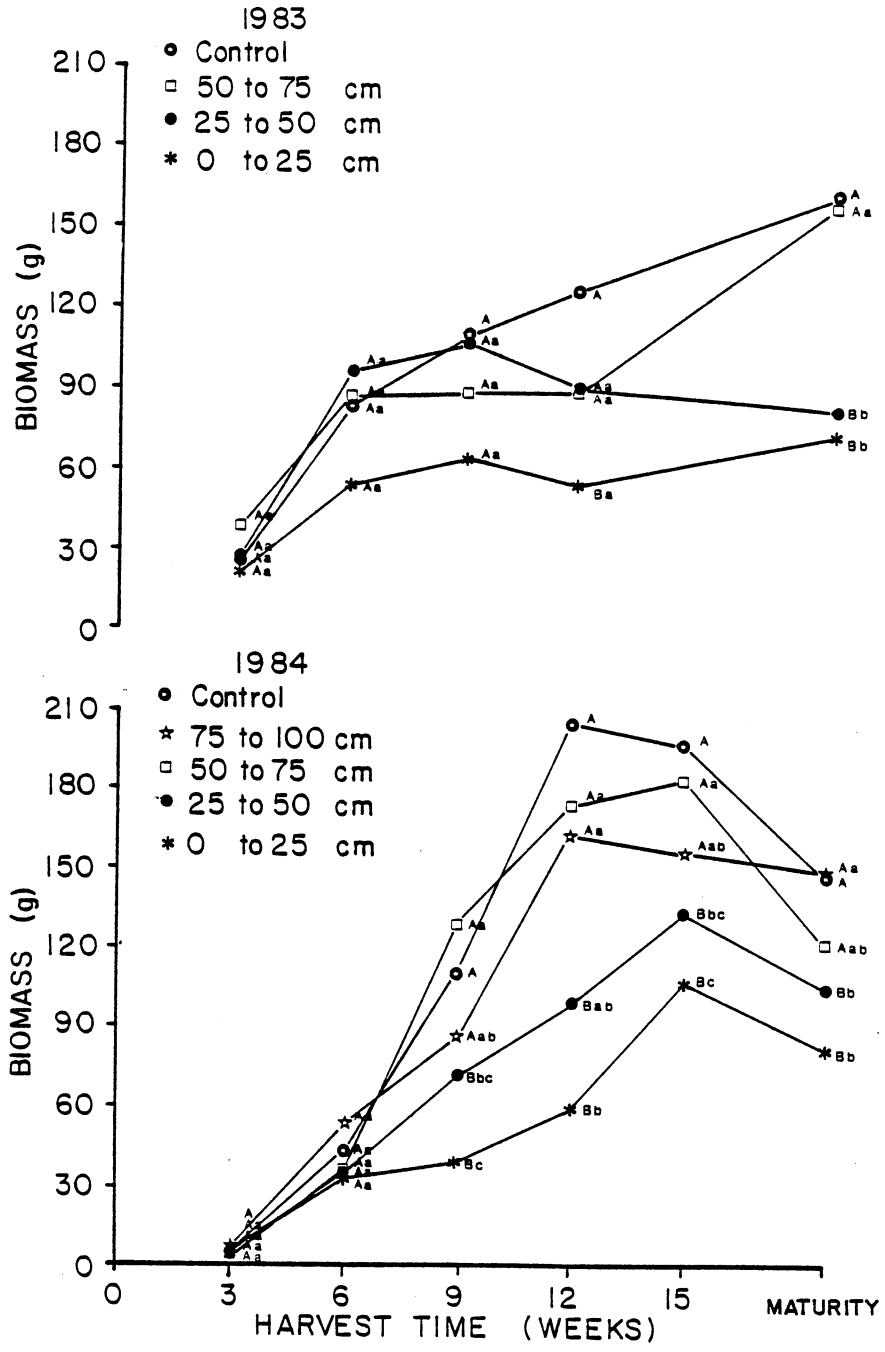

Figure 6. Distance of influence of unicorn-plant on above ground cotton plant dry biomass production. Lower case letters make comparisons among 25 cm sampling intervals within weed-infested treatments at a single harvest time. Upper case letters make comparisons between the weed-free treatment and each of the intervals of a weed-infested treatment at a single harvest time (P = 0.05).

VITA

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