THE PHYSIOLOGICAL EFFECTS OF DIFFERENT RATES OF N-(3,4-DICHLOROPHENYL)METHACRYLAMIDE ON COTTON AT VARIOUS GROWTH STAGES

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INTRODUCTION

The high cost of labor in producing cotton has placed emphasis on the necessity of finding a more economical method of controlling weeds and grasses. Not only do weeds and grasses compete with the cotton for moisture, nutrients and light, but weed-contaminated cotton will usually result in lower quality lint. To prevent downgrading, hand picking instead of mechanical harvesting should be done in weed-infested fields.

Several pre-emergent herbicides on the market today give good control of annual weeds and grasses without injury to cotton. Unfortunately, these herbicides are not used to a great extent in some sections of the cotton-growing area because adverse weather conditions during the planting season may necessitate replanting. When replanting becomes necessary the herbicide which has been applied will no longer be effective.

With an effective post-emergent herbicide, treatment would not be necessary until a weed problem exists. Various herbicidal oils have been used to some extent as post-emergents; however, cotton is not truly tolerant of these chemicals and severe stunting or death may result if they are improperly applied.

Dicryl [N-(3,4-dichlorophenyl)methacrylamide], a selective post-emergent herbicide for use in cotton production, was released in 1958. Preliminary results by numerous investigators indicate that dicryl may be applied directly over cotton at sufficient rates to control many of the common weeds found in the field without severe injury to the cotton.

However, various physiological effects have been noted from the use of this chemical on cotton.

This study is primarily concerned with the growth and fruiting response of cotton treated with dicryl at various rates and applied at different stages of growth.

LITERATURE REVIEW

Very little published information on the use of dicryl is available at present. Numerous herbicidal oils have been utilized for post-emergent weed control in cotton. The oils which give the best weed control with the least amount of damage to cotton are those with a boiling point of 200-400° F. and which contain from 23-25 per cent aromatic compounds (15). Talley (15) using oils with these characteristics reported that five day old cotton could be treated, utilizing a direct spray, with 5 gallons of oil per acre without injury to the cotton. He found that this rate could be applied every five days for a period of 35 days without injury to the plants. Control of weeds and grasses was usually obtained with four or five applications during the year.

Leonard and Harris (10) and Talley, Porter and Davis (16) reported good control of weeds without serious injury to cotton with the application of Lion Herbicidal Oil at the rate of 5 gallons per acre.

Rea (13) working in Texas obtained good results with the application of Lion Herbicidal Oil No. 1 at the rate of 5 gallons per acre. He reported 95 per cent control of annual weeds and grasses when the oils were applied at the proper time. In studies by Ratcliff, Normand and Smilie (11) 23.6 per cent reduction in cotton stand was noted with the treatment of 5 gallons of Lion Herbicidal Oil No. 1 per acre. Work done by Harris (9) indicates that Lion Herbicidal Oil No. 1 applied at the rate of 7 gallons per acre may reduce yield of the cotton.

Five gallons of Esso No. 38 Oil per acre reduced cotton stand and yield in studies by Ratcliff, Normand and Smilie (11) and Williams and Hinkle (17). According to Talley, Porter and Davis (16) Esso and Shell herbicidal oils gave good control of weeds and grasses but were injurious to cotton growth.

Albert and Anderson (1) reported no significant control of established weeds with 12 pounds of CIPC [isopropyl N-(3 chlorophenyl)carbomate] or 4 pounds of CMU (3-p-chlorophenyl-1, 1-dimethylurea) per acre in either overhead or directed sprays. Injury to cotton seedlings was noted when these treatments were applied as overhead sprays.

Cotton in the three-leaf stage, sprayed directly with CMU or Weedkiller D [3-(3,4-dichlorophenyl)-1, 1-dimethylaurea] at the rate of 2 pounds per acre gave a reduction in cotton stand and yield as reported by Rea (13).

ALANAP 1 (N-1-naphthyl phthalamic acid), ALANAP 3 and ACP-L-322 (the sodium and amine salts of this acid, respectively) and ALANAP 5 (a 1-to-1 mixture of the acid and its imide derivative) were used in a post emergent study by Rea (12). He reported that cotton was susceptible to these chemicals when the growing tips were treated. The vertical application of 5 and 2/3 pounds of ALANAP 5 per acre to cotton at the time of 95 per cent emergence resulted in a temporary delay of seedling growth. External hormone injury was observed with the vertical application of 5 pounds of ALANAP 1 and 5 per acre to one week old cotton. However, these treatments did not result in a reduction in stand or seedling growth. The same treatments to cotton five to eight weeks old resulted in fasciation of leaf veins and deep indentations of the leaf margins of the new growth arising from the growing points.

No apparent damage to cotton resulted from the application of 3 pounds of dicryl /N-(3,4-dichlorophenyl)methacrylamide/ to cotton twelve, sixteen and ninteen days after emergence according to Harris, Applewhite and Broadus (8). They also reported that this rate applied directly over three and seven day old cotton plants resulted in severe stunting and chlorosis, and slight stunting, respectively. However, they found these reactions to be temporary and no reduction in total yield, although the fruiting appeared to be slightly delayed.

Double applications of dicryl, with the total of both treatments not exceeding 3 pounds per acre, appeared to give better weed control than only one application at 3 pounds per acre (6, 7). Barns (2) reported that a single application of dicryl gave excellent control of pigweeds and crabgrass without injury to cotton.

Bingham and Porter (3) working in the greenhouse found that three pounds per acre of dicryl, applied to cotton five to six days after planting, markedly reduced the rate and amount of development of the cotyledon cotton. They further noted a reduction in cell enlargement, internode elongation and fresh weight, with marked recovery from these responses within twelve days.

Dicryl reduced the growth of the cotton without any substantial effect on total respiration, according to Bingham and Porter (4). They found that dicryl reduced ascorbic acid oxidase activity in cotyledon tissue to the same extent as it affected the cotton growth.

MATERIALS AND METHODS

A study to determine the effects of N-(3,4-dichlorophenyl) methacrylamide (dicryl), a new post-emergent herbicide, on cotton was conducted at the Agronomy Research Station, Perkins, Oklahoma. This study was carried out on Vanoss loamy soil which had been fallowed for three years preceding the study. A good seedbed was prepared by plowing and disking, and 200 pounds of 16-20-0 fertilizer was broadcast on the plots prior to planting on June 10.

Rainfall from June 1 to November 1 amounted to 18.08 inches and was uniformly distributed. The plots were kept free of weeds by cultivation and hand hoeing from the time of emergence through harvest so that variance in plant growth and yield would be due to the treatments and not weed competition. Insects were controlled with periodical applications of insecticides.

Five stages of cotton growth were designated the main plots in a split-plot field design. These five stages were the two-leaf, four-to-six-leaf, young square, pre-bloom and young boll stage. Each sub-plot of the main plot was composed of four rows which had forty-inch middles and were twenty feet long. Rates of 0, 1, 2, 4, and 8 pounds of active dicryl per acre were applied to the sub-plots.

The herbicide was applied on the first three stages of growth with a knapsack sprayer equipped with a number 8002E Tee-jet nozzle. Dicryl was mixed with water and applied at the rate of 40 gallons per acre with

an air pressure of 30 pounds. The nozzle was held directly above the row during application and the row was covered directly below and eight inches on either side. For application to the fourth and fifth stages of growth a number 8003E Tee-jet nozzle was used. This nozzle was used since a larger spray pattern was needed to completely cover the plants.

Due to the possibility of herbicidal drift only the two center rows were used for all observations taken throughout the study. All plots were thinned to approximately twenty-five plants spaced one foot apart one month after planting.

The two-leaf and four-to-six-leaf stages of growth were treated on June 20 and June 29, respectively. Seven plants used for study were selected at random from each sub-plot of the first and second stages of growth. The height of each of these plants was recorded on July 23 and August 19. A count of the number of nodes per plant was taken at the time of the first height measurement and the number of fruit per plant at the second measurement. A count of the number of bolls and blooms per plant was taken September 15. None of the above readings were taken on the last three stages of growth since the treatments did not appear to affect the plants except for a slight discoloration of the leaves at the higher rates.

All plots were harvested during a two-week period from October 14 to October 28 and again November 12 and 14. The length of time required for the first harvest was due to the adverse weather conditions during this period. The two center rows of each sub-plot were harvested and weighed separately. The pounds of seed cotton per acre for each plot was determined.

The methods for statistical analysis of the data were taken from Snedecor (14) and Duncan (5).

RESULTS AND DISCUSSION

Discoloration of the leaf tissue was noted in all plants which received dicryl treatments in the two-leaf stage of growth. This reponse appeared to be more severe along the margins of the leaves resulting in the death of the tissue affected in the plants which received the higher rates of dicryl. Data from the stand count taken two weeks after treatment of the first stage of growth are presented in Table I. With the application of 8 pounds of dicryl per acre the cotton stand was significantly reduced; however, no reduction in stand occurred with the application of lower rates.

One month after application of the herbicide to the two-leaf stage of growth the average height of plants in the check plots was almost twice that of plants which had received the 8 pound treatment. With the exception of the 1 and 2 pound treatments the amount of reduction in height varied with the rate of treatment with each increase in rate resulting in a significant decrease in plant height. Multiple range tests of the average plant height are presented in Table II. Similar results were observed one month later; however, there was no significant difference in the average plant height of the check and 1 pound treatment at this time (Table III).

The reduction in height as a result of the treatments to the first stage was accompanied by a reduction in the length of the nodes and not by a corresponding reduction in the number of nodes per plant. Only

TABLE I

MULTIPLE RANGE TEST OF THE DIFFERENCE IN THE NUMBER OF PLANTS PER ROW BEFORE AND AFTER TREATMENT OF COTTON IN THE TWO-LEAF STAGE OF GROWTH

Lbs. of Dicryl Per Acre	1	4	0	2	8
Means	1.75	5.0	5.5	8.5	19.0

TABLE II

MULTIPLE RANGE TEST OF THE AVERAGE PLANT HEIGHT (INCHES) ONE MONTH AFTER TREATMENT OF COTTON IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	6.83	9.59	11.61	11.77	12.63

TABLE III

MULTIPLE RANGE TEST OF THE AVERAGE PLANT HEIGHT (INCHES) TWO MONTHS AFTER TREATMENT OF COTTON IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	20.68	24.48	26.92	27.30	27.91

Note: Any two means underscored by the same line are not significantly different at the five per cent level.

the 8 pound treatment resulted in fewer nodes and this difference was only slightly significant, indicating at least a temporary decrease in internode elongation. Table IV gives the multiple range test of the average number of nodes per plant one month after treatment with dicryl to the two-leaf stage of growth.

Fruiting was significantly reduced by the 8 pound treatment to the cotton in the two-leaf stage (Table V). No other treatment significantly reduced fruit set at this stage of growth. The number of bolls and blooms per plant was significantly higher in the check plot than in either the 8 or 4 pound treatment plots three months after treatments. Multiple Range Tests of the average number of bolls and blooms per plant is presented in Table VI.

The per cent of total yield obtained at the first harvest date indicates that the lower number of bolls and blooms per plant in the 4 and 8 pound treatments was due, at least in part, to delayed maturity (Table VII). The per cent of the crop mature at the first picking of the 8 and 4 pound treatments was 44.83 and 66.08 per cent, respectively, while 72.83 per cent of the total yield of the check plot was mature at this time.

The reduction in height in the four-to-six-leaf stage of growth was similar to that obtained in the two-leaf stage. The difference between the check and 8 pound treatment was not as large, nor was there a significant difference in the 2 and 4 pound treatments at the first measurement (Table VIII).

A Multiple Range Test of the average plant height seven weeks after treatment of the four-to-six-leaf stage is given in Table IX. There was no significant difference in the 4 and 8 pound treatments

TABLE IV

MULTIPLE RANGE TEST OF THE AVERAGE NUMBER OF NODES PER PLANT ONE MONTH AFTER TREATMENT OF COTTON IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	7.00	8.07	8.50	8.50	8.54

TABLE V

MULTIPLE RANGE TEST OF THE AVERAGE NUMBER OF FRUIT PER PLANT NINE WEEKS AFTER TREATMENT OF COTTON IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	21.86	25.93	26.86	30.04	30.75

TABLE VI

MULTIPLE RANGE TEST OF THE AVERAGE NUMBER OF BOLLS AND BLOOMS PER PLANT THREE MONTHS AFTER TREATMENT OF COTTON IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	2.89	5.61	7.89	9.57	9.58

Note: Any two means underscored by the same line are not significantly different at the five per cent level.

TABLE VII

THE EFFECTS OF VARIOUS TREATMENTS TO COTTON IN THE TWO-LEAF STAGE ON SEED COTTON PRODUCTION

Rate of Dicryl Per Acre	Total Yield Lbs. per Acre	Yield at First Picking	Per cent of Yield at First Picking
Check	2441.00	1778.50	72.83
1 pound	2306.75	1601.25	69.42
2 pounds	2113.75	1472.50	69.66
4 pounds	2052.50	1356.50	66.08
8 pounds	1769.00	769.50	41.77

TABLE VIII

MULTIPLE RANGE TEST OF THE AVERAGE PLANT HEIGHT (INCHES) THREE WEEKS AFTER TREATMENT OF COTTON IN THE FOUR-TO-SIX-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	9.23	10.69	10.97	12.30	13.32

TABLE IX

MULTIPLE RANGE TEST OF THE AVERAGE PLANT HEIGHT (INCHES) SEVEN WEEKS AFTER TREATMENT OF COTTON IN THE FOUR-TO-SIX-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	0	1
Means	24.48	25.37	26.27	28.07	28.27

Note: Any two means underscored by the same line are not significantly different at the five per cent level.

or the check and 1 pound treatment. This indicates that the growth of the plants during the preceding month had partially overcome the stunting which was observed at the time of the first height measurement.

Earliness as judged by the bolls and blooms per plant of three-month-old plants and the percentage of the crop taken at the first harvest was delayed by the 4 and 8 pound-treatments to cotton in the four-to-six-leaf stage. Table X gives the Multiple Range Test of the average number of bolls and blooms. The percentage of seed cotton harvested at the first date is given in Table XI.

Yield data from the first harvest of the two-leaf and four-to-six-leaf stages of growth are presented in Tables XII and XIII. The 8 pound treatment significantly reduced yield when applied to these stages of growth. The 2 and 4 pound treatment resulted in a significant reduction in yield in the two-leaf stage of growth but not in the other stages. The lower yields are apparently due to the stunting and delayed maturity which resulted from the treatment of the cotton at these stages of growth. There was no significant difference among treatments in the three older stages of growth at either the first or second harvest.

Yields of the 8 pound treatments in the first and second stages of growth were significantly higher at the second harvest than any of the other treatments (Tables XIV and XV). This increase in yield indicates that the corresponding decrease in yield at the first harvest was due, at least in part, to delayed maturity.

There was no significant difference in the average total yields of any treatments to the four older stages of growth. In the first

TABLE X

MULTIPLE RANGE TEST OF THE AVERAGE NUMBER OF BOLLS AND BLOOMS PER PLANT, TEN WEEKS AFTER TREATMENT OF COTTON IN THE FOUR-TO-SIX-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	0	1
Means	5.04	7.29	7.82	9.39	10.02

TABLE XI

THE EFFECTS OF VARIOUS TREATMENTS TO COTTON IN THE FOUR-TO-SIX-LEAF STAGE ON SEED COTTON PRODUCTION

Rate of Dicryl Per Acre	Total Yield Lbs. Per Acre	Yield at First Picking	Per cent of Yield at First Picking
Check	2253.75	1794.25	79.72
1 pound	2311.15	1790.25	77.45
2 pounds	2173.75	1642.50	75.56
4 pounds	2118.75	1622.25	74.91
8 pounds	2165.50	1590.75	71.21

TABLE XII

MULTIPLE RANGE TEST OF THE AVERAGE SEED COTTON YIELDS (POUNDS PER ACRE) FROM THE FIRST HARVEST OF COTTON TREATED IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	739.50	1356.75	1472.50	1601.25	1778.50

Note: Any two means underscored by the same line are not significantly different at the five per cent level.

TABLE XIII

MULTIPLE RANGE TEST OF THE AVERAGE SEED COTTON YIELDS (POUNDS PER ACRE) FROM THE FIRST HARVEST OF COTTON TREATED IN THE FOUR-TO-SIX-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	1509.75	1622.25	1642.50	1790.75	1794.25

TABLE XIV

MULTIPLE RANGE TEST OF THE AVERAGE SEED COTTON YIELDS (POUNDS PER ACRE) FROM THE SECOND HARVEST OF COTTON TREATED IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	2	0	4	1	8
Means	641.25	622.50	695.25	707.75	1030.25

TABLE XV

MULTIPLE RANGE TEST OF THE AVERAGE SEED COTTON YIELDS (POUNDS PER ACRE) FROM THE SECOND HARVEST OF COTTON TREATED IN THE FOUR-TO-SIX-LEAF STAGE

Lbs. of Dicryl Per Acre	0	4	1	2	8
Means	494.50	513.25	526.25	541.25	655.75

Note: Any two means underscored by the same line are not significantly different at the five per cent level.

stage of growth the yield of the 8 pound treatment was significantly less than the yield of any of the other treatments. There was no significant difference in the yield of the 2 and 4 pound treatments; however, these treatments were significantly lower than the check and 1 pound treatments. There was no significant difference between the check and 1 pound treatment (Table XVI).

Analysis of Variance was computed for each plant response noted. The results of these tests are shown in Appendix Tables I through IX. When there was no significant difference among the treatments the Multiple Range Tests were not presented.

TABLE XVI

MULTIPLE RANGE TEST OF THE AVERAGE TOTAL SEED COTTON YIELDS (POUNDS PER ACRE) OF COTTON TREATED IN THE TWO-LEAF STAGE

Lbs. of Dicryl Per Acre	8	4	2	1	0
Means	1769.00	2052.50	2113.75	2306.75	2441.00

Note: Any two means underscored by the same line are not significantly different at the five per cent level.

SUMMARY AND CONCLUSIONS

The effects of dicryl at rates up to 8 pounds per acre on cotton at five different stages of growth were studied at the Agronomy Research Station, Perkins, Oklahoma, in 1960. A split-plot field design was used with stages of cotton growth designated as main plots and treatments of dicryl at 0, 1, 2, 4 and 8 pounds per acre designated as sub-plots.

Statistical analysis indicates that the 8 pound treatment to the two-leaf stage of growth significantly reduced the plant stand. All rates of dicryl retarded growth and reduced internode elongation in the two-leaf stage of growth. Plants treated in the four-to-six-leaf stage were stunted by the 2, 4 and 8 pound treatments. Maturity as judged by the number of bolls and blooms per plant three months after treatment and the per cent of seed cotton harvested at the first picking was delayed by the 8 and 4 pound treatments to the two-leaf and four-to-six-leaf stages of growth.

Total yield was significantly reduced by the 2, 4 and 8 pound treatments to the two-leaf stage of growth. Treatment of the four older stages of growth appeared to have no effect on the total yield of these plants.

These data indicate that the direct application of dicryl at rates of 2 pounds per acre or above, to cotton in the two-leaf stage of growth will result in the stunting of the plants, a reduction in the fruit

set, delayed maturity and a reduction in total yield. Treatment of the four-to-six-leaf stage of growth at rates of 2 pounds per acre or above will result in the stunting of the plants. Eight pounds per acre will delay maturity and reduce the total yield. Treatments of dicryl at rates up to 8 pounds per acre to the young square, pre-bloom or young boll stages of growth appear to have no affect on the maturity or yield of the plants. This indicates that the tolerance of cotton to dicryl increases with age.

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APPENDIX

APPENDIX TABLE I

ANALYSIS OF VARIANCE OF THE PLANT STAND COUNT MADE JUNE 29

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	22.87	7.62	
Treatments	4	351.10	87.77	6.84**
Error	12	154.00	12.83	
Rows in Plot	20	115.00	5.75	
Total	39	642.97		

APPENDIX TABLE II

ANALYSIS OF VARIANCE OF THE JULY 23 HEIGHT MEASUREMENTS OF THE TWO-LEAF AND FOUR-TO-SIX-LEAF STAGES OF GROWTH

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	163.81	54.60	
Stages	1	51.00	51.00	9.45*
Error (a)	3	16.19	5.39	
Treatments	4	772.69	193.16	104.97**
T X S	4	66.84	16.71	9.07**
Error (b)	24	44.33	1.84	
Plants in Plot (Sampling Error)	240	807.35	3.36	
Total	279	1922.18		

*Indicates significance at the five per cent level.
**Indicates significance at the one per cent level.

APPENDIX TABLE III

ANALYSIS OF VARIANCE OF THE AUGUST 19 HEIGHT MEASUREMENTS OF THE TWO-LEAF AND FOUR-TO-SIX-LEAF STAGES OF GROWTH

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	555.65	185.21	
Stages	1	98.41	98.41	3.15
Error (a)	3	31.23	10.41	
Treatment	4	1017.53	254.38	17.98**
T X S	4	213.36	53.34	3.77*
Error (b)	24	339.50	14.41	
Plants in Plot (Sampling Error)	240	2562.05	10.67	
Total	279	4817.77		

APPENDIX TABLE IV

ANALYSIS OF VARIANCE OF THE NUMBER OF NODES PER PLANT IN THE TWO-LEAF AND FOUR-TO-SIX-LEAF STAGES OF GROWTH ON JULY 23

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	45.64	15.21	
Stages	1	13.73	13.73	1.06
Error (a)	3	35.70	11.90	
Treatment	4	51.69	12.92	13.76**
T X S	4	13.16	3.29	3.50*
Error (b)	24	22.52	.94	
Plants in Plot (Sampling Error)	240	215.33	.89	
Total	279	433.87		

*Indicates significance at the five per cent level.
**Indicates significance at the one per cent level.

APPENDIX TABLE V

ANALYSIS OF VARIANCE OF THE NUMBER OF FRUIT PER PLANT IN THE TWO-LEAF AND FOUR-TO-SIX-LEAF STAGES OF GROWTH ON AUGUST 19

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	647.16	215.87	
Stages	1	73.03	73.03	.82
Error (a)	3	266.69	88.89	
Treatment	4	1677.72	419.43	5.36**
T X S	4	419.85	104.96	1.34
Error (b)	24	1876.09	78.17	
Plants in Plots (Sampling Error)	240	16,863.43	70.26	
Total	279	21,824.42		

APPENDIX TABLE VI

ANALYSIS OF VARIANCE OF THE NUMBER OF BOLLS AND BLOOMS PER PLANT IN THE TWO-LEAF AND FOUR-TO-SIX-LEAF STAGES OF GROWTH ON SEPTEMBER 15

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	425.07	141.69	
Stages	1	44.01	44.01	2.23
Error (a)	3	59.20	19.73	
Treatment	4	1231.81	307.95	17.17**
T X S	4	179.33	44.83	3.04*
Error (b)	24	354.12	14.75	
Plants in Plot (Sampling Error)	240	3,259.43	13.58	
Total	279	5,552.97		

*Indicates significance at the five per cent level.
**Indicates significance at the one per cent level.

APPENDIX TABLE VII

ANALYSIS OF VARIANCE OF THE SEED COTTON YIELDS FROM THE FIRST HARVEST

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	1,273,520	424,506.7	
Stages	4	6,183,020	1,545,755.0	45.53**
Error (a)	12	408,240	34,020.0	
Treatment	4	1,386,700	346,675.0	20.73**
T X S	16	1,573,450	98,340.6	5.88**
Error (b)	60	1,001,850	16,697.5	
Total	99	11,826,780		

APPENDIX TABLE VIII

ANALYSIS OF VARIANCE OF THE SEED COTTON YIELDS FROM THE SECOND HARVEST

Source of Variation	D. F.	Sum of Squares	Mean Square	F
Replications	3	846,784	282,261.33	
Stages	4	3,755,721	938,930.25	24.53**
Error (a)	12	459,189	38,265.75	
Treatment	4	241,802	60,540.50	6.05**
T X S	16	347,632	21,727.00	2.17*
Error (b)	60	598,708	9,978.47	
Total	99	6,249,836		

*Indicates significance at the five per cent level.
**Indicates significance at the one per cent level.

APPENDIX TABLE IX

ANALYSIS OF VARIANCE OF THE TOTAL SEED COTTON YIELDS

Source of Variation	D.F.	Sum of Squares	Mean Square	F
Replications	3	1,468,277	489,425.67	
Stages	4	486,777	121,694.25	15.21**
Error (a)	12	960,202	80,016.83	
Treatment	4	662,357	165,589.25	8.98**
T X S	16	794,255	49,640.94	2.69**
Error (b)	60	1,106,345	18,439.08	
Total	99	5,478,213		

*Indicates significance at the five per cent level.
**Indicates significance at the one per cent level.

VITA

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Candidate for the Degree of

Master of Science

Thesis: THE PHYSIOLOGICAL EFFECTS OF DIFFERENT RATES OF N-(3,4-DICHLOROPHENYL)METHACRYLAMIDE ON COTTON AT VARIOUS GROWTH STAGES

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Biographical:

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