# Effect of Application of Plant Growth Regulators on *Earias vittella* (Fabricius), Infestation and Yield Components of Cotton

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**Abstract:** Studies were carried out on the effect of plant growth regulators on bollworm infestation and plant growth of cotton under field conditions. New cotton variety (CRIS-134) was sown in randomized block design with seven treatments including control (check) and was replicated three times on May 22, 2004. Mepiquate chloride, Acetyl salicylic acid and Naphthalene acetic acid (plant growth regulators) were applied on 10th, 25th August and 9th September 2004.The results indicated that there was no significant effect of either removal of leaves and fruiting bodies of cotton plant and application of plant growth regulators on cotton plant height but significantly effect on volume of bolls and yield in comparison to control. Moreover, application of hormones significantly delayed the maturity of cotton. There was also significant effect of application of plant growth regulators on bollworm infestation compared with control treatments.

**Keywords:** *Earias vittella* (F.) infestation, Plant growth regulators, New cotton variety CRIS-134.

## INTRODUCTION

Cotton, *Gossypium hirsutum* L. is the important fiber crop of the world. It is produced in more than 100 countries, the most important countries: China (24% of global cotton production), the USA (19%), India (16%), Pakistan (10%), Brazil (5%) and Uzbekistan (4%) [1]. It is also one of the most important cash crops of the Pakistan. Cotton plays important role in the economy of the country. The average yield of cotton in Pakistan is 780 Kg/ha. Pakistan occupies 4th position in area and production of cotton in the world but ranks 10th in average yield among the top cotton producing countries of the world [2].

Yield is an outcome of genotype with environment. All cotton varieties always have a huge genetic potential exploitable under optimal growing conditions. Growing conditions include climate and input applications. About 50% of the present cotton yields in world are attributable to the use of agrochemicals [3]. Since the use of agrochemicals has become popular in agriculture, technological annovations for best utilization of inputs have become of critical importance for realization of optimum yields.

Plant growth regulators are applied to control undesirable vegetative growth of crop plants, enhancing fruiting bodies and increasing yields. Plant growth regulators are reported to have improved plant water relationships and rate of photosynthesis. The changes incurred in crop plants due to use of plant growth regulators may also affect plant insect relationships. Application of ethephon caused significant abscissions of fruiting form but yield was not affected [4], increased cotton yield [5]. Application of triacontanol, NAA, Atonik, Recine and Cytocyme significantly increased seed cotton yield [6]. Cotton yield stagnation in Pakistan is due to a few factors, like non availability of good quality of seeds, a higher incidence of water logging, shift of good cotton area to sugarcane and absence of proper plant protection measures [7].

Since average yield of Pakistan is low compared with other countries. There exists an enormous potential to increase yield through adoption of modern production technologies. One of the technologies might be application of plant growth regulators. Present investigations report the results of application of plant regulator, (Mepiquate chloride, Acetyle salicylic acid, and Nephthalane acetic acid) on *Earias vittella* (F.) infestation and yield component of cotton.

## MATERIALS AND METHODS

A plot was earmarked at experimental farm, Sindh Agriculture University, Tandojam during the kharif season of 2004. The main purpose of said study was to know the effect of hormone on cotton plant growth and insect infestation. The experiment was laid out in randomized complete block design (RCBD) with seven treatments including control (check) and was replicated three times. Cotton variety CRIS-134 was sown on May, 2004 by dibbling methods on furrows. The distance between plants to plant was 22.5 cms. And row to row was 75cms, respectively. Most of the agricultural practices i-e, thinning, weeding, irrigation and fertilizer etc. were carried out from sowing till harvest as per recommendation.

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The application of hormones viz, Mepiquate chloride (P1), Acetyl salicylic acid (P2) and Naphthalene acetic acid (P3) was made at recommended doses with the shoulder mounted knapsack sprayer. The applications of hormones were made on $10^{th}$, $25^{th}$ August and $9^{th}$ September, 2004. The pre- treatment observation was recorded one day before the application of chemicals and post-treatment observations were made at weekly intervals. Cotton plant damage was simulated by artificially removing cotton leaves and fruiting bodies.

### Method of Artificial Removal of Leaves and Fruiting Bodies

Before application of agrochemicals on cotton leaves and fruiting bodies (i.e. flower buds, flowers and bolls) were removed artificially to simulate pest damage. Total leaves and fruiting bodies of 10 plants were counted at random and average number of leaves and fruiting bodies were calculated on the basis of that average, the leaves and fruiting bodies of whole treatments plot were removed. Two control treatments were maintained, one natural control in which no leaves and fruiting bodies were removed and no application of agrochemicals was made and another control in which leaves and fruiting bodies were not removed but application of agrochemicals was carried out. The details of treatments are as under:

T1 = natural control.

T2 = 10 percent leaves + fruiting bodies removed.

T3 = 20 percent leaves + fruiting bodies removed.

T4 = 30 percent leaves + fruiting bodies removed.

T5 = 40 percent leaves + fruiting bodies removed.

T6 = 50 percent leaves + fruiting bodies removed.

T7 = treated control, in which micro-nutrients were applied.

For recording plant growth and yield components and spotted bollworm infestation of cotton, five plants were observed at random per treatment. Plant height was recorded in centimeters and volume of bolls (cms) was measured with the help of vernier caliper. The crop maturity was observed on opening of bolls as the method described by Fry [8]. The data was analyzed statistically.

## RESULTS AND DISCUSSION

### Plant Growth and Yield Parameters

#### *Plant Height*

The effect of application of plant growth regulators (Hormones) on cotton plant height (Table **1**) indicates that there was no significant ($P<0.05$) effect of either removal of leaves and fruiting bodies of cotton plant or application of plant growth regulators on cotton plant height. However, Salicylic acid applied treatments showed lower plant height compared with other plant growth regulator applied treatments. Where as, the control treatments, plants attained the minimum height as compared to all treated plots in present study.

#### *Boll Volume*

Application of plant growth regulators significantly ($P<0.001$) increased the boll volume of cotton with the passage of time (Table **2**). The highest boll volume was recorded on September 01, 2004. There was (leaf and fruiting bodies removal) significant difference (P, 0.001) in boll volume of different treatments in different plant growth regulators applied treatments and controls. Moreover, a comparison between plant growth regulator applied treatment (T7) and control treatment (T1) revealed that on all observation dates, the volume of the bolls of treated plants was higher than control plant bolls.

#### *Maturity of Cotton*

Application of plant growth regulators significantly ($P<0.05$) delayed the maturity of cotton. The minimum days to the maturity (16.95) was found in control plants followed by hormone treated plants. Whereas, naphthalene acetic acid treatment significantly delayed the maturity of cotton plant which was (84.5) days as determined in Fry [8] method.

**Table 1: Mean (± SD) Cotton Plant Height (cm) after Application of Plant Growth Regulators under Field Conditions**

| Plant growth regulators | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
|---|---|---|---|---|---|---|---|
| Mepiquate Chloride | 36.2±3.10 | 36.33±1.36 | 35.8±2.00 | 36.23±1.00 | 36.4±1.11 | 34.33±2.71 | 36.66±0.80 |
| Acetyl salicylic acid | 34.9±1.80 | 24.93±1.00 | 33.13±1.94 | 35.4±1.83 | 33.7±1.20 | 33.3±2.26 | 35.6±1.90 |
| Naphthalene Acetic acid | 37.4±0.87 | 37.13±1.74 | 36.06±1.40 | 36.63±2.01 | 37.26±1.10 | 37.43±1.11 | 38.73±0.80 |

**Table 2: Mean (± SD) Volume of Bolls after Application of Plant Growth Regulators under Field Conditions**

| Plant growth regulators | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
|---|---|---|---|---|---|---|---|
| Mepiquate Chloride | 3.58±0.09 | 3.65±0.13 | 3.66±0.03 | 3.58±0.08 | 3.68±0.07 | 34.33±2.71 | 3.67±0.13 |
| Acetyl salicylic acid | 3.62±0.18 | 3.72±0.01 | 3.65±0.03 | 3.70±0.12 | 3.66±0.01 | 33.3±2.26 | 3.70±0.10 |
| Naphthalene Acetic acid | 3.59±0.07 | 3.62±0.08 | 3.70±0.09 | 3.63±0.09 | 3.67±0.11 | 3.68±0.07 | 3.68±0.01 |

**Table 3: Effect of Application of Plant Growth Regulators on Maturity of Cotton under Field Conditions (Percent of Boll Opening)**

| Plant growth regulators | 79 days | | 95 days | | 109 days | |
|---|---|---|---|---|---|---|
| | Control | Treated | Control | Treated | Control | Treated |
| Mepiquate Chloride | 16.95 | 22.75 | 81.34 | 81.37 | 73.12 | 78.32 |
| Acetyl salicylic acid | 18.36 | 22.31 | 79.49 | 80.33 | 70.83 | 78.05 |
| Naphthalene Acetic acid | 18.06 | 24.85 | 73.02 | 84.5 | 70.24 | 79.16 |

### *Yield*

There was significant effect of application of plant growth regulator on yield of cotton. The maximum yield was recorded with application of mepiquate chloride (Table **4**) followed by salicylic acid and naphthalene acetic acid. Whereas, minimum yield was recorded in control plot receiving no treatments. Moreover, different treatments (leaf and fruiting bodies removal) had no significant effect ($P<0.05$) on yield of cotton. In present study, cotton plant leaves and fruiting bodies were removed to simulate insect damage and its effect on cotton yield. Plant growth regulators were applied to compensate for damage and enhance crop yield. There are many studies reported in literature which support findings of present study.

Moreno *et al.* [9] carried out studies on effects of simulated boll damage on subsequent cotton yield. The fruit removal ranged from 0,25,50,75 and 100%. The lower levels of fruit removal resulted in over compensation of yield if the damage took place before the period of maximum square production. The results showed that protection against damage should be carried out between 85 days after sowing and up to $8^{th}$ week of flowering. Zhu *et al.* [10] conducted experiment on cotton population compensation to simulate the damaged caused by *Agrotis ipsilon* by removing 0, 1, 2, 4, 6, 8, cotton seedlings per $30m^2$ plot. The result showed that there was significant compensation shown as an increase of effective boll number in cotton yield. Lei and Gaff [11] assessed response of cotton to simulated *Helicoverpa spp*. Damage early in season (tip damage) and during fruiting (square removal) and found high tolerance to simulated pest damage. Plant growth regulators are used in many counties of the world in agriculture for enhancing fruiting bodies, to control undesirable vegetative growth of crop plants. Application of plant growth regulators increase crop yield; Oosterhuis *et al.* [12], Pothiraj *et al.* [13], Josh and Cothren [14], Mert and Caliskan [15], cause early maturity of crop; (Soares *et al.* [16], Pazzetti *et al*. [17] and uniformity of maturation (Pazzetti, [17]. Crozat and Kasemsap [18] reported that mepiquate chloride application at early flowering significantly decreased vegetative growth and shortened crop duration of cotton. Mert and Caliskan [15] treated cotton with mepiquate chloride reported that it reduced plant height and improve earliness, it also increased seed cotton weight per boll compared with control, but did not significantly affect fiber characteristics. El-Shahaway [19] studied application of pix on cotton and reported that increased number of sympodia, number of open

**Table 4: Effect of Application of Plant Growth Regulators on Damage Compensation and Cotton Yield (Gram) Per Plant (Mean)**

| Plant growth regulators | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
|---|---|---|---|---|---|---|---|
| Mepiquate Chloride | 40.81 | 62.08 | 49.74 | 41.47 | 47.73 | 35.19 | 42.03 |
| Acetyl salicylic acid | 39.99 | 56.69 | 40.32 | 44.40 | 35.41 | 37.90 | 41.86 |
| Naphthalene Acetic acid | 34.51 | 32.76 | 34.30 | 36.57 | 34.46 | 38.53 | 33.43 |

**Table 5: Mean(± SD) Percent Infestation of Bollworms Per Plant after Application of Plant Growth Regulators under Field Conditions**

| Dates | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
|---|---|---|---|---|---|---|---|
| **Mepiquate chloride** | | | | | | | |
| 28-7-2004 | 4.65 | 5.10 | 5.07 | 2.94 | 4.48 | 4.27 | 5.54 |
| 4-8-2004 | 7.33 | 4.11 | 7.01 | 8.54 | 6.03 | 7.04 | 8.53 |
| 11-8-2004 | 6.01 | 4.74 | 6.04 | 3.39 | 5.33 | 4.09 | 7.20 |
| 18-8-2004 | 4.99 | 3.77 | 2.63 | 4.90 | 3.55 | 8.08 | 6.66 |
| 25-8-2004 | 5.67 | 5.69 | 5.70 | 5.23 | 5.11 | 4.84 | 6.71 |
| 01-9-2004 | 2.76 | 3.80 | 3.92 | 4.91 | 1.54 | 3.96 | 3.43 |
| 08-9-2004 | 3.10 | 2.04 | 2.26 | 2.28 | 2.26 | 2.05 | 3.36 |
| 15-9-2004 | 2.35 | 2.54 | 2.69 | 2.20 | 2.49 | 1.41 | 3.00 |
| 22-9-2004 | 7.72 | 4.85 | 5.17 | 5.18 | 6.4 | 4.83 | 7.69 |
| Mean(± SD) | 4.95±1.93 | 4.07±1.12 | 4.49±1.59 | 4.39±1.87 | 4.13±1.66 | 4.51±1.21 | 5.79±1.94 |
| Dates | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
| Acetyl salicylic acid | | | | | | | |
| 28-7-2004 | 5.81 | 8.38 | 5.19 | 4.56 | 3.99 | 5.11 | 4.10 |
| 4-8-2004 | 7.03 | 8.11 | 8.17 | 5.09 | 2.05 | 7.10 | 8.05 |
| 11-8-2004 | 4.46 | 4.43 | 6.90 | 2.98 | 4.68 | 5.41 | 7.33 |
| 18-8-2004 | 4.19 | 3.05 | 3.24 | 3.49 | 8.94 | 2.92 | 5.39 |
| 25-8-2004 | 4.14 | 6.60 | 4.73 | 5.17 | 4.31 | 4.72 | 5.21 |
| 01-9-2004 | 4.64 | 1.50 | 2.17 | 2.71 | 1.49 | 2.41 | 5.31 |
| 08-9-2004 | 3.51 | 1.58 | 2.72 | 2.61 | 2.42 | 2.24 | 3.53 |
| 15-9-2004 | 3.28 | 2.54 | 2.80 | 2.33 | 2.42 | 2.29 | 3.25 |
| 22-9-2004 | 4.51 | 2.62 | 2.63 | 6.52 | 3.37 | 7.95 | 4.97 |
| Mean(± SD) | 4.84±1.23 | 4.31±2.56 | 4.28±1.99 | 3.94±1.37 | 3.19±1.06 | 4.46±2.02 | 5.24±1.31 |
| **Naphthalene acetic acid** | | | | | | | |
| 28-7-2004 | 5.19 | 4.34 | 3.73 | 5.44 | 6.73 | 6.43 | 5.61 |
| 4-8-2004 | 6.38 | 4.03 | 8.76 | 6.71 | 5.21 | 3.95 | 7.54 |
| 11-8-2004 | 5.73 | 4.46 | 4.32 | 3.84 | 3.82 | 4.58 | 7.08 |
| 18-8-2004 | 5.93 | 4.98 | 2.74 | 3.16 | 5.50 | 3.45 | 6.68 |
| 25-8-2004 | 5.93 | 6.03 | 5.49 | 5.96 | 3.87 | 4.63 | 5.39 |
| 01-9-2004 | 3.02 | 2.42 | 3.02 | 3.18 | 2.23 | 2.53 | 2.94 |
| 08-9-2004 | 2.85 | 2.63 | 1.91 | 3.15 | 3.07 | 2.14 | 2.92 |
| 15-9-2004 | 3.87 | 2.48 | 1.31 | 1.85 | 1.62 | 3.53 | 4.24 |
| 22-9-2004 | 3.70 | 7.33 | 4.91 | 4.93 | 4.81 | 7.51 | 4.03 |
| Mean(± SD) | 4.73±1.37 | 4.3±3.58 | 4.02±2.10 | 4.28±1.48 | 4.09±1.54 | 4.30±1.64 | 5.16±1.63 |

bolls, percent boll retention earliness, boll weight, lint percentage, seed index and seed cotton yield, while it decreased plant height compared with control. Pothiraj *et al*. [13] reported that application of triacontanol, NAA, atonik, recine and cytocyme significantly increased seed cotton yield. Shehata *et al*. [20] reported that application of salicylic acid at 200 ppm increased the number of fruiting organs, number of total and open bolls / plant and yield also reduced shedding at fruiting organs. Siddique *et al*. [21] observed that application of mepiquate chloride significantly reduced plant height but increased the yield. Sharma and Dungarwal [22]

reported that application of plant growth regulator increased the lint yield significantly.

### *Pest Infestation*

The bollworm infestation showed in (Table **5**) indicated pest infestation on different treatments. On application of insecticides was carried out on August 20, 2004 to contain pest infestation. On overall basis there was a significant effect of application of plant growth regulators on bollworm infestation compared with control treatments.

However, analysis of data on weekly observations indicated that bollworm infestation was significantly lower in mepiquate chloride treated treatments on September 01, 2004. Similarly on September 15, 2004 observation significantly (P, 0.041) less infestation was recorded on salicylic acid applied treatments. Infestation was also significantly different on different dates of variations.

The changes incurred in crop plants due to the application of plant growth regulators may affect insect plant relationships. (For example, gibberellic acid significantly increased the development period of *Bactrocera cucurbitae*. This inhibition in growth was directly related to increase gibberellic acid concentration [23]. Campbell *et al*. [24] reported that significant reduction in the population of green bug, *Schizaphis graminum* (Rond.) and its reproduction in sorghum crop and induced resistance against *H. zea* on tomato plants after application of plant growth regulators. Application of bio-regulators pix and cytokine significantly reduced infestation of pink and spotted bollworm in cotton [25]. Similarly the effect of plant growth regulators on other insects has also been reported by [26-29]. Almost similar observations were recorded in the present study.

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