Chapter 5

ECONOMICS OF COTTON LOSSES CAUSED BY WEEDS

J. M. Chandler
Texas A&M University
Texas Agricultural Experiment Station
College Station, Texas
and
F. T. Cooke, Jr.
Mississippi State University
Delta Branch Experiment Station
Stoneville, Mississippi

INTRODUCTION

Man produces crops such as cotton under a controlled environment or pure culture. This is contrary to nature's ways where no one plant species can fully exploit the resources of a habitat. Thus, as long as there has been agriculture, growers have fought weeds. The universal occurrence of weeds as constant components of agricultural environments as opposed to the epidemic nature of other pests has delayed recognition of the importance of weed control in crop production. Weed control is one of the oldest agricultural practices, yet, one of the newest to receive scientific attention. In general, absence of weed control in a crop may result in no return for that crop regardless of other inputs (Harlan and DeWit, 1965; DeWit and Harlan, 1975).

Weeds are natural occurrences in the agricultural monoculture ecosystem created by man's food and fiber production systems. Cotton losses due to the presence of weeds may occur in several ways, although damage caused is not always as obvious as losses caused by other pests. These losses occur at various stages in the cotton production cycle. Weeds (a) reduce seed cotton yields; (b) reduce the quality of the cotton fiber; (c) increase production costs (costs of hand weeding, mechanical tillage, fertilizer and herbicides); (d) impede efficient irrigation and water management; (e) reduce market value of the land; (f) serve as hosts and habitats for insects, disease-causing organisms, nematodes and rodents; and (g) can cause allergenic reactions in humans (Shaw, 1964). Prior to the early 1900s, weeds in cotton were controlled by hand-hoeing. In the early 1900s, a combination of five to seven mechanical cultivations and hand-hoeing provided adequate weed control. The amount of tillage utilized was determined largely by the kind and number of weeds, economic conditions and prevailing weather (Cates, 1917). Manpower for mechanical cultivation with half-row mule equipment required 24.3 man hours per acre in 1937-38 and 13.2 man hours per acre for one-row mule cultivation. During the same years, 33 man hours of labor per acre were required for chopping and hoeing (Langsford and Thibodeaux, 1939). The change from animal power to tractor power for cultivating cotton occurred very rapidly between 1939 to 1946 (Brown and Ware, 1958). This change to tractor power made possible more timely weed control, but control methods were very similar to those used with animal power. Tillage and crop rotations were the major methods of weed control in cotton prior to 1946.

In the early 1950s, weed control was the last key needed to complete mechanization of cotton production. It was noted that not until hoe labor was completely eliminated would the efficiencies and economics inherent in mechanization be fully realized. An integral part of this mechanization was use of preemergence chemicals and postemergence herbicidal oils (Crowe and Holstun, 1953). During the 1950s, it was stated that none of the weed control techniques were completely effective and that weed control must be a program instead of a technique. Willard (1951) states "what is particularly needed now is to work out the most economical combination of chemical and cultural methods for each weed in each crop under the widely varied conditions represented in this country". Some 20 years later, a producer made the following statement: "In order to remain in the cotton production business, an economical, effective, flexible herbicide plan is an absolute necessity for any cotton producer. This plan must be designed to meet wide weather variation; and while eliminating the necessity of all hand labor which is either unavailable or impractical to use, must also be combined with other equipment operations or eliminate their necessity for further improved efficiency and cost reduction. It is not the herbicide cost, but the elimination of many other costs or elimination of losses of income that determine the real savings and efficiency in a complete, effective cotton herbicide program" (Eller, 1971).

ECONOMICS OF CURRENT COTTON WEED MANAGEMENT SYSTEMS

In highly developed cotton production systems, where weed control is an integral part of production, increased costs of herbicides and fuel in the early 1980s focused attention toward integrated weed management systems. These systems, involving the judicious integration of manual (i.e. hand-hoeing), cultural, mechanical and chemical control procedures, have been developed and refined to current levels of use over the past four decades. During this period, producers shifted from a previously labor-intensive production system to intensive use of herbicides as the integral component for controlling weeds. In 1952, only five percent of the cotton acreage was treated with herbicides to control weeds, but by 1966, the level had risen to 52 percent (Strickler and Hinson, 1962; Fox *et al.*, 1968). Cotton acreage treated with herbicides in 1971 and 1982 was 82 and 97 percent, respectively, and apparently has leveled off with only 94 percent of the acreage treated in 1987 (Andrilenas, 1975; Delvo and Hanthorn, 1983; Delvo, 1988). In the United States, total herbicide purchases for cotton in 1978, 1980, and 1985 were \$128, \$142 and \$125 million, respectively (Anonymous, 1979; Anonymous, 1981; Anonymous, 1985).

Increasing costs of cotton production lowers producer's tolerance of production losses caused by weeds. The development of an economical and effective weed control program is critical to producers since expenditures on weed control further limit the resources that a producer is able to invest toward increasing production efficiency. In developing a weed control program for cotton, the producer must: (a) select the most effective herbicides; (b) consider application equipment and techniques; (c) address timing of herbicide applications; and (d) evaluate the potential use of spot treatments and supplemental hand-hoeing (Holstun and Wooten, 1966).

This chapter will address several components of weed control costs in cotton production in the United States. The first of these is actual cost of inputs used to control weeds in cotton. To do this the cost of each practice and input must be determined. To provide data which can be aggregated, weed control costs are reported for each cotton producing state, or major cotton producing region within a state. The determination of per-acre weed control costs can be done several ways. The method for development of this chapter seems to be most appropriate in providing reliable comparisons between regions and states and was consistent with time and monetary constraints.

Weed scientists or extension cotton specialists in each state were asked to provide for each major subregion in their state the usual inputs, i.e., practices, equipment and size, herbicides and rates, and hoe labor, used for weed control in cotton in 1985. The costs of inputs, i.e., equipment, herbicides and wage rates, vary widely between regions and states and are often not available. Even when they are available, methods of collecting such data vary so greatly that making comparisons between states may not be meaningful. For these reasons machinery, herbicide and labor costs for Mississippi were used for all regions (Williams *et al.*, 1985). The use of Mississippi input costs will result in some under statement of machinery and herbicide costs in many regions. The Mississippi labor rates are the minimum required by law. Wage rates, especially for hand-hoeing, vary greatly from state to state.

The use of specific data from each state reflects the latest technology and makes comparisons between regions and states meaningful. Experience indicates, however, that cotton specialists may tend to report recommended practices rather than usual practices. Thus the weed control costs reported here are somewhat higher than those reported from surveys attempting to measure average cost (Williams *et al.*, 1985). Tables 1 through 17 report regional, state and national costs of weed control inputs for cotton as estimated by the various state cotton weed scientists and specialists.

The second aspect addressed in this chapter is yield reductions and value of these reductions resulting from weed competition. The estimates of reductions in yields and income utilize 1985 production and prices for each cotton growing state. These data are presented in Table 18. The ten most frequently reported weeds that cause cotton yield losses and the degree of loss is presented in Table 20. Table 21 indicates reductions due to weeds for cotton at four different yield potentials and four possible prices.

This chapter also attempts to assess economic losses associated with bales classed "grassy" in the United States from 1961 through 1986. Table 19 presents total bales by year, number of grassy bales and percent of the crop classed grassy. These data are taken from published reports of the Cotton Division, Agricultural Marketing Service, USDA. As the size of the crop and demand for the crop in any given year affect premiums and discounts for specific grades of cotton, it would be extremely difficult to determine the average discount for a grassy bale for each of the years included in this report. For this reason, as well as the desire to use constant dollars, the average difference between grades 41-34 and 51-34, as expressed in terms of loan values for the years 1983 through 1987, plus one cent a pound were used to establish a differential between average grade and staple and grassy bales in this evaluation. Personal communications with Mr. Hollis Bowling, Assistant Chief, Market News, Cotton Division, AMS, Memphis, Tennessee, and Mr. Larry Creed, Director, Cotton Division, AMS Classing Office, Greenwood, Mississippi, suggested that this discount would most accurately reflect prices paid for grassy bales. Thus, an average price difference of one full grade plus one cent per pound or 5.58 cents or $26.78 per bale was used in this evaluation.

The production system used by a producer and the development of an integrated weed management system may be unique for each individual field due to the great diversity in environment. However, within broad production regions throughout the Cotton Belt, general or typical weed control systems can be identified (Tables 1 to 16). The total cost for full-season weed control varied from $19.31 per acre in the Southern High Plains of Texas to $67.18 per acre in Arkansas (Tables 8 and 13). In the Southeastern states (AL, GA, FL, NC, SC, TN) excluding South Carolina and Tennessee, the average costs for full-season weed control was $41.87 per acre. The average for South Carolina and Tennessee was $53.20 per acre where an additional cultivation and post-directed herbicide application were required. In the Mid-South (AR, LA, MS, MO), the average cost for Mississippi and Arkansas was $64.62 per acre while the average cost for Missouri and Louisiana was $43.23 per acre. In the Southwest (OK, TX), the cost for full-season weed control was greatly affected by level of moisture available to the crop. In Oklahoma, cost for full-season weed control was $25.58 and $46.13 per acre for dryland and irrigated production systems, respectively (Table 12). In

Texas, the cost of full-season weed control ranged from $19.31 per acre in the-Southern High Plains to $37.17 per acre in the Coastal Bend and South Texas areas where the annual rainfall is much higher and the season is longer (Table 13). In the West (AZ, CA, NM) irrigated cotton, the average cost of a full-season weed control program was $58.19 per acre.

The use of a preplant incorporated dinitroaniline herbicide (Treflan® or Prowl®) was common to all regions. In Arkansas, Louisiana, and Mississippi, a half rate at 0.75 lb per acre of norflurazon (Zorial®) applied preplant incorporated was also a common practice. There was some variation in the type of incorporation implement used with the disk most widely used. Timing of application was late winter to early spring except in the Coastal Bend and South Texas regions where an early fall application was made. The early fall application necessitates use of winter tillage to control winter annual broadleaf weeds. The total cost of applying a preplant incorporated herbicide ranged from $9.01 to $19.48 per acre with an overall average of $14.86 per acre.

At planting, a preemergence herbicide was banded over the crop row in all regions except in the dryland production region of Oklahoma (Table 12), the West (Tables 14-16) irrigated cotton where chemical activation can be a problem and in Florida (Table 3) where the preemergence treatment was applied broadcast. Where the herbicide was banded, the total cost ranged from $2.51 to $8.04 per acre with an overall average of $5.64 per acre.

Cotton fields in the Southeast and Mid-South are cultivated three or four times during the growing season with the exception of Florida where a typical weed control program contained only two cultivations. In the Southwest and West, two or three cultivations were required. The cost of a single cultivation ranged between $4 to $5 per acre depending on size of equipment. Where twelve-row equipment is used, the cost was lowered to $2.50 per acre. Most directed postemergence applications of herbicides are in conjunction with a cultivation. Generally, one to two directed postemergence herbicide applications are made prior to cotton blooming in the Southeast and Mid-South. Both broadleaf and grass herbicides are applied with the cost of material ranging between $2 to $6 per acre with a mean cost of approximately $4 per acre. In Tennessee, early season over-the-top postemergence herbicide applications are substituted for directed postemergence herbicide applications (Table 7). Typically directed postemergence applications are not made in the Southwest and West.

In regions where moisture is adequate and the growing season is long, a need exists for late-season weed control to insure against weed interference at harvest. Layby herbicide applications are generally made in the higher rainfall regions of the Tennessee Valley in Alabama, South Carolina, Arkansas, Louisiana and Mississippi and irrigated regions of Arizona and California. Cost of these applications ranged from $9 to $15 per acre depending on the rate of herbicide applied. The herbicide rate is generally higher than earlier directed postemergence treatments since residual control is needed to protect the crop until harvest.

The use of hand-hoeing was still employed as an integral part of production systems in the West and irrigated areas of Oklahoma (Tables 12 and 14-16). In Arkansas and Mississippi, weeds not controlled with herbicide programs were removed by hand-hoeing (Tables 8 and 10). The cost of hand-hoeing ranges from less than $10 per acre to more than $20 per acre. Hand-hoeing was especially important where producers are dealing with perennial weed problems. In the Southern High Plains of Texas, expensive hand-hoeing has been replaced with spot-spraying of herbicides (Table 13). This technique was widely used on two very difficult to control perennial weeds, silverleaf nightshade and johnsongrass. In large fields of skip-row cotton, small all- terrain vehicles have been used widely for spot-spraying.

The total costs of equipment used per acre related to weed control was similar in most regions except Tennessee where cost was higher, and in Texas, where the cost was considerably lower (Tables 7 and 13). Total labor cost per acre was extremely high in those areas where hand-hoeing was employed. Labor costs, excluding handhoeing in the Southeast, Mid-South, West and Oklahoma, were very similar but labor costs in Texas were lower, especially in the Southern High Plains. The total cost per acre for herbicides in Arkansas, Louisiana, and Mississippi was substantially higher than other states (Tables 8-10). Herbicide costs per acre in New Mexico, the dryland production region of Oklahoma, Southern High Plains and the Blackland Prairie of Central Texas were substantially lower than the other states.

MONETARY LOSSES WITH CURRENT COTTON WEED MANAGEMENT SYSTEMS

The importance of herbicides in cotton production systems is best understood when considering potential losses that could be expected if weeds were controlled only with non-chemical techniques. It has been estimated that cotton production in the United States without herbicides would result in a net loss of $1.5 billion or 40 percent of the 1976 total crop value (Abernathy, 1981).

An exhaustive search of literature was not able to put a time series together on change in cost of herbicides. A great deal of literature within cotton growing states reports weed control cost from time to time but a series that uses constant methodology and procedures for collecting herbicide cost data does not exist. Chapter 7 in this monograph reports quantities of herbicides used in cotton over an extended period of time.

Based on 1985 planted cotton acreage and the data presented in Tables 1 to 16, the estimated total expenditures for equipment, labor and herbicides used to control weeds in cotton was $406,851,000 or on the average of $38.50 per acre across the entire Cotton Belt (Table 17). This production expense must be considered as a loss resulting from weeds and accounts for 11.3 percent of the total value of the crop. The percentage of the regional totals spent on equipment for both the Southeast and Southwest was 52 percent. The percentage for labor was 12 and 13 percent, respectively, while the percentage for herbicides was 36 and 35 percent, respectively, for the two regions. In the Mid-South and the West, 34 percent of the regional total was spent on equipment. Labor accounted for 19 percent while herbicide expenditures were 47 percent of the Mid-South regional total. This is indicative of the numerous herbicide applications used to control weeds in the Mid-South. In the West where considerable hand-hoeing is used, the labor expense was 43 percent of the total while herbicide expenditures accounted for 23 percent of the total.

The increased use of herbicides along with mechanical tillage since the early 1950s in cotton production systems has lead to a drastic reduction in the hand labor required to control weeds. Even with this shift, we still have weeds as major pests in cotton that resulted in a $188,335,000 loss in 1985 (Table 18). This figure represents only losses resulting from weed interference in the field. This loss represents an average lint yield reduction of 5.2 percent or 716,100 bales in the United States. Yield reduction ranged from 1.0 to 10.1 percent across the production regions. The degree of yield reduction is influenced by weed species infesting the crop, geographic location with associated environmental parameters and level of control technology applied to the weed populations in the cotton fields.

The number of grassy bales and the proportion of the United States crop that were grassy bales for the years 1961 through 1986 are presented in Table 19. The cost to producers of bales classed grassy, is variable from year to year, and is dependent upon the size of crop, demand for the crop, proportion of different grades and staples available, and differs from location to location. For this reason, it was necessary to establish a discount rate for grassy bales relative to the price paid for the average grade and staple for the U.S. crop. The difference between strict low middling, 1-1/32, 43-41 and low middling, 1-1/16, 51-34 plus one cent per pound was chosen to reflect the cost of a bale of cotton being classed as grassy. The price differences used in this analysis are official loan prices and their difference for the two grades. The use of a constant price (5.58 cents per pound or $26.78 per bale) allows a comparison of the economic cost of grassy bales over time. The average number of bales and costs in terms of reduced farm income for each of the years and for 5-year averages is also presented in Table 19.

The number of bales and the percent of the total crop which are classed grassy, thus the loss due to grassy bales, appears erratic and variable. The cost of grassy bales to producers in 1961, 1967 and 1986 were lowest for the time-period covered. The highest two years were 1963 and 1971. The average annual loss due to grassy bales is $9,431,000. If we examine 5-year average costs to producers over time, there appears to be a reduced percentage of the crop with grassy bales since 1982. The introduction of new postemergence herbicides in the early 1980s may be helping in the reduction. Certain rainfall patterns during the growth season probably has a great influence on the number of grassy bales each year, but such an analysis is beyond the scope of this chapter.

Worldwide, approximately 100 plants have been reported as weeds in cotton. In the United States, approximately 30 plants infesting cotton fields are economically important weed species (Holm *et al.*, 1977). Approximately 80 percent of the losses from weeds in cotton can be attributed to 10 weed species (Table 20). In 1985, morningglories and nutsedges reduced cotton yields in all cotton producing states of the United States. Morningglories account for 16 percent of the losses caused by weeds in United States cotton. Pigweeds and johnsongrass caused losses in all states except one with pigweeds causing substantial losses in Oklahoma and Texas. Common cocklebur, prickly sida, crabgrasses, and spurges cause losses mainly in the Southeast and Mid-South states with common cocklebur accounting for 14 percent of the losses caused by weeds in cotton. Silverleaf nightshade caused substantial losses in the Southwest and West. Losses from bermudagrass have been reported in some states in all four production regions. Weed species with limited distribution should be monitored closely to insure against further spread since they survive under control procedures. For additional information on individual weed species see Chapter 6.

INFLUENCE OF DELETERIOUS WEEDS ON MONETARY RETURNS USING CURRENT COTTON WEED MANAGEMENT SYSTEMS

There has always been a concern with identifying economic thresholds for pests which reduce cotton yields. The term "economic threshold" has been widely used by entomologists for many years. It is less frequently used by weed scientists working in cotton but still a considerable concern to both agricultural scientists, extension people and cotton producers. Economic thresholds have different connotations for different disciplines involved in agricultural research. The economist's definition is as follows: the economic threshold for a given pest is that level of infestation where cost of reduced yield is equal to cost of an input (i.e. application of a pesticide). Stated another way, if one dollar is spent to reduce a pest infestation sufficiently to give a yield increase of $1.01, then the input is profitable.

Determination of economic thresholds is complex. The measurement of yield reductions by specific levels of pest infestation is difficult and expensive at best. This problem of exact measurement of economic thresholds for a given pest is compounded under actual cotton production systems. When we consider that a given pest, such as the boll weevil or johnsongrass, is not the only pest species in the field, but is accompanied by other harmful insects and/or weeds. The problem of determining economic thresholds is further compounded by the realities of adequate and accurate sampling techniques to determine levels of pest infestations under production conditions.

The problem of identifying economic thresholds for individual weeds or weed complexes is complicated by the long range impact of such control. It is probable that any weed infestation which results in a measurably lower yield for cotton would justify significant input if, over time, the infestation level is significantly reduced or eliminated.

It appears that before allocation of resources is devoted to the precise measurement of economic thresholds of specific weeds and/or weed complexes, a careful analysis of potential benefits should be made. Such an analysis, of necessity, should take into account the degree of probability of weed species which are not currently considered an economic pest becoming a problem.

The yield potential of a specific cotton field can be drastically reduced by interference of weeds; therefore, sound weed management decisions are mandatory throughout the season. Potential cotton yield losses from weeds are regulated by the density of specific species and duration of interference (Chandler, 1984). Monetary losses related to weed interference are regulated by seed cotton yield and current market value of lint and seed. Producers desiring to maximize profits during a given season must compare the cost of weed control per acre with the potential yield losses associated with a specific weed population. Using prior yield data and published research data, a producer can estimate potential yield losses from specific weed populations.

Calculations have been made that show the value of cotton lint sacrificed by allowing specific percentage of weed losses to occur at selected cotton values over a range of yield potentials (Table 21). For a given production level, value of the loss in yield resulting from specific weed populations will vary with the price of the cotton. For example, a field yielding 500 pounds per acre of lint with a 10 percent yield loss from weed interference would result in monetary losses of \$27.50, \$32.50, \$37.50 or \$45.50 per acre when cotton prices per pound of lint are \$0.55, \$0.65, \$0.75 or \$0.85, respectively.

Weeds such as common cocklebur that are very competitive and widely distributed within a region can cause large monetary losses. In the southeastern region of the United States, common cocklebur over a 3-year period caused a 9 to 21 percent yield loss (Dowler and Hauser, 1975). An early directed postemergence application of MSMA will provide excellent control at a cost of \$6 to \$7 per acre. Even with low market value and low yield potential producers will increase income potential from common cocklebur control.

Other annual broadleaf weeds such as wild okra and devilsclaw are very competitive with cotton causing losses from 10 to 20 percent (Bridges and Chandler, 1984). These weeds have limited distribution within a field and can best be controlled with hand-hoeing or spot-treatment with herbicides. Weed density dictates cost of hand-hoeing which range from \$12 to \$25 per acre. The producer must protect his investment with hand-hoeing on selected and limited areas. The returns on his weed control investment potentially can be very high. The producer with low yield potential must consider the long range impact of these weeds since they are prolific seed producers and the seed have hard coats that maintain seed viability for many years. Where returns are limited, a maintenance or break even weed control program will be required if cotton production is to be maintained over time.

Numerous annual morningglory species are found in fields but in certain areas perennial morningglory species are more prevalent. In moderate to heavy infestations, morningglories reduce cotton yields from 7 to 15 percent (Crowley and Buchanan, 1978). In light infestations, yields may not be reduced, but vines can cause harvest and fiber quality losses. Severe spot infestations of morningglories can prevent cotton pickers from harvesting (Parvin *et al.*, 1985). Delay in harvest can have severe effects on yield, grades, and thus returns to farmers. At best morningglories must be desiccated before problem areas can be harvested.

To obtain full-season morningglory control, producers must use a directed postemergence herbicide in addition to early-season weed control. The cost of each additional directed postemergence treatment ranges from $8 to $12 per acre. In some regions, a portion of hand-hoeing can be attributed to morningglories. An additional investment of $10 to $20 per acre could be required for adequate control. Heavy morningglory-infested fields where the yield potential is low may be rotated with other crops where adequate control techniques are available. Light to moderate morningglory-infested fields with good yield potential can be managed for profitable returns from the additional investment for adequate control.

It is not uncommon for yield losses of 4 to 14 percent to occur from full season johnsongrass interference (Bridges and Chandler, 1987). Herbicides such as fluazifop (Fusilade®) or sethoxydim (Poast®) provide control at $12.80 to $16.00 per acre. A producer with both low yield potential and low prices may not be able to recover cost of control. Producers expecting to make a bale per acre could recover his control investment and possibly double his return if market value is high. A producer with two bale potential would double or triple his weed control investment.

Established infestations of bermudagrass can cause cotton yield losses of 30 to 50 percent (Brown *et al.*, 1985). Generally infestations are in patches across a field. Glyphosate (Roundup®) can be applied to bermudagrass in the fall after harvest or to infestations in fallow fields with cost ranging from $30 to $60 per acre. Multiple applications of sethoxydim (Poast®) or fluazifop (Fusilade®) will provide adequate control at costs ranging from $20 to $40 per acre. It is best to control bermudagrass before it becomes well established. It is easily spread with cultivators or other tillage implements. The cost of bermudagrass control is substantial but so are the potential losses. Where heavy infestations are present, rotations with more closed canopy crops such as soybeans may be appropriate.

Purple nutsedge with field coverage of 20 percent can reduce yields 15 percent or greater (Wills, 1977). Good suppression can be obtained with a preemergence application of norflurazon (Zorial®). Additional control can be obtained with directed postemergence applications of DSMA or MSMA plus prometryn (Caparol®). An investment of $12 to $15 would be required for adequate control. Since this perennial establishes mainly from tubers, the extra effort and investment required for control could be justified over a period of several years.

SUMMARY

In summary, the development of an economical and effective integrated weed management system by individual producers is a necessary component in his overall production strategy. There is great diversity in the weed control strategies employed by cotton producers across the Cotton Belt due to the vast differences in the environment. These diverse environments give rise to weed communities that are unique in composition but contain some of the same pernicious species. Currently, common cocklebur, morningglories, pigweeds, nutsedges and johnsongrass are common in most weed communities across the Cotton Belt in varying intensity.

Across the Cotton Belt with current technology, weeds still cause yield reductions that total $188 million annually or 5.2 percent of the total crop value in 1985. Quality losses due to grassy bales is $9 million annually. The cost of current technology to control weeds is substantial with $406 million spent annually or 11.3 percent of the total crop value. Investments in equipment and herbicides account for 41 and 36 percent, respectively, of this production cost while the remaining 23 percent covers the labor investment. The use of hand labor for controlling weeds in some production regions is still substantial.

The future cost of controlling weeds will rise to keep pace with inflation but the key to future costs will be regulated by the cultural practices and herbicide technology employed by the producer. This in turn will dictate future shifts in species composition of weed communities that infest our cotton fields.

With current government programs and public concern for the environment, we will probably see the development and wide use of limited tillage systems for cotton. This will require the development and use of selective herbicides in place of both primary and secondary tillage operations. These changes will cause shifts in the intensity of weeds interfering with economic cotton production. The developing morningglory problem will be contained with currently emerging herbicide technology. This technology will allow purple nutsedge expansion and it will be even more important and costly to the producer.

Generally speaking, perennial weeds with great genetic diversity such as bermudagrass in the Mid-South and silverleaf nightshade in the Southwest will probably become more dominant. These types of shifts in the weed populations will be very costly to the producer but with increasing costs of production his tolerance of yield losses caused by weeds will be constricted.

Development of herbicide resistant weeds may occur. Currently very few weeds resistant to herbicides used in any crop have been reported in the Cotton

Belt. Most herbicide resistant weeds are developing in states north of the Cotton Belt. Plants developing resistance to herbicides will be more likely to occur in limited tillage systems if we grow continuous cotton. In light of this, an economical crop/herbicide sequence will be very important to future economic production of cotton.

TABLES FOR CHAPTER 5

Table 1. Estimated cost of full-season weed control in solid cotton in Alabama. Based on Alabama (Central and South) practices and four-row equipment in 1985.

Operation[1]	1985 Cost Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); field cultivator (21 ft); broadcast and incorporate 0.5 lb trifluralin/A	7.24	1.16	3.18	11.58
Plant[2]; apply 0.67 lb fluometuron/A (16-in band on 38-in row spacing)	0.47	0.00	5.70	6.17
Cultivate	3.93	1.11	0.00	5.04
Cultivate; post-direct 0.4 lb fluometuron + 0.9 lb MSMA/A (16-in band on 38-in row spacing)	5.99	1.56	4.79	12.34
Cultivate; post-direct 0.33 lb cyanazine + 0.67 lb MSMA/A (16-in band on 38-in row spacing)	4.78	1.25	2.35	8.38
TOTAL	22.41	5.08	16.02	43.51

[1]Source: Personal communication with M. G. Patterson, Auburn, AL, 1987.
[2]Preemergence application equipment cost only.

Table 2. Estimated cost of full-season weed control in skip-row (2 x 1) cotton (one acre cotton requires 1.4 acres land) in Alabama. Based on Alabama (Tennessee Valley) practices and skip-row equipment in 1985.

Operation[1]	1985 Cost Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); field cultivator (21 ft); broadcast and incorporate 0.5 lb pendimenthalin/A	6.73	1.08	2.71	10.52
Plant[2]; apply 0.6 lb fluometuron/A (16-in band on 40-in row spacing + 68-in skip)	0.76	0.00	5.10	5.86
Cultivate	3.94	0.93	0.00	4.87
Cultivate; post-direct 0.3 lb fluometuron + 0.6 lb MSMA/A (16-in band on 40-in row + 68-in skip)	4.86	1.00	3.47	9.33
Cultivate	3.21	0.80	0.00	4.01
Cultivate; post-direct 1.0 lb cyanazine/A (broadcast layby)	3.65	0.80	4.01	8.46
TOTAL	23.15	4.61	15.29	43.05

[1]Source: Personal communication with M. G. Patterson, Auburn, AL, 1987.
[2]Preemergence application equipment cost only.

Table 3. Estimated cost of full-season weed control in solid cotton in Florida. Based on Florida practices and six-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Disk twice (21 ft); broadcast and incorporate 0.75 lb pendimethalin/A	8.96	1.42	4.07	14.45
Plant[2]; apply 1.5 lb fluometuron/A broadcast	0.76	0.00	12.75	13.51
Cultivate	3.94	0.93	0.00	4.87
Cultivate; post-direct 0.37 lb cyanazine + 1.0 lb MSMA/A (20-in band on 40-in row spacing)	3.65	0.80	3.02	7.47
TOTAL	17.31	3.15	19.84	40.30

[1]Source: Personal communications with B. J. Brecke, Jay, FL, 1987.
[2]Preemergence application equipment cost only.

Table 4. Estimated cost of full-season weed control in solid cotton in Georgia. Based on Georgia practices and four-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); broadcast and incorporate 0.75 lb trifluralin/A	8.96	1.42	4.67	15.05
Plant[2]; apply 0.6 lb fluometuron/A (14-in band on 38-in row spacing)	0.47	0.00	5.10	5.57
Cultivate	3.93	1.11	0.00	5.04
Cultivate; post-direct 0.32 lb fluometuron + 0.64 lb MSMA/A (12-in band on 38-in row spacing)	5.99	1.56	3.78	11.33
Cultivate; post-direct 0.32 lb fluometuron + 0.64 lb MSMA/A (12-in band on 38-in row spacing)	4.78	1.25	2.27	8.30
TOTAL	24.13	5.34	15.82	45.29

[1]Source: Personal communication with S. M. Brown, Tifton, GA, 1987.
[2]Preemergence application equipment cost only.

Table 5. Estimated cost of full-season weed control in solid cotton in North Carolina. Based on North Carolina practices and four-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); broadcast and incorporate 0.5 lb trifluralin/A	8.96	1.42	3.14	13.52
Plant[2]; apply 0.5 lb fluometuron/A 12-in band on 36-in row spacing)	0.47	0.00	4.25	6.17
Cultivate	3.93	1.11	0.00	5.04
Cultivate; post-direct 0.3 lb fluometuron + 1.0 lb MSMA/A (12-in band on 36-in row spacing)	4.78	1.25	3.79	9.82
Cultivate	3.21	0.89	0.00	4.10
TOTAL	21.35	4.67	11.18	37.20

[1]Source: Personal communication with H. D. Coble, Raleigh, NC, 1987.
[2]Preemergence application equipment cost only.

Table 6. Estimated cost of full-season weed control in solid cotton in South Carolina. Based on South Carolina practices and four-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); broadcast and incorporate 0.75 lb trifluralin/A	8.96	1.42	4.67	15.05
Plant[2]; apply 0.66 lb fluometuron/a (12-in band on 38-in row spacing)	0.47	0.00	5.61	6.08
Cultivate	5.99	1.56	6.20	13.75
Cultivate; post-direct 0.66 lb fluometuron + 0.38 lb DSMA/A (12-in band on 38-in row spacing)	4.78	1.25	1.83	7.86
Cultivate; post-direct 0.8 lb cyanazine/A (broadcast layby)	4.78	1.25	3.21	9.24
TOTAL	24.98	5.48	21.52	51.98

[1]Source: Personal communication with B. J. Gossett, Clemson, SC, 1987.
[2]Preemergence application equipment cost only.

Table 7. Estimated cost of full-season weed control in solid cotton in Tennessee. Based on Tennessee practices and four-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Disk (14 ft); broadcoast and incorporate 0.75 lb trifluralin/A	9.85	2.18	4.67	16.70
Plant[2]; apply 0.75 lb fluometuron/A (19-in band on 38-in row spacing)	0.47	0.00	6.38	6.85
Cultivate; postemergence over-the-top 0.9 lb DSMA/A (19-in band on 38-in row spacing)	5.99	1.56	1.39	8.94
Cultivate; postemergence over-the-top 0.094 lb flauzifop + 1 qt crop oil concentrate/A (19-in band on 38-in row spacing)	4.78	1.25	7.70	13.73
Cultivate	3.21	0.89	0.00	4.10
Cultivate	3.21	0.89	0.00	4.10
TOTAL	27.51	6.77	20.14	54.52

[1]Source: Personal communication with R. M. Hays, Jackson, TN, 1987.
[2]Preemergence application equipment cost only.

Table 8. Estimated cost of full-season weed control in solid cotton in Arkansas. Based on Arkansas practices and six-row equipment in 1985.

	1985 Cost			
Operation[1]	Equipment	Labor	Material	Total
	(dollars/A)			
Bed Conditioner (21 ft); spring tooth harrow (21 ft); broadcast and incorporate 0.75 lb trifluralin + 0.75 lb norflurazon/A	6.84	1.02	11.62	19.48
Plant[2]; apply 0.75 lb fluometuron/A (19-in band on 38-in row spacing)	0.76	0.00	6.38	7.14
Cultivate; post-direct 0.4 lb fluometuron + 1.0 lb MSMA/A (19-in band on 38-in row spacing)	3.94	0.93	5.94	10.81
Cultivate; post-direct 0.4 lb cyanazine + 0.75 lb MSMA/A (19-in band on 38-in row spacing)	3.21	0.80	5.18	9.19
Hand hoe (2.0 hr/A)	0.00	8.90	0.00	8.90
Post-direct 0.75 lb linuron/A (broadcast layby)	2.86	0.80	8.00	11.66
TOTAL	17.61	12.45	37.12	67.18

[1]Source: Personal communication with R. E. Frans, Fayetteville, AR, 1987.
[2]Preemergence application equipment cost only.

Table 9. Estimated cost of full-season weed control in solid cotton in Louisiana. Based on Louisiana practices and six-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Field cultivator twice (21 ft); broadcast and incorporate 0.75 lb trifluralin + 0.75 lb norflurozon/A	5.82	0.98	11.62	18.42
Plant[2]; apply 0.6 lb fluometuron/A (20-in band on 40-in row spacing)	0.76	0.00	5.10	5.86
Cultivate; post-direct 0.3 lb fluometuron/A (14-in band on 40-in row spacing)	3.94	0.93	2.55	7.42
Cultivate; post-direct 0.2 lb cyanazine/A (16-in band on 40-in row spacing)	3.21	0.80	0.80	4.81
Post-direct 1.2 lb cyanazine/A (broadcast layby, 6-row applicator)	2.86	0.80	4.81	8.47
TOTAL	16.59	3.51	24.88	44.98

[1]Source: Personal communication with S. H. Crawford, Baton Rouge, LA, 1987.
[2]Preemergence application equipment cost only.

Table 10. Estimated cost of full-season weed control in solid cotton in Mississippi. Based on Mississippi practices and eight-row equipment in 1985.

Operation[1]	1985 Cost Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); broadcast and incorporate 0.5 lb trifluralin + 0.48 lb norflurazon/A	5.08	0.80	7.56	13.44
Plant[2]; apply 0.62 lb fluometuron + 0.24 lb norflurazon/A (20-in band on 40-in row spacing)	0.55	0.00	7.49	8.04
Cultivate	3.77	0.71	0.00	4.48
Cultivate; post-direct 0.4 lb fluometron + 1.0 lb MSMA/A (20-in band on 40-in row spacing)	4.56	0.80	4.49	10.30
Cultivate; post-direct 0.25 lb prometryn/A (20-in band on 40-in row spacing)	3.30	0.58	1.90	5.78
Hand hoe (2.5 hr/A)	0.00	11.13	0.00	11.13
Cultivate; post-direct 1.25 lb cyanazine/A (broadcast layby)	3.30	0.58	5.01	8.89
TOTAL	20.56	14.60	26.90	62.06

[1]Source: Personal communication with H. R. Hurst, Stoneville, MS, 1987.
[2]Preemergence application equipment cost only.

Table 11. Estimated cost of full-season weed control in solid cotton in Missouri. Based on Missouri practices and six-row equipment in 1985.

	1985 Cost			
Operation[1]	Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); bed conditioner (14 ft); broadcast and incorporate 1.0 lb pendimethalin/A	9.85	1.69	5.42	16.96
Plant[2]; apply 0.6 lb fluometuron/A (19-in band on 38-in row spacing)	0.76	0.00	5.10	5.86
Cultivate	3.94	0.93	0.00	4.87
Cultivate; post-direct 0.5 lb prometryn + 1.0 lb MSMA/A (14-in band on 38-in row spacing)	3.65	0.80	5.34	9.79
Cultivate	3.21	0.80	0.00	4.01
TOTAL	21.41	4.22	15.86	41.49

[1]Source: Personal communication with H. D. Kerr, Columbia, MO, 1987.
[2]Preemergence application equipment cost only.

Table 12. Estimated cost of full-season weed control in solid cotton in Oklahoma. Based on Oklahoma (dryland and irrigated) practices and six-row or eight-row equipment in 1985.

Operation[1]	1985 Cost Equipment	Labor	Material	Total
	(dollars/A)			
Dryland Production (six-row equipment)				
Disk twice (14 ft); broadcast and incorporate 0.75 lb trifluralin/A	9.85	2.18	4.67	16.70
Cultivate twice	7.15	1.73	0.00	8.88
TOTAL	17.00	3.91	4.67	25.58
Irrigated Production (eight-row equipment)				
Disk twice (21 ft); broadcast and incorporate 1.0 trifluralin/A	8.96	1.42	6.23	16.61
Plant[2]; apply 0.7 lb prometryn/A (14-in band on 40-in row spacing)	0.55	0.00	5.32	5.87
Hand hoe (3 hr/A)	0.00	13.35	0.00	13.35
Cultivate 3 time	8.69	1.61	0.00	10.30
TOTAL	18.20	16.38	11.55	46.13

[1]Source: Personal communication with D. S. Murray, Stillwater, OK, 1987.
[2]Preemergence application equipment cost only.

Table 13. Estimated cost of full-season weed control in solid cotton in Texas. Based on Texas (Southern High Plains, Central Blackland Prairie, Coastal Bend and South Texas) practices and six-row, eight-row, or twelve-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Southern High Plains (twelve-row equipment)				
Spring tooth harrow (30 ft); broadcast and incorporate 0.6 lb trifluralin/A	4.49	0.45	3.74	8.68
Plant[2]; apply 0.25 lb prometryn/A (10-in band on 40-in row spacing)	0.61	0.00	1.90	2.51
Cultivate	1.19	0.41	0.00	2.32
Spot spray[3]; 2% solution of glyphosate for silverleaf nightshade or 1% solution of fluazifop for johnsongrass	1.76	0.45	1.54	3.75
Cultivate	1.74	0.31	0.00	2.05
TOTAL	10.51	1.62	7.18	19.31
Central Blackland Prairie (six-row equipment)				
Disk (21 ft); broadcast and incorporate 0.5 lb trifluralin/A	5.08	0.80	3.13	9.01
Plant[2]; apply 0.5 lb prometryn/A 10-in band on 40-in row spacing)	0.76	0.00	3.80	4.56
Cultivate twice	7.15	1.73	0.00	8.88
TOTAL	12.99	2.53	6.93	22.45

Table 13. Continued

Operation[1]	1985 Cost Equipment	Labor	Material	Total
	(dollars/A)			
Coastal Bend and South Texas (eight-row equipment)				
Disk (21 ft); broadcast and incorporate 1.5 lb trifluralin/A (fall applied)	5.08	0.80	9.35	15.23
Light tillage with hipper (winter)	2.73	0.58	0.00	3.31
Plant[2]; apply 0.3 lb pendimethalin + 0.3 prometryn/A	0.55	0.00	3.91	4.46
Cultivate	3.77	0.71	0.00	4.48
Hand hoe (1.5 hr/A)	0.00	6.68	0.00	6.68
Cultivate	2.56	0.45	0.00	3.01
TOTAL	14.69	9.22	13.26	37.17

[1]Source: Personal communication with J. R. Abernathy, Lubbock, TX, D. N. Weaver, College Station, TX, and J. E. Bremer, Corpus Christi, TX, 1987.
[2]Preemergence application equipment cost only.
[3]20 percent of one acre treated.

Table 14. Estimated cost of full-season weed control in solid cotton in Arizona. Based on Arizona practices and six-row equipment in 1985.

Operation[1]	1985 Cost Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); broadcast and incorporate 0.6 lb trifluralin + 1.2 lb prometryn/A	8.96	1.42	3.74	14.12
Cultivate twice	7.15	1.73	0.00	8.88
Hand hoe (4.0 hr/A)	0.00	17.80	0.00	17.80
Cultivate; post-direct 1.5 lb prometryn/A (broadcast layby)	3.65	0.80	11.40	15.85
TOTAL	19.76	21.75	15.14	56.65

[1]Source: Personal communication with E. S. Heathman, Tucson, AZ, 1987.

Table 15. Estimated cost of full-season weed control in solid cotton in California. Based on California practices and six-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Disk (21 ft); broadcast and incorporate 0.5 lb trifluralin/A	8.96	1.42	3.17	13.55
Cultivate	3.94	0.93	0.00	4.87
Hand hoe (5.0 hr/A)	0.00	22.20	0.00	22.20
Cultivate; post-direct 1.4 lb prometryn/A (broadcast layby)	3.65	0.80	10.64	15.09
TOTAL	26.15	26.15	13.81	59.72

[1]Source: Personal communication with P. E. Keeley, Shafter, CA, 1987.

Table 16. Estimated cost of full-season weed control in solid cotton in New Mexico. Based on New Mexico practices and four-row equipment in 1985.

Operation[1]	1985 Cost			
	Equipment	Labor	Material	Total
	(dollars/A)			
Disk twice (14 ft); broadcast and incorporate 1.0 lb trifluralin/A	9.85	2.18	6.23	18.26
Cultivate three times	10.35	2.89	0.00	13.24
Hand hoe (6.0 hr/A)	0.00	26.70	0.00	26.70
TOTAL	20.20	31.77	6.23	58.20

[1]Source: Personal communication with R. Lee and J. D. Libbin, Las Cruces, NM, 1987.

Table 17. Estimated cost of equipment, labor and herbicides used to control weeds by state and region in United States cotton, 1985.

Region and state	Planted acreage	1985 Average total cost Equipment	Labor	Herbicides	Total
	(x 1,000)	(dollars x 1,000)			
Southeast					
Alabama–Central and South	113	2,532	374	1,810	4,916
Alabama–Tennessee Valley	187	4,329	862	2,859	8,080
Florida	25	424	77	486	978
Georgia	255	6,153	1,351	4,034	11,548
North Carolina	88	1,878	410	983	3,271
South Carolina	124	3,097	679	2,668	6,444
Tennessee	340	9,353	2,301	6,847	18,501
SUBTOTAL	1,132	27,766 (52)[1]	6,264 (12)	19,687 (36)	53,717
Mid-South					
Arkansas	465	8,188	5,789	14,349	28,717
Louisiana	640	10,617	2,246	15,923	28.786
Mississippi	1,050	21,588	15,330	28,245	65,163
Missouri	152	3,254	641	2,410	6,305
SUBTOTAL	2,307	43,647 (34)	24,006 (19)	60,927 (47)	128,971
Southwest					
Oklahoma–dryland	279	4,743	1,090	1,302	7,135
Oklahoma–irrigated	91	1,656	1,490	1,051	4,197
Texas–Southern High Plains	4,107	43,164	6,653	29,488	79,305
Texas–Central Blackland Prairie	215	2,792	543	1,489	4,824
Texas–Coastal Bend and South Texas	678	9,959	6,251	8,990	25,200
SUBTOTAL	5,370	62,314 (52)	16,027 (13)	42,320 (35)	120,661
West					
Arizona	360	7,113	7,830	5,450	20,393
California	1,330	26,280	34,779	18,367	79,426
New Mexico	70	1,414	2,223	436	4,073
SUBTOTAL	1,760	34,807 (34)	44,832 (23)	24,253 (23)	103,892
TOTAL	10,569	168,535	91,129	147,187	406,851

[1]Percent of regional total

Table 18. Estimated average annual losses caused by the ten most frequently reported weeds by states in United States cotton, 1985.

Region and state	Estimated loss from potential production		
	Reduction[1]	Quantity	Value[2]
	(%)	(bales)	(dollars x 1,000)
Southeast			
Alabama	6.0	26,000	6,838
Florida	10.0	2,300	605
Georgia	8.0	31,200	8,205
North Carolina	8.0	9,600	2,525
South Carolina	8.5	15,500	4,077
Tennessee	10.1	40,400	10,625
SUBTOTAL	—	125,000	32,875
Mid-South			
Arkansas	9.8	64,700	17,016
Louisiana	8.4	66,700	17,542
Mississippi	1.7	28,900	7,601
Missouri	10.0	18,500	4,866
SUBTOTAL	—	178,800	47,025
Southwest			
Oklahoma	6.2	16,100	4,234
Texas	6.0	258,000	67,854
SUBTOTAL	—	274,100	72,088
West			
Arizona	10.0	102,000	28,826
California	1.0	31,000	8,153
New Mexico	6.9	5,200	1,368
SUBTOTAL	—	138,200	36,347
TOTAL	—	716,100	188,335

[1]Whitwell, Ted and J. H. Higgins. 1986. Report of 1985 cotton and weed loss committee. 1986 Proc. Beltwide Cotton Prod. Res. Conf. pp. 255.

[2]Total United States bales produced in 1985 was 13,626,000 with a total value of approximately $3,583,638,000. Calculation of value was based on the average 1985 United States price of $263 per bale. Ginned bale weight was 480 pounds.

Table 19. Losses due to grassy bales by year in United States cotton, 1961-1986.

Production year	Total production	Total grassy	Percentage grassy	Value loss[1]
	(bales)	(bales)	(%)	(1,000 dollars)
1961	14,263,365	156,008	1.0	4,178
1962	14,754,396	312,220	2.1	8,361
1963	15,128,775	572,404	3.7	15,329
1964	15,032,314	410,928	2.7	11,005
1965	14,830,810	417,889	2.8	11,191
1966	9,491,197	256,044	2.6	6,857
1967	7,370,293	142,508	1.9	3,816
1968	10,838,384	318,291	2.9	8,524
1969	9,860,230	416,736	4.2	11,160
1970	10,055,237	377,298	3.7	10,104
1971	10,133,419	575,473	5.6	15,411
1972	13,175,522	513,671	3.8	13,756
1973	12,532,901	371,657	2.9	9,953
1974	11,239,735	444,113	3.9	11,893
1975	8,097,552	243,743	3.0	6,527
1976	10,284,056	344,516	3.4	9,226
1977	13,909,121	483,347	3.5	12,944
1978	10,459,210	332,017	3.2	8,891
1979	14,165,664	499,874	3.5	13,387
1980	10,724,266	281,752	2.6	7,545
1981	15,072,854	421,707	2.8	11,293
1982	11,429,648	435,119	3.8	11,652
1983	7,413,334	186,142	2.5	4,985
1984	12,418,749	239,207	1.9	6,406
1985	12,837,088	261,022	2.0	6,990
1986	9,236,839	142,758	1.5	3,823
Average	11,721,344	352,170		9,431
Avg. 61-65	4,801,932	373,890		10,013
Avg. 66-70	9,523,068	302,172		8,092
Avg. 71-75	11,035,826	429,731		11,508
Avg. 76-80	11,908,462	388,301		10,399
Avg. 81-86	11,401,419	280,993		7,525

[1]The average price difference of one full grade (0.0458 cents/lb) plus one cent per pound or 5.58 cents or $26.78 per bale was used to obtain these values.

Table 20. Estimated reduction in percentage of cotton yields caused by the ten most frequently reported weeds by state, 1985.[1]

Region and state	Total percent cotton loss	Morning-glories	Common cocklebur	Pig-weeds	Nutsedges	Johnson-grass	Prickly sida	Silverleaf nightshade	Crab-grass	Bermuda-grass	Spurges
					(percentage of total %)						
Southeast											
Alabama	6	10	11	10	10	15	14	—	—	10	1
Florida	10	20	20	5	9	—	—	—	—	—	—
Georgia	8	6	22	1	10	4	4	—	2	—	1
North Carolina	8	30	15	6	3	2	8	—	2	3	1
South Carolina	8.5	15	19	1	15	3	8	—	1	6	4
Tennessee	10.1	10	25	6	3	12	10	—	5	5	5
Mid-South											
Arkansas	9.8	20	10	5	5	10	10	—	6	5	14
Louisiana	8.4	15	15	5	8	4	11	—	4	—	4
Mississippi	1.7	17	27	5	2	8	8	1	3	3	8
Missouri	10.0	20	20	—	4	4	17	—	5	5	8
Southwest											
Oklahoma	6.2	9	—	36	4	15	2	22	1	—	—
Texas	6.0	5	7	23	6	7	—	18	—	2	—
West											
Arizona	10.0	10	1	10	10	7	—	9	—	6	1
California	1.0	10	—	15	16	8	—	25	—	4	—
New Mexico	6.9	25	3	2	12	10	—	9	—	3	—

[1]Whitwell, Ted and J. H. Higgins, 1986. Report of 1985 cotton weed loss committee. 1986 Proc. Beltwide Cotton Prod. Res. Conf. pp. 255.

Table 21. Value of cotton lint sacrificed by allowing specific weed losses to occur at selected cotton prices over a range of yield potentials.

Cotton price	Potential yield loss	Potential cotton lint yields (lb/A)			
		250	500	750	1000
		Potential monetary losses			
(dollars/lb)	(%)	(dollars/A)			
	2	2.75	5.50	8.25	11.00
	5	6.88	13.75	20.64	27.52
	7	9.63	19.26	28.89	38.52
$0.55	10	13.75	27.50	41.25	55.00
	12	16.50	33.00	49.50	66.00
	15	20.63	41.26	61.89	82.52
	20	27.50	55.00	82.50	110.00
	2	3.25	6.50	9.75	13.00
	5	8.13	16.26	24.39	32.50
	7	11.38	22.76	34.14	45.52
$0.65	10	16.25	32.50	48.75	65.00
	12	19.51	39.02	58.53	78.04
	15	24.38	48.76	73.14	97.52
	20	32.50	65.00	97.50	130.00
	2	3.75	7.50	11.25	15.00
	5	9.38	18.76	28.14	37.52
	7	13.13	26.26	39.39	52.52
$0.75	10	18.75	37.50	56.25	75.00
	12	22.50	45.00	67.50	90.00
	15	28.13	56.26	84.39	112.52
	20	37.50	75.00	112.50	150.00
	2	4.25	8.50	12.75	17.00
	5	10.63	21.26	31.89	42.52
	7	14.88	29.76	44.64	59.52
$0.85	10	21.25	42.50	63.75	85.00
	12	25.50	51.00	76.50	102.00
	15	31.88	63.76	95.64	127.52
	20	42.50	85.00	127.50	170.00

LITERATURE CITED

Anonymous, 1979. A look at world pessticide markets. Farm Chem. 142(9):62-68.

Anonymous. 1981. A look at world pesticide markets. Farm Chem. 144(9):55-60.

Anonymous. 1985. A look at world pesticide markets. Farm Chem. 148(9):28-34.

Abernathy, J. R. 1981. Estimated crop losses due to weeds with nonchemical management. Pages 159-167 *in* D. Pimental, ed. Handbook of Pest Management in Agriculture. Vol. I. CRC Press, Boca Raton, Florida.

Andrilenas, P. A. 1975. Farmers' use of pesticides in 1971-Extent of crop use. U.S. Dep. Agric., Agric. Econ. Rpt. 268. 25 pp.

Bridges, D. C. and J. M. Chandler. 1984. Devilsclaw and wild okra competition with cotton. Proc. South. Weed Sci. Soc. 37:312.

Bridges, D. C. and J. M. Chandler. 1987. Influence of johnsongrass (*Sorghum halepense*) density and period of competition on cotton yield. Weed Sci. 35:63-67.

Brown, H. B. and J. O. Ware. 1958. Cotton. McGraw-Hill, New York. 566 pp.

Brown, S. M., T. Whitwell, and J. E. Street. 1985. Common bermudagrass (*Cynodon dactylon*) competition in cotton (*Gossypium hirsutum*). Weed Sci. 33:503-506.

Cates, H. R. 1917. Farm practices in the cultivation of cotton. U.S. Dep. Agric. Bull. 511. 62 pp.

Chandler, J. M. 1984. Cotton protection practices in the USA and world: Weeds. Pages 330-365 *in* R. J. Kohel and C. F. Lewis, eds. Cotton. Agron. Monogr. No. 25. Am. Soc. of Agron., Madison, Wisconsin.

Chandler, J. M. 1985. Economics of weed control in crops. Pages 9-20 *in* A. C. Thompson, ed. The Chemistry of Allelopathy-Biochemical Interactions Among Plants. ACS Symp. Ser. 268. Am. Chem. Soc., Washington, DC.

Crowe, G. B. and J. T. Holstun, Jr. 1953. The economics of weed control in cotton. Miss. Agric. Exp. Stn., Cir. 179. 14 pp.

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

Delvo, H. and M. Hanthorn. 1983. Pesticides. Pages 4-17 *in* T. Eichers, ed. Inputs, Outlook and Situation. U.S. Dep. Agric., Econ. Rpt. Ser., IOS-2.

Delvo, H. W. 1988. 1987 herbicide use in cotton production. 1988 Proc. Beltwide Cotton Prod. Res. Conf. pp. 383-384.

DeWet, J. M. J. and J. R. Harlan. 1975. Weeds and domesticates: Evolution in the man-made habitat. Econ. Bot. 29:99-107.

Dowler, C. C. and E. W. Hauser. 1975. Weed control systems in cotton on Tifton loamy sand soil. Weed Sci. 23:40-42.

Eller, J. M. 1970. Cost-cutting weed control practices at work. 1970 Proc. Beltwide Cotton Prod. Mech. Conf. pp. 24-25.

Fox, A., T. Eichers, and P. Andrilenas. 1968. Extent of farm pesticide use on crops in 1966. U.S. Dep. Agric., Agric. Econ. Rpt. 147. 23 pp.

Harlan, J. R. and J. M. J. DeWet. 1965. Some thoughts about weeds. Econ. Bot. 19:16-24.

Holm, L. G., D. L. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. The World's Worst Weeds, Distribution, and Biology. Univ. Press of Hawaii, Honolulu. 609 pp.

Holstun, Jr., J. T. and O. B. Wooten. 1966. Weeds and their control. Pages 152-181 *in* F.C. Elliot, M. Hoover, and W. K. Porter, Jr., eds. Advances in Production and Utilization of Quality Cotton: Principles and Practices. Iowa State Univ. Press, Ames, Iowa.

Langford, E. L. and B. H. Thibodeaux. 1939. Plantation organization and operation in the Yazoo-Mississippi Delta area. U.S. Dep. Agric., Tech. Bull. 682. 91 pp.

Parvin, D. W., Jr., F. T. Cooke, Jr., W. P. Scott and J. W. Smith. 1985. The economics of cotton harvesting in the Mid-South. Miss. Agric. For. Exp. Stn., Dep. of Agric. Econ., Staff Paper Ser. 69. 18 pp.

Shaw, W. C. 1964. Weed science—Revolution in agricultural technology. Weed Sci. 12:153-162.
Strickler, P. E. and W. C. Hinson. 1962. Extent of spraying and dusting on farms, 1958—with comparisons. U.S. Dep. Agric., Statist. Bull. 314. 28 pp.
Willard, C. J. 1951. Where do we go from here? Weeds. 1:9-12.
Williams, B., G. Mullendore, B. Head, J. Thomas, J. Musick, R. Baker, J. Hamill, M.L., D. Parvin, W.I. Spurgeon, and R. Williford. 1985. Estimated costs and returns, cotton, all areas of Mississippi, 1985. Miss. Agri. For. Exp. Stn. Publ. 1483:66 pp.
Wills, G. D. 1977. Pernicious weeds in cotton—nutsedge. 1977 Proc. Beltwide Cotton Prod. Res. Conf. p. 164.