TOLERANCE OF COMMERCIAL COTTON VARIETIES TO THE COTTON BOLLWORM, *HELIOTHIS ZEA* (BODDIE)

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ZEA (BODDIE)

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TABLE OF CONTENTS

LIST OF TABLES

NOMENCLATURE

A.I.	Active Ingredient
^{o}C	degree(s) centigrade
cc	cubic centimeter
cm	centimeter
2E	two pounds per gallon
4E	four pounds per gallon
gm	gram
ha	hectare
hr	hour
kg	kilogram
l	litre
m	meter

CHAPTER I

INTRODUCTION

For the past two decades emphasis in pest control has steadily shifted from almost total reliance on pesticides to integrated pest control. This change was not accidental. The wide use of synthetic insecticides following the discovery of the insecticidal properties of DDT in the 1940's led to the now familiar problems of environmental pollution and health hazards (Brown 1951, Stern et al. 1959, Carson 1962, Bartlett 1964, Rudd 1964, Chichester 1965, van den Bosch et al. 1971. Further, the use of chemicals, particularly the organophosphates which largely replaced DDT caused additional problems: 1) pest resurgence in which the target pest species rebounded to equal or greater numbers, 2) outbreak of secondary pests due to the elimination of their natural enemies and 3) pest resistance due to selection pressure imposed by the frequent applications. Larger pesticide doses and higher frequency of application of pesticides were employed whenever a case of pest resistance was observed. This aggravated the problem in the long run, leading to what van den Bosch (1978) has termed the "Pesticide treadmill".

The rise of the cotton bollworm, Heliothis zea (Boddie), to serevere pest status in the late 1950's is a case in point. Prior to the use of DDT in cotton to control the boll weevil, Anthonomus grandis Boheman, bollworms were only a minor pest of cotton. However, due to their broad spectrum, the new insecticides, particularly DDT, eliminated most of the bollworm's natural enemies such that by the early 1960's it had become the major pest which threatened to destroy the cotton industry (van den Bosch et al. 1969, Luck et al. 1977). This situation called for a new approach to cotton pest control strategies that would involve non-chemical methods as alternatives. These would be used singly or in combination with insecticides in what is now known as "Integrated Pest Management".

One such method with a promising outcome was the use of host plant resistance, which had been reported to control several pests in cotton before the advent of DDT. Painter (1951) has given an excellent review of these early reports which include the blister mite, Eriophyes gossypii Banks; leafhoppers, Empoasca spp.; tobacco thrips, Thrips tabaci Lindeman; and the pink bollworm, Pectinophora gossypiella (Saunders).

Following this realization, considerable research effort was directed once more towards host plant resistance, particularly resistance to the bollworm. As a result of this effort, several resistance characters were identified and extensively tested both in the laboratory and in the field during the 1960's and 1970's. Maxwell (1977) and Schuster (1979) have summarized the achievements made during this period.

Currently four major characters are known to impart resistance in cotton against bollworms, 1) glabrousness (smooth leaf), which deters oviposition, 2) nectarilessness, which deprives the moths of a valuable food source, 3) antibiosis, which causes adverse effects or mortality to the feeding larvae and 4) tolerance, which enables the plant to repair and or compensate for injury from insect attack. Whereas much has been done and reported on the first three, little is known about tolerance. Gallun (1972, p.259) mentioned that it was not utilized well enough and suggested that it could be a "formidable means of protecting the crop against insect damage". This is not difficult to realize considering the successes encountered in other crops; for example, in wheat against the hessian fly, Mayetiola destructor (Say), in corn against corn rootworms, Diabrotica spp. and in alfalfa against the meadow spittlebug, Philaenus spumarius (L.).

The present research was intended as a continuation of studies started by Mussett (1981) on the tolerance of commercial cotton varieties to H. zea under Oklahoma conditions. The objectives were 1) to determine whether the varieties tested were tolerant to H. zea, 2) to attempt to explain the mechanisms responsible for the tolerance and 3) to find out if bollworm infestation of tolerant cottons had any effect on lint percent, fiber quality or the rate of maturity.

With Heliothis being reported as still the number one enemy of cotton both in Oklahoma and in the country as a whole (Head 1982)[1], and with currently high and still spiraling costs of control, it is appropriate to explore the still untapped potentials of tolerance as a form of host plant resistance. This may increase the germplason available to producers, hopefully leading to better, less costly and effective management of Heliothis in cotton.

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[1] Lint losses due to Heliothis zea and H. Virescens (F.) in 1981 were: 33,000 bales or 8% for Oklahoma and 323,710 bales or 2.08% for the U.S.

CHAPTER II

REVIEW OF LITERATURE

Early work on the resistance of cotton, Gossypium hirsutum (L.) to bollworms was carried out by several workers: Thomas et al. (1931), Gaines (1933, 1941), Parsons and Marshall (1940), Rainey (1940) and Fletcher (1941). However, the work which has contributed most to the current knowledge in this field was done in the 1960's and 1970's after the bollworm became the major pest of cotton in the United States (Luck et al. 1977).

Numerous reports from this latter period indicate that four major characters impart resistance in cotton to bollworms, namely glabrousness, nectarilessness, antibiosis and tolerance (Maxwell 1977).

Of these, glabrousness is probably the most widely studied. Lukefahr et al. (1971) demonstrated the non-preference of adult moths to deposit eggs on glabrous cottons. He also found a consistent reduction in the number of eggs deposited on no-choice tests with an equivalent amount of larval reduction. Normal commercial cottons have 3000-5000 trichomes per 6.45 cm^2 on the terminal leaves where 70-80% of the eggs are laid (Schuster 1979). According to Meredith and Schuster (1979), cotton with less than 200 trichomes per 6.5 cm^2 is necessary for a strong non-preference for oviposition to be expressed. Lukefahr (1977) reported that 200 trichomes or less per 6.45 cm^2 would give a 50% reduction in egg production and larval population, and that the more glabrous the plant the higher the oviposition suppression. Smith et al. (1975) reported that plant hairs offer resistance in cotton to the pink bollworm, Pectinophora gossypiella Saunders, by hindering the movement of first instar larvae. However, increased glabrousness has been associated with ultrasensitivity to plant bugs (Meredith and Shuster 1979) and the detrimental effect of glabrous alleles on fiber quality (Lee 1971, Niles et al. 1974).

Nectarilessness is the absence of nectaries, the gland-like structures found in the flowers, the midrib on the lower surface of the leaf and on the bracts. These secrete nectar on which adult bollworm moths feed. Nectarless cottons have no nectaries outside the flowers, and different species of cotton vary in the number of nectaries present. Gossypium hirsutum (L.) possesses both floral and extrafloral nectaries, but according to Lukefahr and Rhyne (1960) floral nectaries are not considered to be of any value to the important lepidopterous insects attacking cotton as the flowers are closed during the formers' active period.

The importance of nectar to bollworms cannot be overemphasized. Quaintance and Brues (1905) observed that bollworm moths in the laboratory did not begin to oviposit until they began to feed. Further, McDonald and Fielding (1938) and Anson et al. (1948) observed that the first appearance of flowers was a good indication of the beginning of bollworm infestations on cotton as egg-laying did not begin until then.

Meyer and Meyer (1961) were the first to describe the heritability of nectarilessness and later were successful in transfering this character from Gossypium tomentosum Nutt to G. hirsutum. Later, Lukefahr and Meyer (1965) reported bollworm oviposition reduction of between 39 and 64% on nectariless cottons. Similar results from cage tests were reported by Davis et al. (1973).

The reduction in available food resulting from the use of nectarless cottons has also been shown to cause a reduction in the fecundity and longevity of adult moths. Lukefahr and Rhyne (1960) observed a 50% reduction in fecundity in a cage field experiment. In a subsequent study, Lukefahr and Meyer (1965) reported a 40% reduction in egg deposition and some reduction in longevity.

The two resistance characters (glabrousness and nectarilessness) are classified under the resistance modality "nonpreference" (Painter 1941), also known as "antixenosis" (Kogan and Ortman 1978). Plants with both characters have been reported to have a combined effect on egg reduction. Lukefahr and Meyer (1965) reported an 80% reduction in egg deposition by both *H. zea* and *H. virescens* on such cottons, and Wilson and Wilson (1976) reported that the two characters have a cummulative effect on the yield of several varieties tested.

Antibiosis was first proposed by Painter (1951) to describe the adverse effects on insects resulting from feeding on resistant plants. These effects are caused by chemical substances or alleles present in the plant as a form of a defense mechanism. The most well known of these is gossypol (1,1', 6,6', 7,7' hexahydroxy - 5,5' diisopropyl - 3,3' - demethyl 2,2' - binaphthalene), which has recieved considerable attention as a source of resistance to *Heliothis* spp. in some cottons. It is carried in pigment glands situated in the flower buds and seed of cotton and is known to be toxic to non-ruminants, which is why it was originally bred out of some commercial cotton varieties (Eagle et al.

1948, Bottger et al. 1964). Lukefahr and Martin (1966) reported that when gossypol was incorporated into an artificial diet, it became toxic to both the bollworm and the budworm. Further, Maxwell et al. (1965) and Jenkins et al. (1964) found glandless cottons to be more susceptible to insect attack than glanded ones. Lukefahr et al. (1966) suggested the possibility of breeding cotton with higher gossypol content to control Heliothis spp. in cotton. Later, Lukefahr and Graham (1971) reported that the high gossypol trait could be enhanced by combining it with the glabrous character for larval reduction of 60–80%. More recently, Schuster (1979) reported that field tests in Texas, Louisiana and Mississippi had confirmed that high gossypol content could be increased from a normal 0.05% to a high 1.5% genetically, and that larval mortality of 50% could be expected when square gossypol was increased to 1.2%.

Other substances with antibiotic properties have also been identified (Pratt and Wender 1959, Chan et al. 1978, Stipanovic et al. 1978). The most important of these are hemigossypolone and Heliocide H_1 and H_2. Elligar et al. (1978) found the toxicities of these compounds to equal that of gossypol, but were present in smaller amounts, suggesting that they might have been there to supplement the activity of gossypol, themselves being of only minor importance. High tannin, another one of the antibiotic compounds, has been shown to cause mortality and feeding deterrence to Heliothis spp. in tests conducted by Chan et al. (1978) and Schuster (1979).

Tolerance is the least known of the resistance characters of cotton. Painter (1951) defined it as the ability to yield while supporting a pest population capable of causing economic damage to a susceptible host. He observed that tolerance response was more subject to variations in the environment and that it was sometimes difficult to separate from the other resistance modalities. Horber (1980, p.19) called it ..."the collective plant reactions to insect attack...deserving to be treated as one of the three mechanisms of resistance along with , but not distinct from antibiosis and nonpreference". Beck (1965, p.208), however, differs on this issue by refusing to recognize it as a form of resistance, calling it a "...biological relationship between insects and plants that is quite different from resistance in the strict sense".

The earliest reports on the tolerance of cotton to insects are those of Parnel (1927) and Cameron (1928) who found some cotton lines to be tolerant to leafhoppers, Empoasca spp. Painter (1951) has given an extensive review of the work done during this period. More recently, Meredith and Laster (1975) reported that some genetic populations of cotton were tolerant to the tarnished plant bug, Lygus lineolaris (Palisot de Beauvois).

Little is known about the tolerance of cotton and other crops to Heliothis spp. Wiseman (1972) investigated the tolerance of corn to H. zea and found that some of the varieties he studied could harbor larvae in the ears without suffering significant damage, as the insects were confined to the silk. More recently, Mussett (1981) reported that some commercial varieties of cotton did not suffer significant loss of lint yield after being subjected to an artificial infestation in the field. This was the first and so far the only study in the literature on the tolerance of cotton to this pest.

CHAPTER III

MATERIALS AND METHODS

General

Two tests were conducted in 1982[1] and one test in 1983 at the Southwestern Agronomy Research Station, Tipton, Oklahoma. Each test consisted of 12 commercial varieties of irrigated cotton chosen from among the currently grown commercial varieties in Oklahoma and other states. The design was randomized complete blocks with split plots where the main plots were varieties and the two sub-plots were the treatments. The plots consisted of four rows 15.2 m long and 1.0 m apart. One sub-plot was selected at random and artificially infested with first instar bollworm larvae, while the other received weekly sprays of pemethrin beginning August 2. Of the two rows in each sub-plot, only one received a treatment, the other acting as a guardrow.

The soil type in this test area was fine-loamy, mixed, thermic Pachic Argiustolls.

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[1] This research was first carried out in 1981, but was abandoned because of lack of adequate infestation levels. This was caused by the use of a new technique of applying the artificial infestation which turned out to be ineffective. This technique, hitherto used mainly in corn resistance studies, uses cob grits mixed with first instar larvae which are then dispensed in the plant terminals with the aid of the Davis modified-CIMMYT inocultor. The technique has since been modified for use in cotton by Jenkins et al. (1982).

The 1982 Tests

Test 1 was planted with Westburn M, Tamcot SP21, DES 56, Stoneville 213, Paymaster 145, Stoneville 825, Deltapine 55, Stoneville 256, Lankart LX571, Deltapine SR 5, Paymaster 785 and Coker 5110.

Test 2 had GSA 75, Lankart 57 Sel. Cascot BR-1, Cascot L-7, CAMD-E, GP 3774, GP 3755, Tamcot SP21S, PR-68, Lockett 77, HG 1845-N and Earlycot 32A. HG 1845-N, a high gossypol variety, and Stoneville 213, a variety with known susceptibility to *H. zea* were used as landmarks in experiments 2 and 1 respectively.

The experiments were initially planted on May 19, 1982, but due to a sand storm which destroyed most of the seedlings replanting was done on June 16. For this purpose a four row planter was used, planting at the rate of 28 kg of seed per hectare.

Four weeks after planting the cotton was thinned to a within row spacing of about 15 cm or 100 plants per row, which is equivalent to about 16600 plants/ha. On July 26, all the plots were sprayed with Galecron 4E at the rate of 900cc A.I. per ha to kill pests and beneficial insects before the treatments were applied. Thereafter the control sub-plots were sprayed weekly with permethrin 2E at the rate of 255 gm A.I. per ha using a backpack sprayer to control natural *Heliothis* populations. The first spraying was applied on August 2.

Infestations with first instar *H. zea* larvae was conducted once a week between 0600 and 0700 hrs., so that the larvae had a chance to take shelter from the sun and heat of the day. These infestations were made on August 3, 10 and 17. One larva was placed on the main terminal of each plant (about 100 larvae per row) by hand using a small camel's hair brush. It was estimated that about 1 in 12 of these would survive (Hall et al. 1980) giving a population of about eight larvae per 100 plants. This plus some anticipated natural infestation was expected to provide enough larvae to cause economic damage (Baldwin et al. 1974).

All other management operations such as fertilizer application, irrigation and weed control were carried out as normal for cotton production in this area of Oklahoma.

Egg and Larvae Production

Eggs from a colony maintained at the Entomology laboratory, Oklahoma State University, were allowed to hatch and the first instar larvae from these eggs were placed one each in 2.5 cm diameter pill cups containing freshly prepared artificial diet (Burton 1967). The cups were then arranged on trays and placed in a growth chamber at 27^{o}C where the larvae were allowed to grow to maturity and pupate. Pupae were separated by sex and six pairs were put in 2 l cylindrical paper cartons whose tops were covered with paper towels as a substrate for egg deposition. Moths were fed on sugar solution contained in glass vials placed inside the cartons.

Two days after egg laying commenced the paper towels with the eggs were removed and placed in 0.5 l mason fruit jars which were then held at room temperature for the eggs to hatch. When most of the eggs had hatched the jars were placed in an ice chest containing crushed ice and transported to the field. The whole process was timed so that there were first instar larvae available on the same day every week.

Taking Counts and Yield Assessment

Damage assessment was carried out in both tests by taking counts of undamaged squares, blooms and bolls on August 10 and 17. Harvesting was conducted for both tests on October 25 and December 17. Both the counting and harvesting were taken from the middle 7.6 m (one half) of each treated row. Fifteen boll samples were taken to the laboratory, weighed, cleaned and ginned. The lint from these samples was used to calculate lint weight, lint percent and fiber quality. The weight of bur cotton, seed cotton and lint were converted into kilograms per hectare.

Tolerance was measured by the difference in lint yield of the sub-plots in each variety (main plot) i.e. uninfested vs. infested rows. The smaller the difference the higher the tolerance. Fruit counts, multiple harvests and earliness of maturity among varieties based on percent first harvest were used to determine the causes of tolerance. Differences in percent first harvest between infested and uninfested sub-plots were used to determine the effect of infestation on the rate of maturity. Other factors which were evaluated are lint percent, fiber quality (2.5% span length, 50% span length, uniformity index and strength).

Fiber quality tests were conducted at the Cotton Quality Research Laboratory, Agronomy Department, Oklahoma State University. Fiber length was measured on the digital fibrograph as 2.5% and 50% span length in inches and then converted into centimeters. 50% span length was divided by 2.5% span length and converted to a percent to obtain fiber length uniformity indexes. Fiber strength was measured on the stelometer at the 0.32 cm gauge setting and was expressed in grams-force per tex. The lint percentages and fiber quality measurements were adjusted to the percent first and second harvests by multiplying each value by the percent first harvest, then by the percent second harvest, then adding the two products to give the adjusted value.

The 1983 Test

The location, design, plot size and plot arrangement, treatments and planting rates were the same as for tests 1 and 2 in 1982. Eight varieties from among the 24 tested in 1982 were included in this test. These were: GP 3774, Coker 5110, GSA 75, CAMD-E, Stoneville 825, Westburn M, Paymaster 145 and Stoneville 213. In addition 4 new ones which had been recommended for the 1983 growing season were included: Deltapine 90, Deltapine SR-383, Stoneville 302 and Deltapine 61.

The experiment was planted on June 1, thinned on July 6 and sprayed against pests and beneficials on July 13. Weekly spraying of the control sub-plots commenced on July 20 and infestations were applied on July 27, August 2 and 10. No counts were taken for squares, blooms or bolls.

Harvesting was carried out on December 1, and as previously only half a row (7.62 m) of each treated row was harvested. The yield was handled and processed in the same way as in 1982. This time however, there was only one harvest instead of two.

The data were analyzed at the Computer Center, Oklahoma State University, using the Statistical Analysis System Program designed by Anthony J. Barr and James H. Goodnight, Department of Statistics, North Carolina State University, Raleigh, North Carolina.

CHAPTER IV

RESULTS AND DISCUSSION

The 1982 Tests

Fruit[1] Counts

The fruit counts on August 10 and 17 were meant to give an indication of the extent of fruit damage in the infested sub-plots. The results are given in Tables I-IV. As can be seen in Tables I and II, there were no significant differences in the number of squares, blooms or bolls between infested and uninfested sub-plots for any variety in either Test 1 or Test 2 on August 10. However, the counts taken on August 17 (Tables III and IV) showed significantly fewer squares in the infested sub-plots of some varieties, namely, DES 56, Stoneville 213, Deltapine 55 and Paymaster 785 in Test 1, and Cascot BR-1, Tamcot CAMD-E, GP 3755 and Earlycot 32A in Text 2. There were no significant differences in the number of blooms or bolls for any of the varieties.

The absence of damaged fruits on August 10 was probably due to the short time interval between the date of the first infestation and that of the first count (August 3-10). Even assuming that the insects fed normally, 7 days was too short a time for a significant amount of

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[1] Fruit here means squares, blooms and bolls collectively.

damage to occur. Moreover, at this early stage some of the squares being damaged would be shed anyway. Smith and van den Bosch (1967) have reported that the cotton plant has a limited capacity to set fruit, and any squares in excess of this level would be shed.

By August 17, significant numbers of damaged squares were showing in the infested sub-plots, but there were still no significant differences in the number of blooms or bolls. Again the reason for this could be attributed to the time factor. At the time this count was made (2 weeks after the first infestation) the larvae were probably too young to cause any significant damage to blooms and bolls. According to Kincade et al. (1967) young larvae placed on plants feed on small to medium squares on the top one third of the plant for 7-11 days, then they move to the middle third of the plant where they feed on large squares and very young bolls for 3-5 days before moving on to medium size bolls on the bottom third. This is in agreement with the observations of Little and Martin (1942) that bolls were rarely attached by the newly hatched larvae and that generally they did not feed on them until they were one third grown.

It is interesting to note that of the varieties which lost a significant number of squares, only Stoneville 213, in Test 1, and Tamcot CAMD-E and Earlycot 32A, in Test 2, went on to show significant lint losses. The rest were able to rebound and avoid significant lint loss most likely by replacing the damaged squares or by shedding less squares. This is not uncommon for some cotton varieties. For example, Baldwin et al. (1974) reported that the superior squaring rate of 1x6-56, an experimental strain, enabled it to overcome square damage. Further, Pate and Young (1973) reported that up to 4 weeks of square loss either increased or caused only a slight reduction in yields of some varieties.

It is felt that more counts on fruit damage should have been taken to furnish more information on damage versus loss trends.

Lint Yield

The lint yield data by harvests are presented in Tables V-VIII. These results show that there were significantly lower yields in the infested sub-plots of some varieties in both harvests of Test 1 and 2. In the first harvest of Test 1 these varieties were Stoneville 213, Paymaster 145 and Lankart LX 571 (Table V), and in the second harvest they were Stoneville 213, Deltapine SR-5 and Coker 5110 (Table VI). In Test 2 they were Cascot L-7, Tamcot CAMD-E and Earlycot 32A in the first harvest, (Table VII), and Cascot L-7 and PR-68 in the second harvest (Table VIII).

The total mean yields for both tests are given in Tables IX and X. In Test 1 (Table IX) varieties, Stoneville 213, Lankart LX 571 and Coker 5110 produced significantly lower lint yields per hectare in the infested sub-plots. Paymaster 145 and Deltapine SR-5 which had shown susceptibility[2] in the first and second harvests, respectively, did not do so when the two harvests were combined. Both Lankart LX 571 and Coker 5110 had suffered significant losses in one harvest; only Stoneville 213 was consistent in both harvests.

In Test 2 (Table X), significantly lower lint yields were recorded

[2] Susceptibility, significant loss and significantly lower yields are used here interchangeably.

from Tamcot CAMD-E and Earlycot 32A. Cascot L-7, which had shown susceptibility in both harvests, and PR-68, which had shown susceptibility in the second harvest, both emerged without significant losses in total mean yields.

As can be seen from these results there were four potentially susceptible and 18 potentially tolerant varieties[3]. The causes of tolerance in these varieties are not easily apparent, but they can be discerned from the results and from a few known facts. For example Painter (1951) has described the mechanisms involved in the tolerance of plants to chewing insects as, repair of injured parts, growth of new tissue and escape. In cotton this translates into growing new branches (Hopkins et al. 1982), rapid replacement of damaged squares (Pate and Young 1973, Caldwell et al. 1979) and earliness of maturity (Baldwin et al. 1974, Niles 1980, McCarty et al. 1982).

The varieties which showed significant square and lint losses mentioned earlier, but which suffered no significant total mean lint loss could be showing tolerance due to repair/regrowth and or replacement of damaged squares. The rest of the varieties, the ones which suffered no significant square or lint loss at any time, could also have used these same mechanisms albeit less apparently.

Another mechanism of tolerance involved could have been earliness of maturity. In order to discern this factor, an analysis of earliness of maturity using percent of lint taken at first harvest as a criterion was performed. The listings of the varieties according to increasing

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[3] This is excluding Stoneville 213 and HG 1845-N which have known susceptibility and resistance respectively to Heliothis spp.

late maturity are given in Tables XI and XII.

In Test 1 (Table XI) Paymaster 145 was the earliest with 61.9% first harvest and Coker 5110 was the latest in maturing with 29.3%. There were roughly three groups, 1) a slightly early group consisting of Paymaster 145; 2) a group of medium ones including Stoneville 825, Westburn M, Tamcot SP21, and Stoneville 213; and 3) a slightly later group consisting of Deltapine 55, Lankart LX 571, Stoneville 256, Paymaster 785, DES 56, Deltapine SR-5 and Coker 5110. In Test 2 (Table XII) there were similarly three groups, 1) Tamcot CAMD-E; 2) GP 3775, Tamcot SP21S, HG 1845-N, Lockett 77, Earlycot 32A, Cascot L-7, GP 3774; and 3) GSA 75, Lankart 57 Selection, Cascot BR-1 and PR-68. The lists of potentially tolerant varieties according to earliness of maturity are presented in Tables XIII and XIV.

Despite there being differences in earliness between the varieties in both tests, results of varietal trials conducted by Oklahoma State University (McCall et al. 1980, 1981; Bayles et al. 1982, 1983) show that nearly all the varieties used in this study to be early or medium maturing. According to these trials, in Test 1 (Table XI) Paymaster 145, Westburn M, Tamcot SP21, Lankart LX 571 and Paymaster 785 are early maturing while Stoneville 825, Stoneville 213, Stoneville 256, DES 56, Deltapine SR-5 and Coker 5110 are medium maturing. In Test 2 (Table XII) Tamcot CAMD-E, Tamcot SP21S, Lockett 77, Cascot L-7, Cascot BR-1 and PR-68 are early maturing and GP 3755, Earlycot 32A, GP 3774, GSA 75 and Lankart 57 Sel. are medium maturing.

As is evident from these results, there appears to be no definite pattern linking tolerance to earliness of maturity. For example the four earliest varieties in Test 1 (Table XI) Paymaster 145, Stoneville

825, Westburn M and Tamcot SP21 showed no significant lint loss, while three of the medium maturing varieties, Stoneville 213, Lankart LX 571 and Coker 5110 did. On the other hand, in Test 2 (Table XII) the earliest maturing variety, Tamcot CAMD-E was susceptible while the latest maturing variety, PR-68 was not.

This does not mean that earliness was not involved in the tolerance of some of these varieties. Rather, it is to suggest that some other mechanisms, alone or acting in combination with earliness are suspected. Two of these were mentioned earlier and there could be others, but as for now the three discussed here are strongly favored to be the ones responsible for the tolerance of these varieties.

Lint Percent

Lint percent data for the four harvests are presented in Tables V-VIII. Statistical analysis showed that there were no significant differences in lint percent between infested and uninfested sub-plots of any variety in the first harvest of either Test 1 or 2 (Table V and VII). However, in the second harvest of both tests there were significant differences shown by some varieties (Tables VI and VIII), namely Paymaster 145 and Coker 5110 in Test 1 and HG 1845-N in Test 2.

When the lint percentages for the two harvests of each test were combined and averaged to obtain a mean for each variety, no significant difference between infested and uninfested sub-plots was indicated by any variety in either test (Table IX and X). This was a welcome finding since about 90% of the price paid to the producer is for lint, and it would be of no consequence if *Heliothis* tolerant varieties had lint percent which was lower than that of susceptible ones.

Earliness of Maturity

Tables XV and XVI present the results of analyses for earliness of maturity as expressed by percent first harvest of infested versus uninfested sub-plots. In Test 1 (Table XV), only Deltapine 55 had a significant delay in earliness of maturity (10%) due to Heliothis infestation. The experimental average delay was slight (2.3%), and not significant, in the infested sub-plots. In Test 2 (Table XVI), as in the rest of Test 1 no significant delay in maturity was shown by any of the varieties. The experimental average, was slightly higher (1.4%) in the uninfested sub-plots.

Earliness of maturity is an important agronomic quality of cotton for the management of late season pests, and for early harvesting. However, several authors, notably Baldwin et al. (1974), Namken et al. (1975) and McCarty et al. (1982) have reported delays in the maturity of cotton varieties infested with Heliothis. This was true in the case of Deltapine 55 but not for any of the other varieties in the two tests.

Fiber Quality

Tables XVII - XX contain the results of fiber quality analyses for Tests 1 and 2 by harvest. Significant differences in fiber quality parameters[4] were shown by some varieties in Test 1 (Tables XVII and XVIII), but none by any of the varieties in Test 2 (Tables XIX and XX).

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[4] 2.5% Span Length, 50% Span Length, Uniformatly Index and 0.32 cm Gauge Stelometer.

In both harvests of Test 1 significant differences were found only in 2.5% and 50% span length. There were no significant differences in uniformity index or strength of any variety. In the first harvest (Table XVII), Lankart LX 571 had significantly higher values for 2.5% and 50% span length; it was the only one with significantly different values in the first harvest.

In the second harvest (Table XVIII), Coker 5110 had significantly higher values for both 2.5% and 50% span length in the infested sub-plots. Both Deltapine 55 and Deltapine SR-5 had significantly higher values for 2.5% span length, and Westburn M had significantly higher values for 50% span length all in the infested sub-plots.

The overall fiber quality parameters[5] are presented in Tables XXI and XXII. Again there were no significant differences in any parameter for any variety in Test 2 (Table XXII). In Test 1 however, there were differences in 2.5% and 50% span length shown by some varieties (Table XXI). Tamcot SP21 and Deltapine 55 showed highly significant, and Deltapine SR-5 significant differences in 2.5% span length, the values for Tamcot SP21 being higher in the uninfested sub-plots while those of Deltapine 55 and Deltapine SR-5 were higher in the infested sub-plots. Deltapine 55 also showed significantly higher values for 50% span length in the infested sub-plots. Stoneville 825, Lankart LX 571 and Coker 5110 showed significantly higher values for 50% span length in the infested sub-plots while Stoneville 256 showed highly significant higher values for 50% span length in the uninfested sub-plots.

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[5] Overall lint quality parameters were adjusted to percent first and second harvests.

There were no significant differences in either uniformity index or strength for any variety. There were also no significant differences in the experimental means between infested and uninfested sub-plots.

Thus as far as fiber quality was concerned the results indicated that Tamcot SP21 and Stoneville 256 suffered reduced 2.5% and 50% span length values respectively as a result of Heliothis infestation. These results are fully consistent with those obtained by Mussett (1981), who reported significantly higher 2.5% and 50% span length values in the infested sub-plots and no significant differences in uniformity index or 0.32 cm (1/8") gauge stelometer. They are not, however, in agreement with the findings of some workers in this field. For instance, Adkisson et al. (1964) found only slight differences in micronaire[6], staple length and strength between infested and uninfested plots, and Pate and Young (1973), in a study on the effect of square loss on cotton, reported that fiber quality was not affected by any of the square removal treatments.

The 1983 Test

Lint Yield

The lint yield results for the twelve varieties are shown in Table XXIII. Four varieties, Stoneville 213, Tamcot CAMD-E, Deltapine 90 and Deltapine 61 produced significantly lower lint yields in the infested sub-plots. Tamcot CAMD-E had the highest loss (103 kg/ha). Deltapine SR-5 on the other hand produced significantly more

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[6] This measure of fiber fineness was not taken due to lack of sufficient fiber sample.

lint in the infested sub-plots (70 kg/ha). Other varieties, Westburn M, Paymaster 145 and Stoneville 302 also produced slightly higher but non-significant lint yields in the infested sub-plots. The cause of this increase was not clear, although similar results have been reported before by other investigators, notably van den Bosch et al. (1971) and Hopkins et al. (1982).

Lint yields of the eight varieties in this test which had also been tested in 1982 were consistent for the 2 years. Of these varieties, Stoneville 213, Coker 5110 and Tamcot CAMD-E showed susceptibility while Westburn M, Paymaster 145, Stoneville 825, GP 3774 and GSA 75 exhibited tolerance (Table XXV).

<u>Lint Percent</u>

Lint percent for both bur and seed cotton are presented in Table XXIV. There was a small, but significantly higher (2.7%) lint percent of seed cotton in the infested sub-plots exhibited by Stoneville 302. Other than this there was very little variation in lint percent, the experimental mean being 37.0% for uninfested and 36.9% for infested sub-plots. There was no significant difference in lint percent of bur cotton.

Overall, the pattern of the results for the two years is consistent with that of the results reported by Mussett (1981) who tested twelve commercial varieties in 1980 and found eight of them to be tolerant and four to be susceptible to <u>H. zea</u>. The varieties in the 1982 tests included six of the ones studied by Mussett in 1980. They were Westburn M, Tamcot SP21, DES 56, Stoneville 213, Coker 5110, and Lockett 77.

Table XXV summarizes the lint yield results of the varieties tested in 1982 and 1983 and includes the 1980 yield results of the six varieties tested by Mussett. As can be seen in the table, the lint yields of the eight varieties tested for two seasons were all consistent for both seasons except DES 56 which showed significant loss in one season. As for the three varieties tested for three seasons, only Coker 5110 was inconsistent in one season, having suffered a significant lint loss in 1983.

CHAPTER V

SUMMARY AND CONCLUSIONS

The objectives of this study which were to determine tolerance to Heliothis zea (Boddie) in commercial cotton varieties, the factors causing it, and its effect on lint percent, rate of maturity and fiber quality were achieved.

Of the seventeen varieties tested for one season, twelve[1] were tolerant and four were susceptible; six out of the eight which were tested for two seasons showed tolerance in both seasons, while one showed susceptibility, also in both seasons and another in one season; one of the three that were tested for three seasons was tolerant in all three seasons, one was susceptible in all three seasons and one was susceptible in two seasons.

Heliothis infestation of these varieties did not cause any significant reduction in lint percent of seed cotton. It did, however, significantly delay the maturity of one variety and significantly reduced the 2.5% span length of one variety and the 50% span length another, while significantly increasing the 2.5% span length of two varieties and the 50% span length of four others. Thus twenty two

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[1] HG 1845-N has known resistance to Heliothis spp. based on antibiosis, and was therefore excluded from the list of tolerant varieties.

varieties suffered no significant fiber quality reduction, and the two that did, did so in only one parameter, span length.

These results are fairly consistent with the findings of Mussett reported in 1981. It is felt, however, that these tests should be run a few more times to further confirm these findings. In addition, more studies on the mechanisms responsible for tolerance in cotton to Heliothis spp. should be pursued.

Based on these results, tentative conclusions are that (1) most commercial cotton varieties are tolerant to H. zea; (2) the mechanisms responsible for the tolerance were efficient replacement of damaged squares, earliness of maturity (host evasion) and growth of new organs; (3) Heliothis infestations affected the 2.5% and 50% span length of some varieties, reducing it in some and enhancing it in others; other fiber quality parameters[2] were not affected (4) infestations delayed the maturity of one variety of cotton, but had no effect on lint percent.

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[2] Uniformity index and 0.32 cm Gauge stelometer.

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APPENDIX

TABLE I

AVERAGE NUMBERS OF SQUARES, BLOOMS AND BOLLS PER HECTARE ON AUGUST 10, 1982, TEST 1

	Number/Ha					
	Squares		Blooms		Bolls	
Variety	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested
Westburn M	172700	172700	8070	4519	20337	10329
Tamcot SP21	144293	147521	3228	4519	11298	10007
DES 56	153978	128476	3874	3551	6779	3874
Stoneville 213	171086	180445	3228	3551	4842	4519
Paymaster 145	231451	218861	8716	14526	13558	20014
Stoneville 825	209177	215956	10652	7747	10652	11621
Deltapine 55	147521	154946	3228	5488	15172	12912
Stoneville 256	128799	172377	1614	2905	2260	4519
Lankart LX 571	138805	124280	5488	3228	11944	6228
Deltapine SR-5	73600	105880	1937	2905	7937	6456
Paymaster 785	98778	90385	1937	4196	2582	4842
Coker 5110	77473	71340	3551	2905	3551	2070

TABLE II

AVERAGE NUMBERS OF SQUARES, BLOOMS AND BOLLS PER HECTARE ON AUGUST 10, 1982, TEST 2

	Number/Ha					
	Squares		Blooms		Bolls	
Variety	Unin-fested	Infested	Unin-fested	Infested	Unin-fested	Infested
GSA 75	152041	143971	3228	5165	9361	14203
Lankart 57 Sel.	116532	97487	14203	3228	9039	6133
Cascot BR-1	136547	118469	5165	4842	10330	7425
Cascot L-7	171732	176897	8393	5165	14526	11621
CAMD-E	224027	232420	8716	16786	21628	31635
GP 3774	163662	149136	2905	3551	5488	8716
GP 3755	218862	187550	5165	5488	10007	8070
Tamcot SP21S	146553	143971	3551	4196	7102	10007
PR-68	135255	124603	4196	9684	10007	20660
Lockett 77	163339	181739	9361	5165	18400	19045
HG 1845-N	144294	190455	10330	11944	18723	16140
Earlycot 32A	128154	105234	2260	3228	12912	14849

TABLE III

AVERAGE NUMBERS OF SQUARES, BLOOMS AND BOLLS PER HECTARE ON AUGUST 17, 1982, TEST 1

	Number/Ha					
	Squares		Blooms		Bolls	
Variety	Unin-fested	Infested	Unin-fested	Infested	Unin-fested	Infested
Westburn M	242104	190132	19368	20014	60687	46161
Tamcot SP21	180448	175283	24856	18400	52617	54877
DES 56	254693	198525*	25179	22274	57136	48744
Stoneville 213	281486	199493*	23888	21305	60042	61333
Paymaster 145	296012	268251	32926	47130	88126	84252
Stoneville 825	220476	195620	26793	23242	96519	78764
Delatpine 55	209500	138161*	26793	16786	60365	59719
Stoneville 256	186904	205627	22274	22596	41965	60042
Lankart LX 571	176574	138483	33249	16463	50680	41319
Deltapine SR-5	130736	124602	10975	14203	50680	36154
Paymaster 785	207886	126217*	16786	19368	36800	40996
Coker 5110	130413	140420	14849	9684	32281	24856

* Significantly different at the 5% level.

TABLE IV

AVERAGE NUMBERS OF SQUARES, BLOOMS AND BOLLS PER HECTARE ON AUGUST 17, 1982, TEST 2

	Number/Ha					
	Squares		Blooms		Bolls	
Variety	Unin-fested	Infested	Unin-fested	Infested	Unin-fested	Infested
GSA 75	172378	179157	24210	15817	62886	66821
Lankart 57 Sel.	150427	113627	15172	12589	34862	35509
Cascot BR-1	183999	131704*	15495	15172	52617	38737
Cascot L-7	168827	187550	31958	30021	67789	75536
CAMD-E	224672	172378*	43577	32603	91677	91677
GP 3774	167213	171732	24856	20982	40351	41965
GP 3755	215634	157529*	32281	24210	59396	63915
Tamcot SP21S	176897	167859	19691	20337	50104	61979
PR-68	162694	141389	17110	12912	41642	54877
Lockett 77	157529	184967	21305	29052	76505	63593
HG 1845-N	156560	165599	20660	27116	57136	53263
Earlycot 32A	158497	116210*	22919	18077	48744	47775

* Significantly different at the 5% level.

TABLE V

LINT YIELD AND LINT PERCENT[1] FROM THE FIRST HARVEST IN 1982, TEST 1

	Lint Yield in Kg/Ha			Lint %[1]	
Variety	Uninfested	Infested	Difference	Unin-fested	In-fested
Westburn M	341	298	43	33.7	37.7
Tamcot SP21	374	327	47	40.1	35.8
DES-56	306	248	58	36.6	36.2
Stoneville 213	411	301	110*	38.3	35.6
Paymaster 145	527	447	80*	36.8	37.0
Stoneville 825	442	396	46	35.0	39.8
Deltapine 55	291	228	63	36.3	33.7
Stoneville 256	338	310	28	38.8	37.3
Lankart LX 571	322	212	110*	38.2	36.3
Deltapine SR-5	211	198	13	37.7	36.5
Paymaster 785	267	200	67	38.9	38.1
Coker 5110	171	176	-5	35.9	39.6

* Significantly different at the 5% level.

[1] Lint as a percent of seed cotton.

TABLE VI

LINT YIELD AND LINT PERCENT[1] FROM THE SECOND HARVEST IN 1982, TEST 1

Variety	Lint Yield in kg/ha Uninfested	Infested	Difference	Lint %[1] Uninfested	Infested
Westburn M	311	363	-52	33.9	32.9
Tamcot SP21	381	366	15	34.4	35.6
DES-56	447	468	-21	32.2	35.2
Stoneville 213	448	322	126*	35.3	35.5
Paymaster 145	326	272	54	36.8	32.6*
Stoneville 825	369	342	27	34.8	35.0
Deltapine 55	335	395	-60	36.5	35.9
Stoneville 256	486	506	-20	35.5	34.7
Lankart LX 571	358	345	13	34.9	33.8
Deltapine SR-5	447	342	75*	34.9	34.7
Paymaster 785	406	365	41	36.9	36.2
Coker 5110	487	351	136*	36.4	34.2*

* Significantly different at the 5% level.

[1] Lint as a percent of seed cotton.

TABLE VII

LINT YIELD AND LINT PERCENT[1] FROM THE FIRST HARVEST IN 1982, TEST 2

	Lint Yield in kg/ha			Lint %[1]	
Variety	Uninfested	Infested	Difference	Uninfested	Infested
GSA-75	169	175	-6	34.2	30.6
Lankart 57 Sel.	153	126	27	36.7	36.6
Tamcot BR-1	152	145	7	33.8	35.6
Cascot L-7	284	192	92*	37.6	34.8
CAMD-E	459	345	115*	37.1	37.1
GP 3774	221	233	-12	36.8	36.2
GP 3755	349	315	-34	36.6	35.0
Tamcot SP21S	352	321	31	35.3	34.9
PR-68	149	165	-16	33.3	33.8
Lockett 77	227	225	2	32.8	33.8
HG 1845-N 785	246	266	-20	35.2	37.3
Earlycot 32A	269	182	87*	40.0	34.9

* Significantly different at the 5% level.

[1] Lint as a percent of seed cotton.

TABLE VIII

LINT YIELD AND LINT PERCENT[1] FROM THE SECOND HARVEST IN 1982, TEST 2

Variety	Lint Yield in kg/ha			Lint %[1]	
	Uninfested	Infested	Difference	Unin-fested	In-fested
GSA-75	403	339	64	32.9	32.1
Lankart 57 Sel.	356	313	43	33.5	34.0
Cascot BR-1	361	365	-4	36.6	36.1
Cascot L-7	386	311	74*	37.1	36.3
CAMD-E	230	249	-19	37.9	36.6
GP 3774	333	338	-5	36.8	35.6
GP 3755	329	318	11	34.6	35.6
Tamcot SP21S	332	344	12	34.8	34.3
PR-68	453	374	79*	35.0	34.9
Lockett 77	333	324	9	35.4	36.2
HG 1845-N	269	258	11	34.9	32.5*
Earlycot 32A	340	293	47	35.1	34.6

* Significantly different at the 5% level.

[1] Lint as a percent of seed cotton.

TABLE IX

OVERALL MEAN LINT YIELD AND LINT PERCENT IN 1982, TEST 1

	Kg/ha			%	
Variety	Unin-fested	Infested	Difference	Unin-fested	Infested
Westburn M	651	661	-10	33.8	35.3
Tamcot SP21	755	693	62	37.2	35.7
DES 56	752	715	37	34.4	35.7
Stoneville 213	859	723	136*	36.8	35.6
Paymaster 145	783	719	64	36.8	34.8
Stoneville 825	811	737	74	34.9	37.4
DPL 55	626	622	4	36.4	34.8
Stoneville 256	824	816	8	36.8	36.0
Lankart LX 571	681	557	124*	36.6	35.1
DPL SR-5	627	540	87	36.3	35.6
Paymaster 785	673	565	108	37.9	37.1
Coker 5110	659	527	132*	36.2	36.9
Experimental Mean	725	656	69		

* Significantly different at the 5% level.

TABLE X

OVERALL MEAN LINT YIELD AND LINT PERCENT IN 1982, TEST 2

	Kg/ha			%	
Variety	Unin-fested	Infested	Difference	Unin-fested	Infested
GSA - 75	508	578	-70	35.6	34.4
Lankart 57 Sel.	465	482	-17	35.1	35.4
Cascot BR-1	507	506	1	35.2	35.9
Cascot L-7	595	566	29	38.4	35.8
CAMD-E	709	575	134*	37.5	36.9
GP 3774	559	576	-17	37.8	35.9
GP 3755	667	643	24	35.6	35.3
Tamcot SP-21S	695	653	42	35.5	34.6
PR-68	602	539	63	34.2	34.4
Lockett 77	551	608	-57	34.1	34.8
HG 1845-N 785	504	535	-31	35.1	34.9
Earlycot 32A	606	405	121*	37.6	34.8
Experimental Mean	581	556	35		

* Significantly different at the 5% level.

TABLE XI

PERCENT OF LINT TAKEN AT FIRST HARVEST FOR COTTON VARIETIES LISTED IN ORDER OF INCREASING LATE MATURITY IN 1982, TEST 1

Variety	Percent First Harvest
Paymaster 145	61.9 a[1]
Stoneville 825	52.1 b
Westburn M	48.7 bc
Tamcot SP21	48.4 bc
Stoneville 213*	48.1 bc
Deltapine 55	43.8 cd
Lankart LX 571*	43.2 cde
Stoneville 256	39.5 de
Paymaster 785	37.8 de
DES 56	37.7 de
Deltapine SR-5	35.0 e
Coker 5110*	29.3 f

[1] Values followed by the same letter are not significantly different at the 5% level.

* Varieties which showed overall susceptibility to *H. zea*.

TABLE XII

PERCENT OF LINT TAKEN AT FIRST HARVEST FOR COTTON VARIETIES LISTED IN ORDER OF INCREASING LATE MATURITY IN 1982, TEST 2

Variety	Percent First Harvest
CAMD-E*	62.7 a[1]
GP 3755	50.6 b
Tamcot SP21S	49.9 b
HG 1845-N	49.3 b
Lockett 77	43.3 b
Earlycot 32A*	42.0 b
Cascot L-7	40.6 b
GP 3774	40.3 b
GSA 75	31.7 bc
Lankart 57 Sel.	29.4 c
Cascot BR-1	29.0 c
PR-68	27.5 c

[1] Values followed by the same letter are not significantly different at the 5% level.

* Varieties which showed overall susceptibility to *H. zea*.

TABLE XIII

POTENTIALLY TOLERANT COTTON VARIETIES LISTED IN ORDER OF INCREASING LATE MATURITY IN 1982, TEST 1

Variety	
Paymaster 145*	Early
Stoneville 825	Medium
Westburn M	Medium
Tamcot SP21	Medium
Deltapine 55	Late
Stoneville 256	Late
Paymaster 785*	Late
DES 56	Late
Deltapine SR-5**	Late

* Showed susceptibility in the first harvest.

** Showed susceptibility in the second harvest.

TABLE XIV

POTENTIALLY TOLERANT COTTON VARIETIES LISTED IN ORDER OF INCREASING LATE MATURITY IN 1982, TEST 2

Variety	
GP 3755	Medium
Tamcot SP21S	Medium
HG 1845-N	Medium
Lockett 77	Medium
Cascot L-7*	Medium
GP 3774	Medium
GSA 75	Late
Lankart 57 Sel.	Late
Cascot BR-1	Late
PR-68**	Late

* Showed susceptibility in the first harvest.

** Showed susceptibility in the second harvest.

TABLE XV

EARLINESS OF MATURITY AS EXPRESSED BY PERCENT OF LINT TAKEN AT FIRST HARVEST AND COMPARED BETWEEN INFESTED AND UNINFESTED SUB-PLOTS IN 1982, TEST 1

Variety	% First Harvest	
	Uninfested	Infested
Westburn M	52.8	46.7
Tamcot SP21	48.4	50.7
DES 56	41.2	36.4
Stoneville 213	48.0	39.7
Paymaster 145	60.3	61.2
Stoneville 825	54.7	51.7
Deltapine 55	47.0	37.0*
Stoneville 256	40.4	38.3
Lankart LX 571	45.8	40.6
Deltapine SR-5	34.5	39.4
Paymaster 785	37.4	34.2
Coker 5110	25.6	33.3
Experimental Mean	44.7	42.4

* Significantly different at the 5% level.

TABLE XVI

EARLINESS OF MATURITY AS EXPRESSED BY PERCENT OF LINT TAKEN AT FIRST HARVEST AND COMPARED BETWEEN INFESTED AND UNINFESTED SUB-PLOTS IN 1982, TEST 2

Variety	% First Harvest	
	Uninfested	Infested
GSA 75	32.0	31.9
Lankart 57 Sel	27.9	22.6
Cascot BR-1	28.4	27.7
Cascot L-7	46.6	33.0
Tamcot CAMD-E	65.2	59.6
GP 3774	40.8	47.5
GP 3755	51.6	48.6
Tamcot SP21S	50.1	48.3
PR-68	25.7	29.3
Lockett 77	40.8	45.3
HG 1845-N	48.2	50.7
Earlycot 32A	43.3	39.2
Experimental Mean	41.7	40.3

TABLE XVII

MEAN FIBER LENGTH[1/], UNIFORMITY INDEX AND STRENGTH[2/] OF THE FIRST HARVEST IN 1982, TEST 1

Variety	2.5% Span Length		50% Span Length		Uniformity Index		0.32cm(1/8") Guage Stelometer	
	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested
Westburn M	2.563	2.621	1.244	1.263	48.5	48.2	19.5	20.2
Tamcot SP21	2.606	2.616	1.285	1.285	49.3	49.2	20.0	20.1
DES 56	2.710	2.705	1.344	1.328	49.6	49.1	21.1	20.8
Stoneville 213	2.723	2.753	1.308	1.339	48.0	48.6	18.9	19.3
Paymaster 145	2.791	2.753	1.255	1.250	50.2	49.7	20.4	20.0
Stoneville 825	2.616	2.685	1.232	1.280	47.0	47.7	19.4	19.8
Deltapine 55	2.662	2.764	1.252	1.285	47.0	46.5	18.8	19.6
Stoneville 256	2.809	2.771	1.346	1.349	47.9	47.0	19.5	19.8
Lankart LX 571	2.456	2.629*	1.189	1.313*	48.4	49.9	8.1	18.7
Deltapine SR 5	2.560	2.642	1.232	1.290	48.1	48.9	21.4	19.7
Paymaster 785	2.410	2.431	1.245	1.229	51.6	50.6	20.1	20.0
Coker 5110	2.781	2.776	1.349	1.354	48.5	48.7	21.0	20.4

* Significantly different at the 1% level.

1/ In centimeters

2/ In grams-force per tex.

TABLE XVIII

MEAN FIBER LENGTH, UNIFORMITY INDEX
AND STRENGTH OF THE SECOND
HARVEST IN 1982,
TEST 1

Variety	2.5% Span Length		50% Span Length		Uniformity Index		0.32cm(1/8") Guage Stelometer	
	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested
Westburn M	2.786	2.863	1.267	1.359*	45.5	47.6	20.9	20.0
Tamcot SP21	2.799	2.588	1.316	1.328	47.0	46.5	20.4	19.9
DES 56	2.891	2.893	1.354	1.344	46.9	46.5	20.7	20.9
Stoneville 213	2.842	2.863	1.293	1.290	45.5	45.1	18.2	19.3
Paymaster 145	2.659	2.682	1.250	1.280	47.0	47.8	20.1	20.8
Stoneville 825	2.873	2.903	1.288	1.339	44.8	46.2	18.1	18.4
Deltapine 55	2.845	2.969*	1.293	1.341	45.5	45.2	18.9	19.9
Stoneville 256	2.936	2.962	1.313	1.303	44.8	43.9	18.7	18.4
Lankart LX 571	2.791	2.789	1.328	1.323	47.6	47.5	18.9	18.4
Deltapine SR 5	2.797	2.926*	1.346	1.354	48.1	47.2	22.0	22.4
Paymaster 785	2.611	2.588	1.298	1.273	49.7	49.2	20.5	19.8
Coker 5110	2.946	3.056*	1.367	1.440*	46.3	47.1	20.3	20.2

* Significantly different at the 1% level.

TABLE XIX

MEAN FIBER LENGTH, UNIFORMITY INDEX
AND STRENGTH OF THE FIRST
HARVEST IN 1982,
TEST 2

	2.5% Span Length		50% Span Length		Uniformity Index		0.32cm(1/8") Guage Stelometer	
Variety	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested
GSA 75	2.756	2.583	1.270	1.270	49.1	49.2	21.9	23.2
Lankart 57 Sel.	2.543	2.667	1.267	1.252	49.8	50.5	18.3	18.3
Cascot BR-1	2.639	2.667	1.273	1.280	48.2	47.9	19.6	19.3
Cascot L-7	2.786	2.695	1.387	1.300	49.8	48.4	20.4	20.8
CAMD-E	2.537	2.517	1.245	1.227	49.3	49.1	19.9	18.9
GP 3774	2.543	2.634	1.219	1.252	47.8	49.3	18.9	18.8
GP 3755	2.750	2.776	1.331	1.303	47.9	46.9	17.9	18.8
Tamcot SP21S	2.783	2.697	1.339	1.323	49.2	49.0	19.5	20.1
PR-68	2.690	2.624	1.346	1.303	50.4	49.6	21.6	21.0
Lockett 77	2.581	2.624	1.257	1.308	48.7	49.8	21.3	20.9
HG 1845-N	2.741	2.621	1.306	1.242	47.7	47.8	20.9	19.7
Earlycot 32A	2.624	2.583	1.285	1.262	48.9	48.9	20.9	19.7

TABLE XX

MEAN FIBER LENGTH, UNIFORMITY INDEX
AND STRENGTH OF THE SECOND
HARVEST IN 1982,
TEST 2

	2.5% Span Length		50% Span Length		Uniformity Index		0.32cm(1/8") Guage Stelometer	
Variety	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested
GSA 75	2.756	2.781	1.308	1.336	47.5	48.0	19.7	21.1
Lankart 57 Sel.	2.774	2.769	1.326	1.313	47.8	47.4	18.4	17.7
Cascot BR-1	2.903	2.951	1.379	1.359	47.4	45.7	19.2	19.5
Cascot L-7	2.985	2.921	1.397	1.377	46.8	47.2	19.7	20.7
CAMD-E	2.771	2.731	1.311	1.280	46.1	46.9	18.7	19.6
GP 3774	2.873	2.880	1.311	1.326	45.7	46.1	19.4	19.0
GP 3755	2.964	2.974	1.334	1.326	45.0	44.6	18.6	19.5
Tamcot SP21S	2.906	2.939	1.306	1.389	46.3	47.3	19.7	20.3
PR-68	2.873	2.863	1.311	1.323	46.7	46.2	20.8	20.8
Lockett 77	2.804	2.870	1.273	1.331	45.4	46.3	20.6	20.5
HG 1845-N	2.964	2.916	1.316	1.229	43.9	42.2	19.0	19.1
Earlycot 32A	2.832	2.924	1.290	1.349	45.5	46.2	20.4	19.9

TABLE XXI

ADJUSTED OVERALL MEAN FIBER LENGTH, UNIFORMITY INDEX AND STRENGTH OF COTTON VARIETIES IN 1982, TEST 1

Variety	2.5% Span Length Unin-fested	2.5% Span Length Infested	50% Span Length Unin-fested	50% Span Length Infested	Uniformity Index Unin-fested	Uniformity Index Infested	0.32cm(1/8') Guage Stelometer Unin-fested	0.32cm(1/8') Guage Stelometer Infested
Westburn M	2.667	2.717	1.245	1.312	46.9	47.7	20.2	20.1
Tamcot SP21	2.705	2.601**	1.301	1.307	48.2	47.8	19.9	20.1
DES 56	2.850	2.850	1.364	1.351	48.4	47.9	21.1	21.7
Stoneville 213	2.784	2.810	1.300	1.314	46.7	46.8	18.5	19.3
Paymaster 145	2.691	2.726	1.253	1.261	49.0	49.0	20.3	20.3
Stoneville 825	2.733	2.785	1.258	1.307*	46.0	47.0	18.8	19.2
Deltapine 55	2.765	2.879**	1.275	1.316*	46.2	45.8	18.9	19.8
Stoneville 256	2.886	2.887	1.332	1.048**	46.0	47.1	17.9	19.8
Lankart LX 571	2.646	2.720	1.268	1.319*	47.9	48.5	18.4	18.5
Deltapine SR-5	2.714	2.798*	1.306	1.332	48.1	47.8	21.8	21.5
Paymaster 785	2.535	2.529	1.278	1.256	50.4	49.7	20.3	19.9
Coker 5110	2.898	2.974	1.362	1.415*	46.9	47.6	20.5	20.3
Experimental Average	2.740	2.773	1.295	1.295	47.6	47.7	19.9	20.0

* Significantly different at the 5% level.

** Significantly different at the 1% level.

TABLE XXII

ADJUSTED OVERALL MEAN FIBER LENGTH, UNIFORMITY INDEX AND STRENGTH OF COTTON VARIETIES IN 1982, TEST 2

	2.5% Span Length		50% Span Length		Uniformity Index		0.32cm(1/8') Guage Stelometer	
Variety	Unin-fested	Infested	Unin-fested	Infested	Unin-fested	Infested	Unin-fested	Infested
GSA 75	2.756	2.718	1.296	1.315	48.0	48.4	20.4	21.8
Lankart 57 Sel.	2.706	2.739	1.309	1.352	48.2	48.3	18.3	17.9
Cascot BR-1	2.826	2.869	1.348	1.336	47.6	46.3	18.4	19.4
Cascot L-7	2.904	2.829	1.395	1.358	17.7	47.7	20.0	20.7
CAMD-Eter 145	2.624	2.597	1.270	1.247	48.1	48.3	19.5	19.0
GP 3774	2.731	2.772	1.281	1.316	46.4	47.3	19.1	18.9
GP 3755	2.856	2.869	1.332	1.314	46.5	45.8	18.2	19.1
Tamcot SP 21S	2.845	2.818	1.323	1.356	47.8	48.2	19.6	20.2
PR-68	2.823	2.970	1.321	1.365	47.7	47.9	20.2	20.9
Lockett 77	2.620	2.763	1.267	1.321	46.8	47.8	20.9	20.7
HG 1845-N	2.854	2.771	1.311	1.235	44.9	45.0	19.9	19.4
Earlycot 32A	2.745	2.781	1.288	1.312	46.9	47.3	20.6	19.8
Experimental Average	2.774	2.791	1.312	1.312	47.2	47.4	19.6	19.8

TABLE XXIII

LINT YIELD, OF COTTON VARIETIES IN 1983

Variety		Kg/ha Uninfested	Kg/ha Infested	Kg/ha Difference
Westburn M	a	356	386	-30
Paymaster 145	a	335	361	-26
Stoneville 213[1]	a	397	325	72*
Stoneville 825	a	365	341	24
Coker 5110[2]	a	355	318	37
GP 3774	b	383	358	25
GSA 75	b	294	275	19
CAMD-E[3]	b	421	318	103*
Deltapine 90	c	457	385	72*
Deltapine SR 383	c	277	347	-70*
Deltapine 61	c	418	332	86*
Stoneville 302	c	268	317	-49
Experimental Mean		361	339	22

* Significantly different at the 5% level.

a Varieties were included in Test 1 in 1982

b Varieties were included in Test 2 in 1982

c Varieties were tested in 1983 only

1, 2, & 3 varieties which showed susceptibility in 1982.

TABLE XXIV

LINT PERCENT OF COTTON VARIETIES IN 1983

	%			
	Bur Cotton		Seed Cotton	
Variety	Uninfested	Infested	Uninfested	Infested
Westburn M	26.2	28.2	34.9	35.8
Paymaster 145	28.0	28.9	37.3	37.1
Stoneville 213	28.2	30.0	37.2	35.5
Stoneville 825	27.4	29.1	36.2	36.1
Coker 5110	26.6	31.3	38.0	39.1
GP 3774	25.4	25.9	35.7	35.6
GSA 75	24.0	25.6	33.8	33.8
CAMD-E	29.7	27.6	35.4	36.3
Deltapine 90	32.3	31.4	41.4	39.2
Deltapine SR 383	23.0	22.7	35.9	35.9
Deltapine 61	28.3	28.6	39.0	37.3
Stoneville 302	28.9	30.5	38.9	41.6*
Experimental Mean	27.3	28.3	37.0	36.9

* Significantly different at the 5% level.

TABLE XXV

A SUMMARY OF LINT YIELD RESULTS OF THE COTTON VARIETIES TESTED IN 1982 AND 1983. THE 1980 FIGURES[1] HAVE BEEN INCLUDED HERE FOR COMPARISON

	1982		1983		1980[1]	
Variety	Uninfested	Infested	Uninfested	Infested	Uninfested	Infested
Westburn M	651	661	356	386	433	378
Tamcot SP21	755	693			422	388
DES-56	752	715			399	212*
Stoneville 213	859	723*	397	325*	451	270*
Paymaster 145	783	719	335	361		
Stoneville 825	811	737	365	341		
Deltapine 55	626	622				
Stoneville 256	824	816				
Lankart LX571	681	557*				
Deltapine SR-5	627	540				
Paymaster 785	673	565				
Coker 5110	659	527*	355	318	315	151*
GSA 75	508	578				
Lankart 57 Sel.	465	482	294	275		
Cascot BR-1	507	506				
Cascot L-7	595	566				
Tamcot CAMD-E	709	575*	421	318*		
GP 3774	559	576	383	358		
GP 3755	667	643				
Tamcot SP21S	695	653				
PR-68	602	539				
Lockett 77	551	608			419	365
HG 1845-N	504	535				
Earlycot 32A	606	405*				
Deltapine 90			457	385*		
Deltapine SR383			277	347		
Deltapine 61			418	332*		
Stoneville 302			268	317		

[1] These figures are from the varieties which were among the twelve tested by Kevin Mussett in 1980.

* Significantly different at the 5% level.

VITA

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