FULL-SEASON INTERFERENCE OF IVYLEAF MORNINGGLORY (*Ipomoea hederacea*) WITH COTTON (*Gossypium hirsutum*)

By

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WITH COTTON (*Gossypium hirsutum*)

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Full-season interference of ivyleaf morningglory (*Ipomoea hederacea*) with cotton (*Gossypium hirsutum*)

Field experiments were initiated in 1994 and 1996 at Chickasha and Perkins, OK, to measure the effects of seven ivyleaf morningglory densities on cotton lint yield, harvest efficiency, and cotton fiber properties. The seven densities used were 0, 2, 4, 6, 8, 10, and 12 weeds $10m^{-1}$ of crop row. Cotton lint yield and percentage of the check data best fit a linear regression model. Cotton lint yield reductions for each increase of one weed $10m^{-1}$ of crop row were estimated to range from 30.7 to 36.2 kg ha^{-1} at Chickasha in 1994 and 1996, respectively. At Perkins cotton lint yield reductions were estimated to range from 36.4 to 35.4 kg ha^{-1} in 1994 and 1996, respectively. Percent lint yield reduction for each increase of one weed $10m^{-1}$ of crop row was estimated to range from 3.8 to 6.9% at Chickasha in 1994 and 1996, respectively. At Perkins percent lint yield reduction was estimated to range from 3.9 to 6.0% in 1994 and 1996, respectively. All plots could be mechanically harvested except for densities of 10 and 12 weeds $10m^{-1}$ of crop row at Chickasha in 1994 and 12 weeds $10m^{-1}$ of crop row at Perkins in 1996. Mechanical harvest efficiencies were not different for either year or location. Fiber property analyses demonstrated no difference for Chickasha in 1996 and Perkins in 1994 and 1996; however, in 1994 at Chickasha micronaire and strength showed differences at an LSD of 0.05.

Key words: Competition, fiber quality, harvest efficiency, lint yield, IPOHE, prediction models.

INTRODUCTION

Approximately 154 thousand hectares of cotton were grown in Oklahoma in 1995. Of that area, approximately 4,800 hectares were infested with morningglory species, and those weeds caused a 14% yield reduction when present (Byrd 1996). Yield losses for morningglory can be attributed to the growth of the vines throughout the crop canopy and to the trailing ability of the plant to spread. Previous reports have noted that morningglory can cover a crop by growing upward and outward, causing cotton to grow abnormally, creating difficulty in machine harvest (Buchanan and Burns 1971; Crowley and Buchanan 1978; Rogers et al. 1996).

Dowler (1995) reported that morningglory species ranked as the third "most common" and fifth "most troublesome" weed in Oklahoma cotton production. Several factors contribute to those rankings: 1) common PPI or PRE herbicide applications do not effectively control morningglories, and some herbicides, that do control it cannot be used safely on sandy soils; 2) if the weed emerges and is not controlled by PPI or PRE treatments, it is likely that it will be present in the crop for the entire season; 3) cultivation does not control weeds in the row and; 4) and POST directed spray applications are rarely used in Oklahoma.

Buchanan and Burns (1971) reported that, eight tall morningglory [*I. purpurea* (L.) Roth] plants 7.3m^{-1} of row reduced picker-harvested cotton lint yields 10 to 75%, in Alabama. Crowley and Buchanan (1978) reported on the competitiveness of four *Ipomoea* spp. and their effects on picker-harvested cotton in the same state. Species tested included tall morningglory, entireleaf morningglory (*I. hederacea* var. *integriuscula*

Gray), ivyleaf morningglory, and pitted morningglory (*I. lacunosa* L.) at densities of 4, 8, 16, and 32 plants $15m^{-1}$ of row. At the eight plant density, cotton lint yield was reduced by those species 19, 9, 6, and 3%, respectively. Harvest efficiency was reduced by tall morningglory with each increasing density, but no other morningglory species caused harvest efficiency reductions.

Rogers et al. (1996) conducted research in Oklahoma to measure stripper-harvested cotton lint yield losses from seven ivyleaf morningglory densities at two locations; the densities used were similar to those of Crowley and Buchanan (1978). Data from Rogers et al. (1996) fit a linear-linear (or piecewise regression) model as described by Neter et al. (1985). The first linear component "broke" at a an estimated joint of 8.7 and 9.0 weeds $10m^{-1}$ of row at Perkins and Chickasha, respectively. Reported yield reductions for each increase of one weed $10m^{-1}$ of row were 36.9 and 29.7 kg ha^{-1} for densities up to an estimated 8.7 and 9.0 weeds $10m^{-1}$ of row at Perkins and Chickasha, respectively. Data converted to a percentage of the check demonstrated for each increase of one weed $10m^{-1}$ cotton lint yield reductions of 5.9 to 3.9% at weed densities up to an estimated 10.0 and 11.4 $10m^{-1}$ of row for Perkins and Chickasha, respectively. At Perkins, densities greater than 16 weeds $10m^{-1}$ of row could not be mechanically harvested. At Chickasha, densities greater than eight could not be mechanically harvested. Plots that could be mechanically harvested demonstrated no significant differences at either location.

Determining the effects of full-season interference over moderate densities of ivyleaf morningglory on stripper-harvested cotton would provide Oklahoma producers a way to decide how much of their efforts should be allocated to control of this species.

Therefore, the objectives of this research were to measure the effects of such interference by seven weed densities on cotton lint yield, stripper-harvest efficiency, and fiber quality properties, and to develop prediction models for them to compare with those constructed previously by Rogers et al. (1996).

MATERIALS AND METHODS

Study environments. Experiments were conducted in 1994, 1995, and 1996 on a Reinach silt loam (a coarse-silty, mixed, thermic Pachic Haplustoll) in South Central Oklahoma near Chickasha and on a Teller fine sandy loam (a fine-loamy, mixed, thermic Udic Argiustoll) in North Central Oklahoma near Perkins. Soil pH of the Chickasha location was 7.7 in all 3 yr, and organic matter content was 1.0 and 1.1% for 1994 and 1996, respectively. Soil pH of the Perkins location was 6.4, 6.9, and 7.1 in 1994, 1995, and 1996, respectively; and organic matter was 0.7% for all 3 yr. In 1995 at Chickasha, insect infestations severely limited yields; and at Perkins, excessive rainfall early in the season followed by a drought were judged to result in poor yield data (Appendix Tables 7 through 14). Therefore, those data are not reported herein. Each year, studies at a location were moved to new sites. Both locations received irrigation on an "as needed" basis using an overhead sprinkler, side-roll system. At Chickasha and Perkins, ammonium nitrate was applied at a rate of 45 and 48 kg N ha^{-1} in 1994 and 1996, respectively.

Experimental design. Plots were arranged in a randomized complete-block design replicated four times. 'Paymaster HS-26', a commonly grown stripper-harvested cultivar, was planted in all experiments using a 91-cm row spacing. Planting dates for Chickasha were June 2, 1994 and May 20, 1996. Planting dates for Perkins were June 8, 1994 and May 22, 1996. Plots were four-rows wide by 13m long, with 1.5m being removed from each end before harvest to reduce the end-row effect. A harvested-row length of 10 m resulted.

Ivyleaf morningglory densities. Ivyleaf morningglory seed were acid scarified for approximately 10 min with H_2SO_4, rinsed in running tap water, and then neutralized with a sodium bicarbonate solution. Seven weed densities of 0 (weed-free check), 2, 4, 6, 8, 10, and 12 plants $10m^{-1}$ of crop row were tested. At Chickasha in 1994 and at Perkins in 1996, densities for some replications were often less than the target level. Immediately after cotton planting, morningglory seed were hand planted approximately 1.25 cm deep and 8 cm to the left side of crop rows two, three, and four in hills with 5 to 7 seed $hill^{-1}$. Row one served as a weed-free border row between adjacent plots. All trailing morningglory vines were cut to prevent weed encroachment between adjoining plots.

Experimental area. In 1994, a PRE treatment of prometryn [*N*, *N'*-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine] plus metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide] were applied at rates of 1.1 kg ai ha^{-1} and 1.7 kg ai ha^{-1}, respectively. In 1996, a PRE treatment of prometryn was applied at a rate of 1.1 kg ai ha^{-1} plus metolachlor at a rate of 1.4 kg ai ha^{-1}. Herbicides were applied at rates below recommended rates for these soil types to avoid crop injury and reduce the chances of injury to the weeds. Prior to treatment, paper plates were placed over the morningglory hills to also protect them from any herbicide injury and removed immediately after the application. Previous research has reported the prevention of accidental herbicide damage to desired weeds by placing a cover over the weed hills (Jacobson et al. 1994; Pawlak et al. 1990; Rogers et al. 1996; Smith et al. 1990). Herbicides were applied to aid in the control of unwanted weeds, but primary weed control was obtained by hoeing throughout the season. Approximately 2 wks after planting, morningglory hills were thinned to the desired density of one plant $hill^{-1}$.

Data collection. In 1994 and 1996, cotton from the two center rows was hand harvested at Chickasha on December 5 and 6 and at Perkins on November 11 and December 6, respectively. Plot samples were weighed, mechanically deburred, and seed cotton weighed. Seed cotton was ginned and lint was weighed after ginning to determine the gin "turnout" percentage. All lint yields are reported as kg ha^{-1} and as a percentage of the check. Grab samples were collected for determinations of fiber quality.

Harvest-efficiency investigations. Harvest efficiencies were estimated from row four of each plot using a one-row, mechanical, brush-roll stripper. Harvesting was conducted by first stripping the weed-free check (or 0 density) and then stripping higher and higher densities until the plots could not be mechanically harvested. Any seed cotton or bolls that remained in the plots after stripping was picked up by hand and weighed separately. The remaining cotton and stripper-harvested cotton were then used to determine harvest efficiency as a percentage. Harvest efficiency was determined at Chickasha in 1994 and at Perkins in both years.

Fiber quality analyses. In 1994, fiber traits were measured at the USDA, Agricultural Marketing Service, Cotton Division Classing Office, Altus, OK. In 1996 this work was performed at the International Textile Center, Texas Tech University, Lubbock, TX.

High-volume instruments (HVI) were used to measure fiber length, length uniformity, strength, and micronaire for each plot in both years. Elongation was also measured in 1996. Other grade components such as color and trash content were not analyzed. In 1994 at Chickasha and Perkins, harvest-efficiency fiber samples were tested; therefore, for the Chickasha location densities greater than 10 weeds $10m^{-1}$ of crop row were not tested.

Data analyses. All dependent variables measured, (lint yield, percent-of-check, harvest efficiency, and fiber property) were analyzed using the appropriate analyses of variance statistical model. Lint yield and percent-of-check data were tested for goodness-of-fit to linear, curvilinear, linear plateau, and linear-linear (or piecewise linear) regression (Neter et al. 1985) models. The linear and curvilinear models were analyzed using PROC GLM in SAS (SAS Inst. Inc. 1996), but the linear plateau and piecewise linear regressions required using PROC NLIN in SAS (SAS Inst. Inc. 1996).

RESULTS AND DISCUSSION

Ivyleaf morningglory densities. In 1994 at Chickasha, for each increase of one weed $10m^{-1}$ of crop row, yield loss was estimated as 30.7 kg ha^{-1} (Figure 1). At Perkins in 1994, the corresponding yield loss was estimated as 36.4 kg ha^{-1}. In 1996, for each weed increase $10m^{-1}$ of row, cotton yield losses were 36.2 kg ha^{-1} at Chickasha and 35.4 kg ha^{-1} at Perkins.

Rogers et al. (1996) reported equations of:

$$Y = 573.7 - 29.7X \qquad [1]$$

$$Y = 551.2 - 36.9X \qquad [2]$$

for their first linear component at Chickasha and Perkins, respectively. The current data are in close general agreement with Rogers et al. (1996).

Since environmental conditions can vary widely over years and locations, it is desirable to examine the data as a percentage of the check. Estimated percent yield loss for each increase of one weed $10m^{-1}$ of crop row was 3.8 and 3.9% at Chickasha and Perkins in 1994, respectively (Figure 2). In 1996 estimated percent yield loss for each increase of one weed $10m^{-1}$ of crop row was 6.9 and 6.0% at Chickasha and Perkins, respectively. Rogers et al. (1996) reported equations of:

$$Y = 97.0 - 3.9X \quad [3]$$

$$Y = 100.2 - 5.9X \quad [4]$$

for their first linear component at Chickasha and Perkins, respectively. The current data are again in close general agreement with Rogers et al. (1996).

Harvest-efficiency investigations. At Chickasha in 1994, mechanical harvest above 10 weeds $10m^{-1}$ of crop row was deemed impossible without damaging the machine. Densities below 10 weeds $10m^{-1}$ of crop row demonstrated no differences for harvest-efficiency (Appendix Table 1). At Perkins in 1994, all plots were harvested, and no significant differences were detected among them. At Perkins in 1996, mechanical harvest for a density of 12 weeds was not possible, and densities below 12 weeds demonstrated no significant differences.

Fiber quality analyses. At Chickasha in 1994, micronaire and strength were the only fiber properties that showed significant differences (Appendix Table 2). Micronaire differences from the weed-free check were detected for densities of 8, and 10 weeds

$10m^{-1}$ of crop row. Strength differences for a density 2 weeds was not different from 4 weeds, but was different for densities of 0, 6, 8, and 10 weeds $10m^{-1}$ of crop row. For all other fiber properties and environments no differences were detected at the 5% level (Appendix Tables 2, 3, 4, and 6). Because only those two traits in one year demonstrated a difference, it was possibly a chance occurrence.

CONCLUSIONS

Yield data for the 2 yr and 2 locations demonstrated similar results reported by Rogers et al. (1996); however, four additional densities between 0 and 12 weeds $10m^{-1}$ were included in this research. With these added densities we believe the linear models reported here adequately determine potential yield loss. Based on our results, yield reductions can occur from as little as two weeds $10m^{-1}$ of crop row. While this is small, it can reduce cotton production. If a cotton producer chooses to harvest a highly infested morningglory area, mechanical-harvest efficiency may not be reduced and it is likely that fiber quality will also, not be affected.

LITERATURE CITED

Buchanan, G. A. and E. R. Burns. 1971. Weed competition in cotton. I. Sicklepod and tall morningglory. Weed Sci. 19:576-579.

Byrd, J. D., Jr. 1996. Report of the 1995 Cotton Weed Loss Committee. p. 1513-1516 in P. Dugger and D. Richter, eds. Proc. Beltwide Cotton Conf., Nashville, TN. Jan. 9-12, 1996. Natl. Cotton Counc. Am., Memphis, TN.

Crowley, R. H. and G. A. Buchanan. 1978. Competition of four morningglory (*Ipomoea* spp.) species with cotton (*Gossypium hirsutum*). Weed Sci. 26:484-488.

Dowler, C. C. 1995. Weed survey-southern states: Broadleaf crops subsection. Proc. South. Weed Sci. Soc. 48:290-325.

Jacobson, B. D., D. S. Murray, and J. F. Stone. 1994. Soil-water extraction profiles of cotton (*Gossypium hirsutum*) and weed species. Weed Technol. 8:190-198.

Neter, J., W. Wasserman, and M. H. Kutner. 1985. Applied Linear Statistical Models. 2nd ed. Richard D. Irwin, Inc., Homewood, IL. p. 346-351.

Pawlak, J. A., D. S. Murray, and B. S. Smith. 1990. Influence of capsule age on germination of nondormant jimsonweed (*Datura stramonium*) seed. Weed Technol. 4:31-34.

Rogers, J. B., D. S. Murray, L. M. Verhalen, and P. L. Claypool. 1996. Ivyleaf morningglory (*Ipomoea hederacea*) interference with cotton (*Gossypium hirsutum*) Weed Technol 10:107-114.

SAS Institute Inc. 1988. SAS/STAT® User's Guide, Release 6.03 Edition Cary, NC: Statistical Analysis Systems Institute.

Smith, B. S., D. S. Murray, and D. L. Weeks. 1990. Velvetleaf (*Abutilon theophrasti*) interference with cotton (*Gossypium hirsutum*). Weed Technol. 4:799-803.

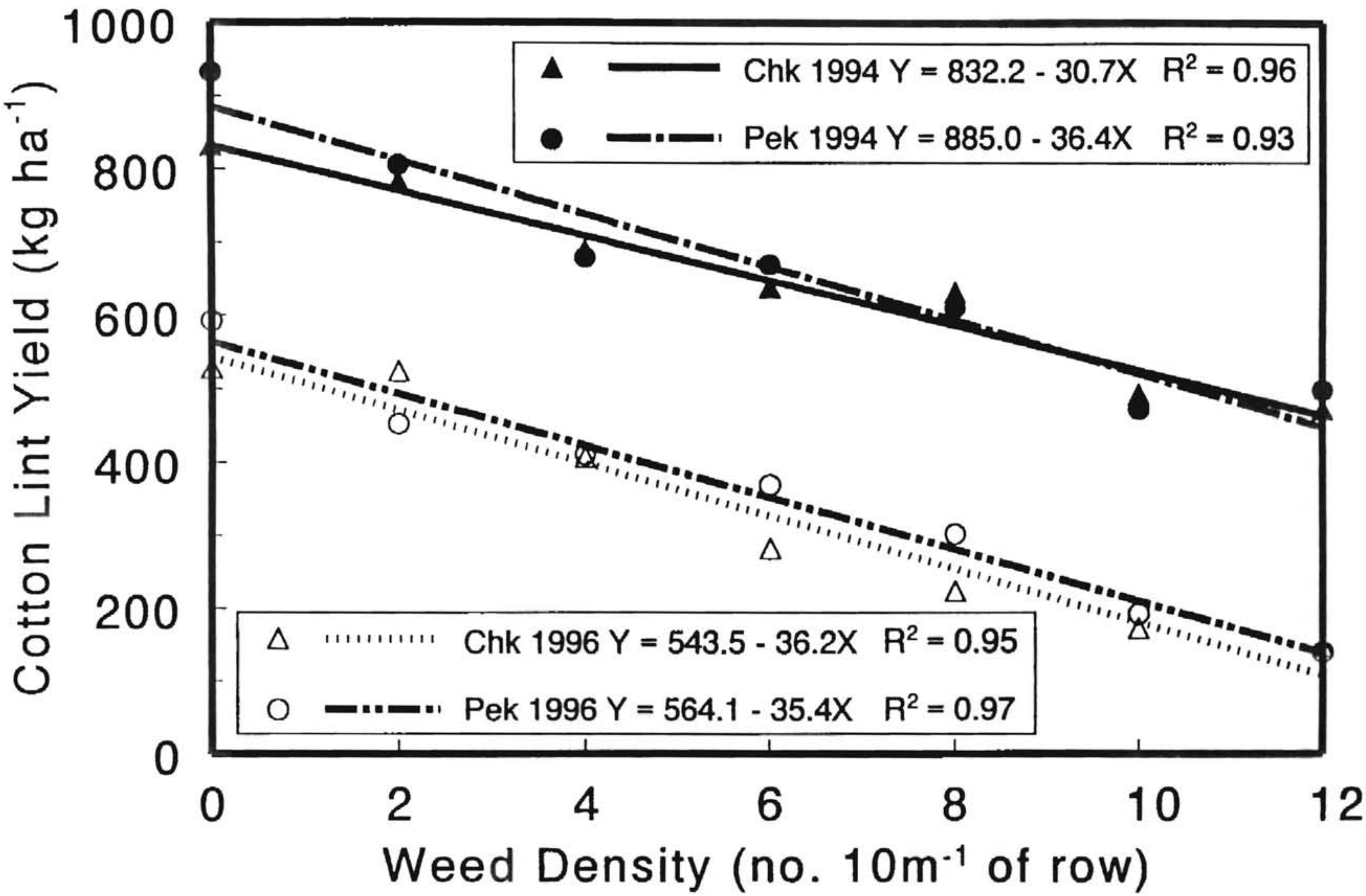


Figure 1. Mean cotton lint yield response to ivyleaf morningglory densities at Chickasha (Chk) and Perkins (Pek) in 1994 and 1996.

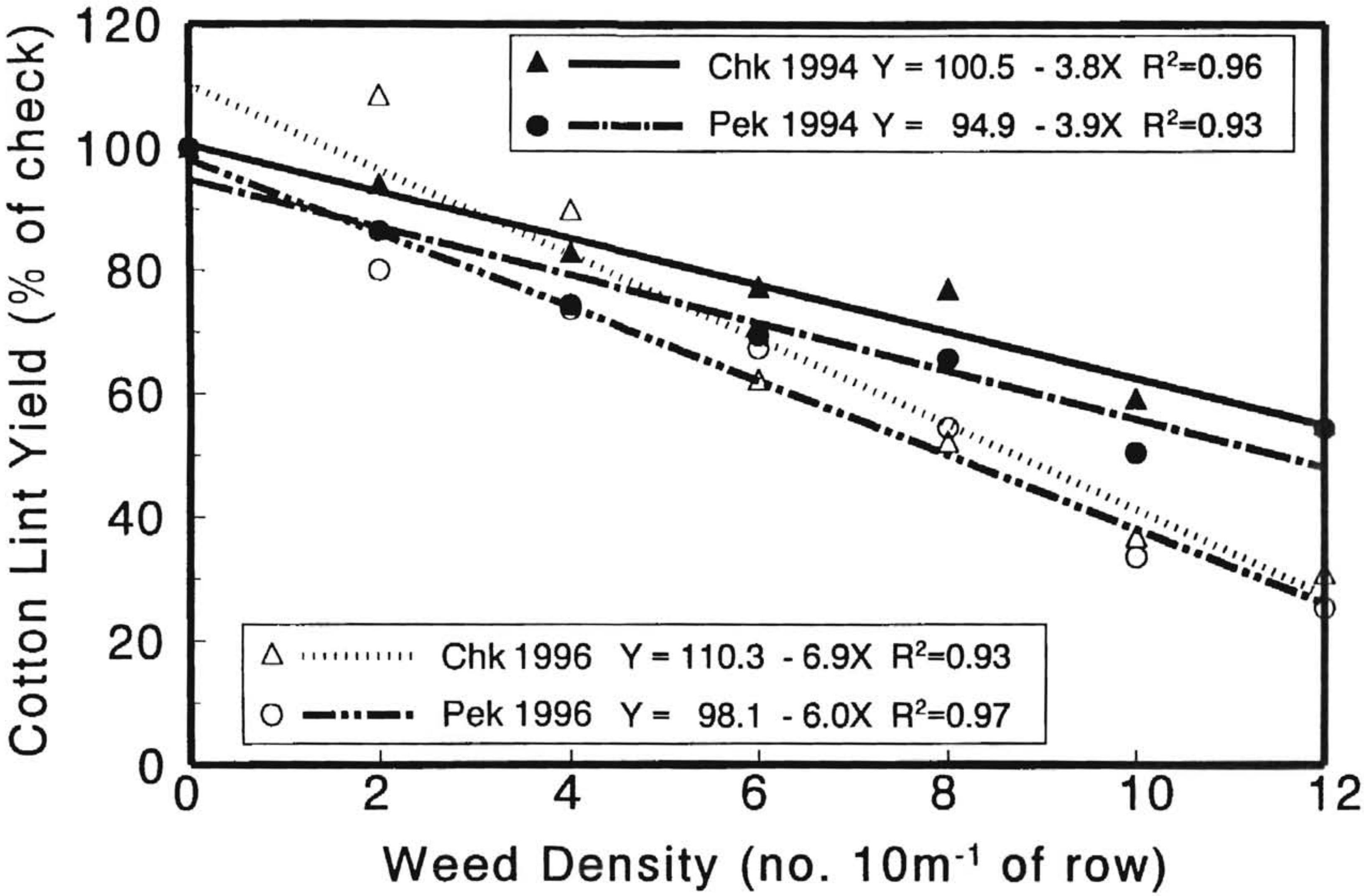


Figure 2. Mean cotton lint yield (expressed as a percentage of the check) response to ivyleaf morningglory densities at Chickasha (Chk) and Perkins (Pek) in 1994 and 1996.

APPENDIX

Appendix Table 1. Machine-harvest efficiency relative to ivyleaf morningglory density.

Weed density no. $10m^{-1}$ row	Harvest efficiency		
	Chickasha	Perkins	
	1994	1994	1996
		%	
0	63.8	52.2	36.7
2	69.3	50.1	80.6
4	73.1	49.5	70.5
6	71.3	54.6	37.0
8	70.2	62.3	47.7
10	70.9	55.9	0
12	0	57.6	0
LSD (0.05)	NSD[b]	NSD	NSD

[a]Harvest efficiencies of 0 occur at densities that could not be mechanically harvested.

[b]NSD indicates no significant differences among means at the 0.05 probability level (using the protected LSD).

Appendix Table 2. Fiber quality relative to ivyleaf morningglory density at Chickasha and Perkins in 1994.

	Fiber quality							
	Chickasha				Perkins			
Weed density	Fiber length	Length uniformity	Strength	Micronaire	Fiber length	Length uniformity	Strength	Micronaire
no. $10m^{-1}$ row	cm	%	g tex^{-1}	unit	cm	%	g tex^{-1}	unit
0	2.54	83	28b[a]	5.2a	2.64	84	32	4.2
2	2.67	83	33a	5.2a	2.67	82	30	4.6
4	2.62	83	30ab	4.9ab	2.64	84	33	4.5
6	2.66	82	29b	4.9ab	2.59	84	31	4.3
8	2.62	83	30b	4.7b	2.54	84	30	4.3
10	2.60	83	27b	4.8b	2.62	84	30	4.4
12	NH[b]	NH	NH	NH	2.62	83	30	4.2
LSD (0.05)	NSD[c]	NSD	3	0.3	NSD	NSD	NSD	NSD

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

[b]NH indicates no harvest.

[c]NSD indicates no significant difference among means at the 0.05 probability level (using the protected LSD).

Appendix Table 3. Fiber quality relative to ivyleaf morningglory density at Chickasha in 1995.

Weed density	Fiber quality				
	Fiber length	Length uniformity	Strength	Micronaire	Elongation
no. $10m^{-1}$ row	cm	%	$g tex^{-1}$	unit	%
0	2.49	82	27	4.5	7.1
2	2.39	81	26	4.5	7.1
4	2.46	82	28	4.5	7.2
6	2.41	81	28	4.4	7.2
8	2.51	80	28	4.5	7.2
10	2.51	82	32	4.4	7.5
12	2.44	81	30	4.4	7.4
LSD (0.05)	NSD[a]	NSD	NSD	NSD	NSD

[a]NSD indicates no significant differences among means at the 0.05 probability level (using the protected LSD).

Appendix Table 4. Effect of ivyleaf morningglory densities on fiber quality at Perkins 1995.

Weed density	Fiber quality				
	Fiber length	Length uniformity	Strength	Micronaire	Elongation
No. $10m^{-1}$ row	cm	%	$g\ tex^{-1}$	unit	
0	2.67	83	35	4.5	7.5
2	2.59	83	36	4.5	7 7
4	2.54	83	34	4.5	7.4
6	2.59	83	35	4.5	7.5
8	2.59	83	34	4.4	7.6
LSD (0.05)	NSD[a]	NSD	NSD	NSD	NSD

[a]NSD indicates no significant differences among means at the 0.05 probability level (using the protected LSD).

Appendix Table 5. Fiber quality relative to ivyleaf morningglory density at Chickasha in 1996.

Weed density	Fiber quality				
	Fiber length	Length uniformity	Strength	Micronaire	Elongation
no. $10m^{-1}$ row	cm	%	g tex^{-1}	unit	
0	2.79	80	31	3.5	9.4
2	2.79	81	31	3.3	9.2
4	2.79	81	30	3.3	9.4
6	2.79	80	31	3.2	9.0
8	2.79	80	30	3.3	9.4
10	2.82	80	32	3.1	9.4
12	2.79	80	31	3.3	9.2
LSD (0.05)	NSD[a]	NSD	NSD	NSD	NSD

[a]NSD indicates no significant differences among means at the 0.05 probability level (using the protected LSD).

Appendix Table 6. Fiber quality relative to ivyleaf morningglory density at Perkins in 1996.

Weed density	Fiber quality				
	Fiber length	Length uniformity	Strength	Micronaire	Elongation
no. $10m^{-1}$ row	cm	%	g tex^{-1}	unit	
0	2.69	81	33	3.7	9.4
2	2.64	81	32	3.5	9.2
4	2.64	82	32	3.4	9.3
6	2.72	81	31	3.7	9.4
8	2.64	82	31	3.4	9.6
10	2.69	83	34	3.5	9.5
12	2.64	82	32	3.5	9.2
LSD (0.05)	NSD[a]	NSD	NSD	NSD	NSD

[a]NSD indicates no significant differences among means at the 0.05 probability level (using the protected LSD).

Appendix Table 7. Yield and harvest efficiency data at Chickasha in 1995, rep I.

			Chickasha			
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
				no.	kg ha^{-1}	%
1	0	0	102	2	315	—[a]
1	0	0	102	3	475	—
1	0	0	102	4	—	51.3
1	2	2	101	2	388	—
1	1	2	101	3	407	—
1	2	2	101	4	—	27.5
1	4	4	103	2	341	—
1	4	4	103	3	137	—
1	4	4	103	4	—	30.1
1	3	6	104	2	296	—
1	3	6	104	3	489	—
1	1	6	104	4	—	64.9
1	8	8	106	2	153	—
1	7	8	106	3	136	—
1	6	8	106	4	—	46.3
1	5	10	107	2	463	—
1	9	10	107	3	202	—
1	6	10	107	4	—	46.8
1	7	12	105	2	297	—
1	6	12	105	3	217	—
1	8	12	105	4	—	48.2

[a]Harvest efficiency conducted for row three only, yield is not reported.

Appendix Table 8. Yield and harvest efficiency data at Chickasha in 1995, rep II.

			Chickasha			
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
				no.	kg ha^{-1}	%
2	0	0	201	2	92	—[a]
2	0	0	201	3	109	—
2	0	0	201	4	—	64.6
2	2	2	202	2	196	—
2	2	2	202	3	253	—
2	2	2	202	4	—	48.9
2	4	4	203	2	112	—
2	4	4	203	3	144	—
2	3	4	203	4	—	56.4
2	5	6	204	2	121	—
2	5	6	204	3	274	—
2	2	6	204	4	—	59.4
2	7	8	205	2	231	—
2	2	8	205	3	265	—
2	4	8	205	4	—	56.9
2	3	10	206	2	189	—
2	2	10	206	3	206	—
2	8	10	206	4	—	51.5
2	7	12	207	2	297	—
2	10	12	207	3	132	—
2	10	12	207	4	—	49.6

[a] Harvest efficiency conducted for row three only, yield is not reported.

Appendix Table 9. Yield and harvest efficiency data at Chickasha in 1995, rep III.

Chickasha						
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
				no.	kg ha^{-1}	%
3	0	0	302	2	107	—[a]
3	0	0	302	3	130	—
3	0	0	302	4	—	64.9
3	1	2	304	2	106	—
3	1	2	304	3	230	—
3	2	2	304	4	—	60.4
3	4	4	305	2	229	—
3	3	4	305	3	75	—
3	4	4	305	4	—	51.6
3	3	6	303	2	146	—
3	1	6	303	3	99	—
3	5	6	303	4	—	47.9
3	5	8	301	2	74	—
3	3	8	301	3	86	—
3	6	8	301	4	—	42.6
3	4	10	306	2	143	—
3	7	10	306	3	128	—
3	8	10	306	4	—	38.7
3	12	12	307	2	116	—
3	8	12	307	3	108	—
3	12	12	307	4	—	0

[a]Harvest efficiency conducted on row four only.

Appendix Table 10. Yield and harvest efficiency data at Chickasha in 1995, rep IV.

			Chickasha			
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
				no.	kg ha^{-1}	%
4	0	0	405	2	196	—[a]
4	0	0	405	3	108	—
4	0	0	405	4	—	54.1
4	1	2	407	2	73	—
4	1	2	407	3	108	—
4	0	2	407	4	—	52.2
4	3	4	401	2	95	—
4	1	4	401	3	82	—
4	3	4	401	4	—	45.1
4	2	6	403	2	133	—
4	3	6	403	3	172	—
4	3	6	403	4	—	46.7
4	6	8	406	2	86	—
4	8	8	406	3	148	—
4	3	8	406	4	—	54.8
4	5	10	402	2	75	—
4	5	10	402	3	139	—
4	7	10	402	4	—	22.9
4	11	12	404	2	9	—
4	11	12	404	3	16	—
4	10	12	404	4	0	0

[a]Harvest efficiency conducted for row three only, yield is not reported.

Appendix Table 11. Yield and harvest efficiency data at Perkins in 1995, rep I.

			Perkins			
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
					kg ha^{-1}	%
1	0	0	101	2	446	—[a]
1	0	0	101	3	412	—
1	0	0	101	4	—	69.1
1	2	2	107	2	450	—
1	2	2	107	3	447	—
1	1	2	107	4	—	75.7
1	4	4	103	2	441	—
1	3	4	103	3	396	—
1	2	4	103	4	—	68.1
1	5	6	106	2	445	—
1	2	6	106	3	428	—
1	4	6	106	4	—	61.0
1	8	8	102	2	328	—
1	4	8	102	3	378	—
1	5	8	102	4	—	62.4
1	10	10	105	2	374	—
1	1	10	105	3	436	—
1	5	10	105	4	—	69.1
1	9	12	104	2	380	—
1	7	12	104	3	321	—
1	11	12	104	4	—	72.8

[a]Harvest efficiency conducted on row four only.

Appendix Table 12. Yield and harvest efficiency data at Perkins in 1995, rep II.

Perkins						
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
				no.	$kg\ ha^{-1}$	%
2	0	0	201	2	421	—[a]
2	0	0	201	3	505	—
2	0	0	201	4	—	63.2
2	2	2	202	2	539	—
2	1	2	202	3	496	—
2	2	2	202	4	—	70.2
2	4	4	203	2	398	—
2	4	4	203	3	358	—
2	2	4	203	4	—	73.7
2	5	6	204	2	461	—
2	5	6	204	3	446	—
2	3	6	204	4	—	54.9
2	8	8	205	2	441	—
2	4	8	205	3	487	—
2	5	8	205	4	—	47.5
2	9	10	206	2	496	—
2	3	10	206	3	489	—
2	7	10	206	4	—	65.7
2	9	12	207	2	556	—
2	6	12	207	3	405	—
2	6	12	207	4	—	66.9

[a]Harvest efficiency conducted on row four only.

Appendix Table 13. Yield and harvest efficiency data at Perkins in 1995, rep III.

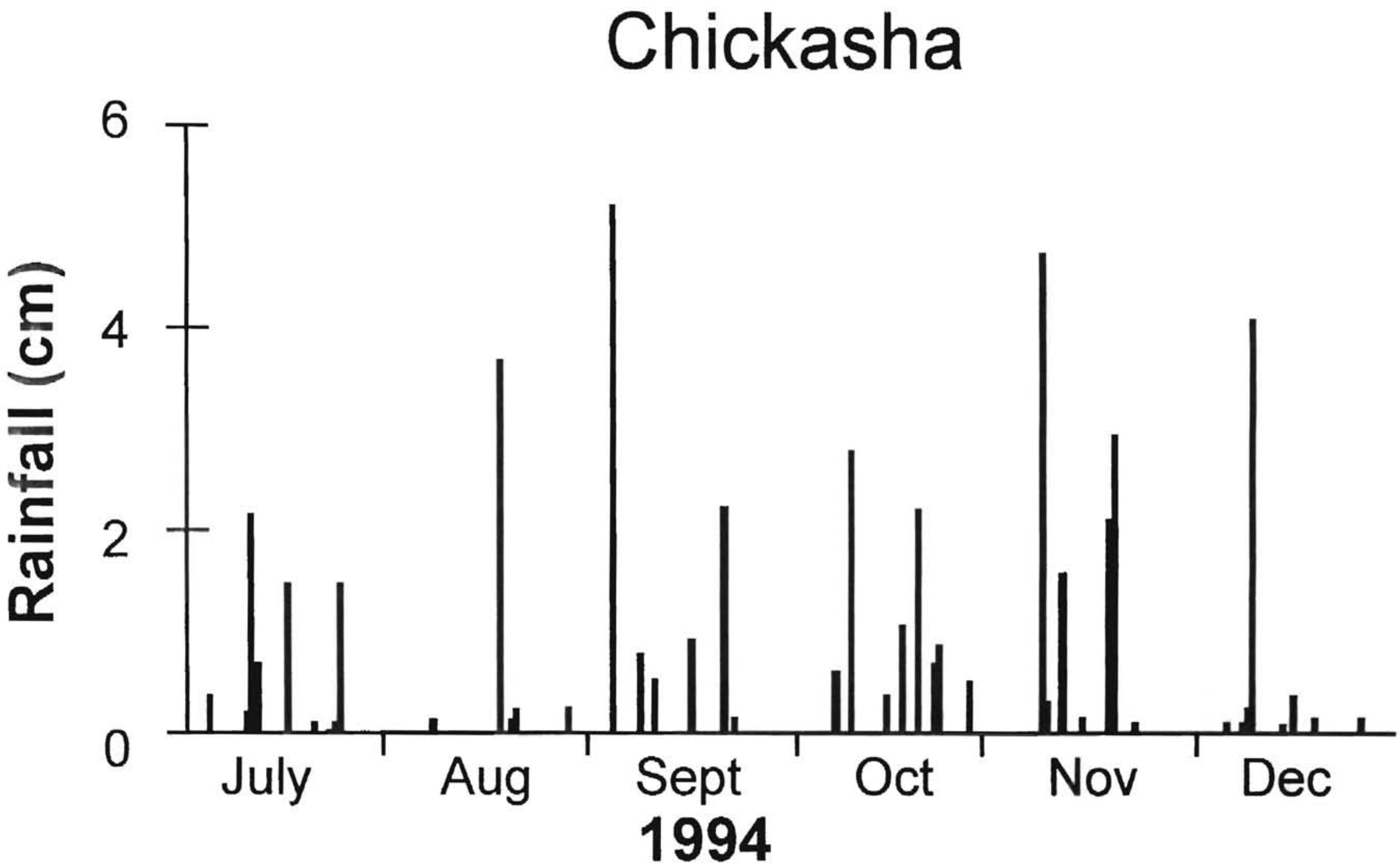
Perkins						
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
				no.	$kg\ ha^{-1}$	%
3	0	0	307	2	444	—[a]
3	0	0	307	3	554	—
3	0	0	307	4	—	71.8
3	2	2	304	2	466	—
3	2	2	304	3	436	—
3	2	2	304	4	—	66.5
3	4	4	303	2	461	—
3	2	4	303	3	343	—
3	3	4	303	4	—	59.7
3	5	6	302	2	543	—
3	4	6	302	3	446	—
3	2	6	302	4	—	69.9
3	6	8	306	2	360	—
3	5	8	306	3	292	—
3	8	8	306	4	—	68.9
3	6	10	301	2	392	—
3	8	10	301	3	432	—
3	10	10	301	4	—	72.5
3	7	12	305	2	309	—
3	7	12	305	3	322	—
3	9	12	305	4	—	64.1

[a]Harvest efficiency conducted on row four only.

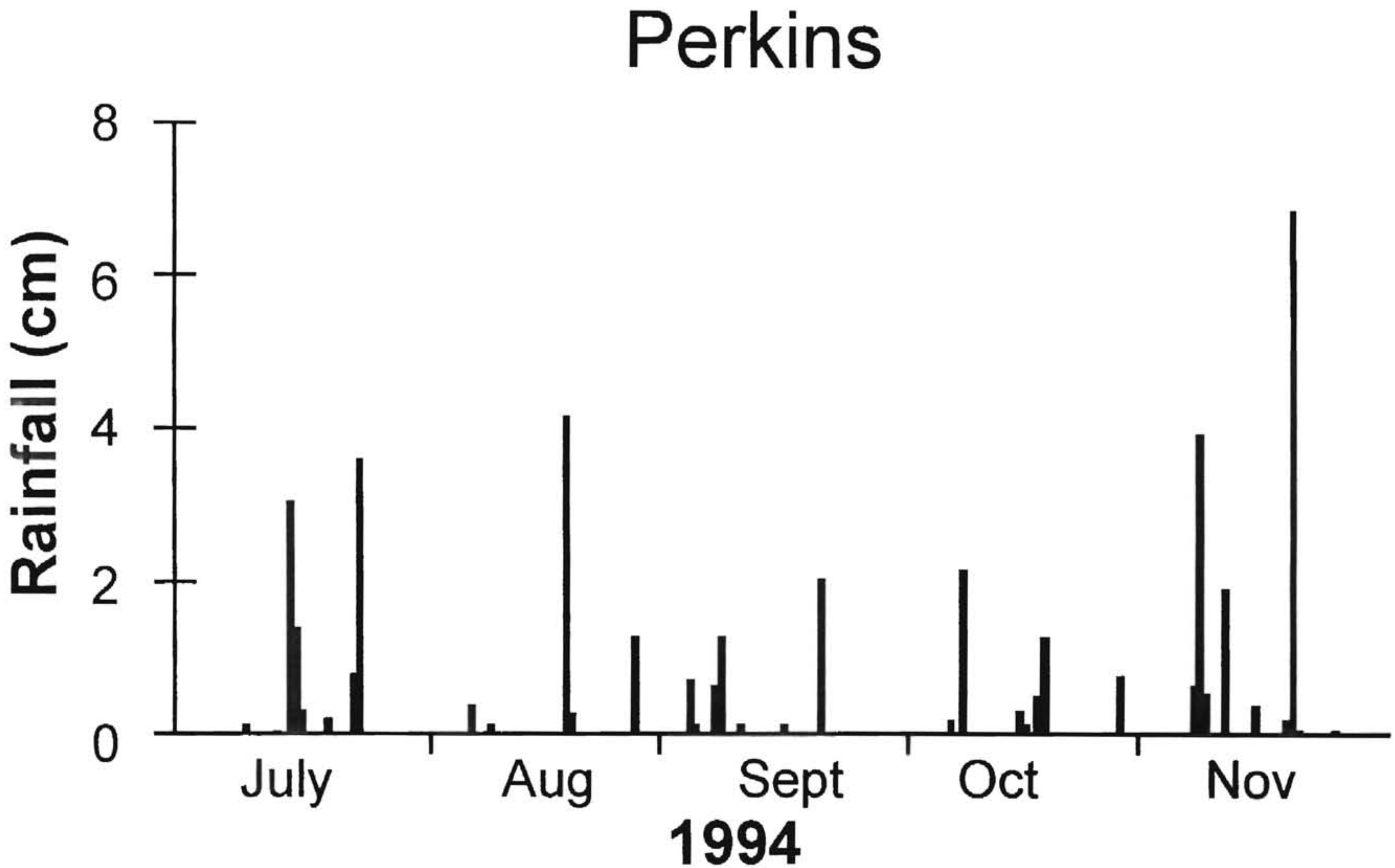
Appendix Table 14. Yield and harvest efficiency data at Perkins in 1995, rep IV.

			Perkins			
Rep	Observed Density	Target Density	Plot	Row	Lint yield	Harvest efficiency
					kg ha^{-1}	%
4	0	0	403	2	407	—[a]
4	0	0	403	3	375	—
4	0	0	403	4	—	65.9
4	1	2	404	2	493	—
4	1	2	404	3	442	—
4	1	2	404	4	—	65.9
4	2	4	407	2	354	—
4	4	4	407	3	304	—
4	1	4	407	4	—	62.7
4	6	6	406	2	433	—
4	2	6	406	3	526	—
4	4	6	406	4	—	61.7
4	8	8	401	2	417	—
4	4	8	401	3	319	—
4	4	8	401	4	—	68.4
4	9	10	402	2	445	—
4	7	10	402	3	452	—
4	5	10	402	4	—	71.8
4	7	12	405	2	445	—
4	6	12	405	3	340	—
4	9	12	405	4	—	57.0

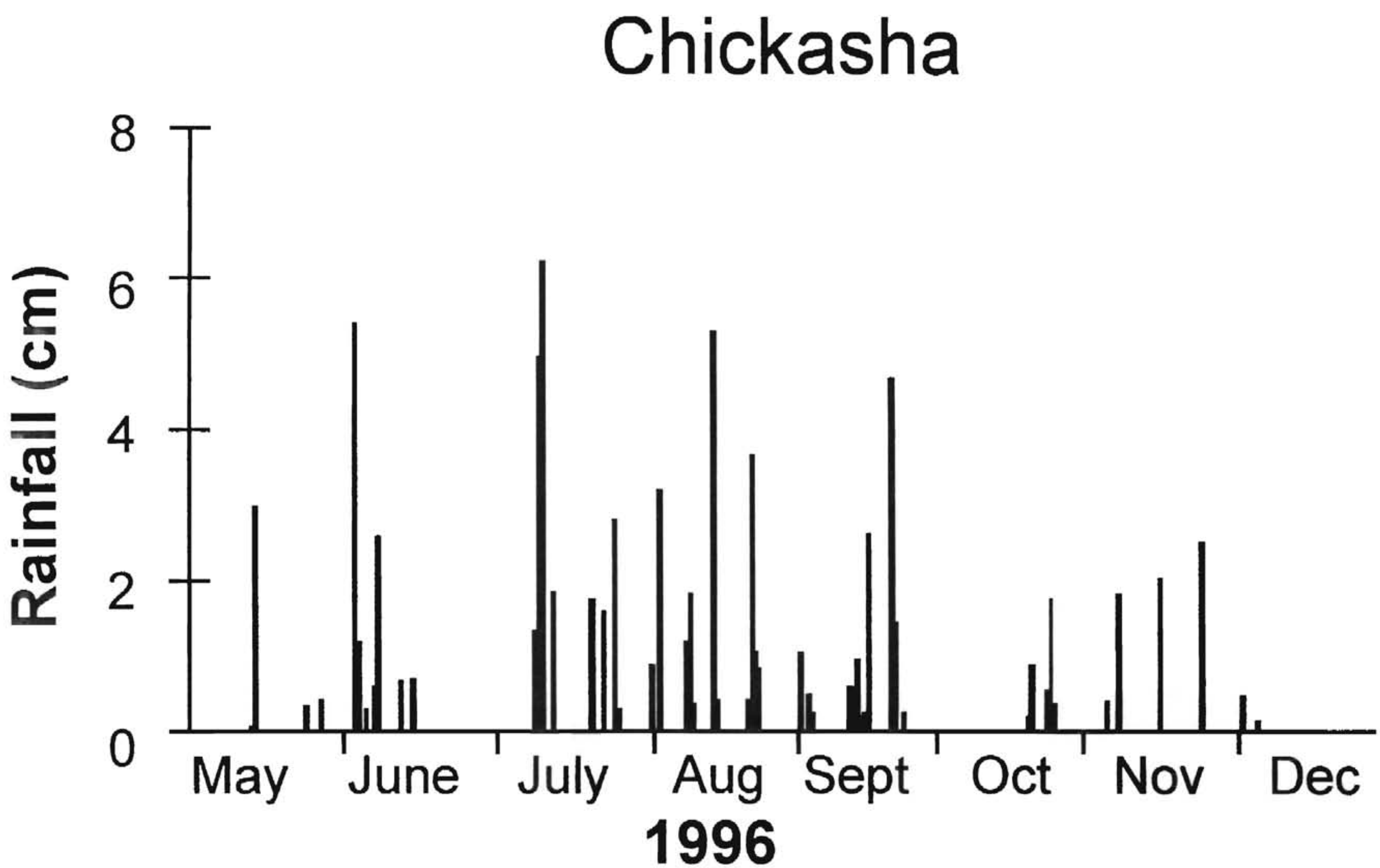
[a]Harvest efficiency conducted on row four only.



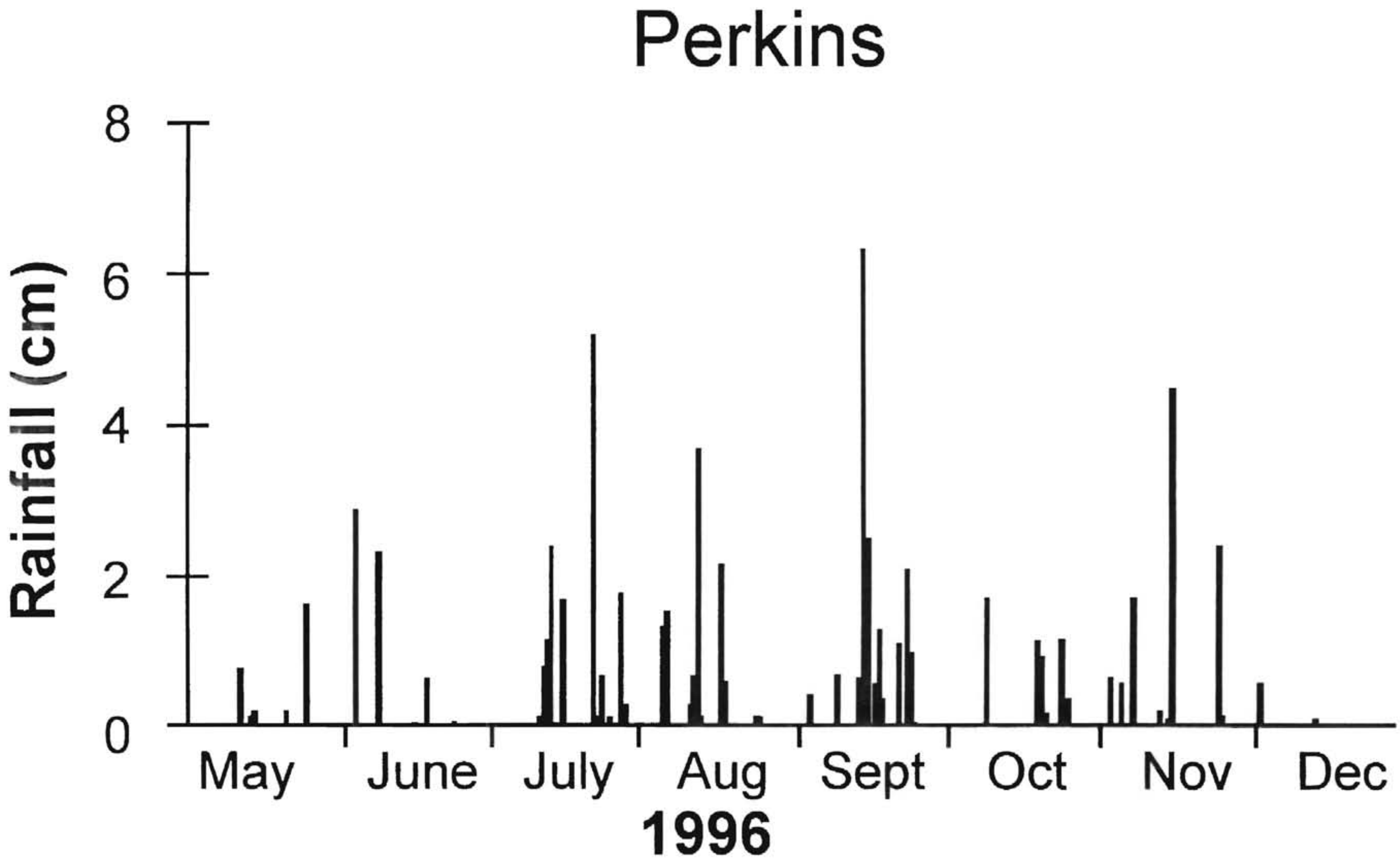
Appendix Figure 1. 1994 rainfall accumulation during the growing season at Chickasha.



Appendix Figure 2. 1994 rainfall accumulation during the growing season at Perkins.



Appendix Figure 3. 1996 rainfall accumulation during the growing season at Chickasha.



Appendix Figure 4. 1996 rainfall accumulation during the growing season at Perkins.

VITA

Mark Louis Wood

Candidate for the Degree of

Master of Science

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