Journal of Entomology, 1 (1): 12-16, 2004
ISSN 1812-5670

Effect of Application of a Plant Growth Regulator and Micronutrients on Insect Pest Infestation and Yield Components of Cotton

G.H. Abro, T.S. Syed, M.A. Unar and [1]M.S. Zhang
Department of Entomology, Sindh Agriculture University, Tandojam, Pakistan
[1]Department of Entomology, S.China Agricultural University, Guangzhou, China

Abstract: Studies were carried out on the effect of hormone and micronutrients on plant growth and insect infestation of cotton crop under field conditions. Cotton (TH-3/83) was sown in randomized block design with four replications on May 15, 2001. Planofix (plant growth regulator) and two micronutrients (Bonus Non-chelated and Bonus chelated) were applied on August 20, 2001 and two subsequent applications were made at weekly intervals. The results indicated that there was significant effect of application of hormone and micronutrients on plant height, number of fruiting bodies (bolls), volume of bolls and yield in comparison to control. There was no significant effect of application of hormone and micronutrients on multiplication of thrip, *Scirtothrips dorsalis*, Jassid, *Amrasca devastans*, Whitefly, *Bemisia tabaci* and percent infestation of bollworms. However, application of plant growth regulator and micronutrients significantly delayed the maturity of cotton.

Key words: Plant growth regulators, micronutrients, insect infestation, cotton

INTRODUCTION

Cotton, *Gossypium hirsutum* L., is one of the important cash crops of Pakistan. Cotton plays important role in the economy of the country. Pakistan occupies fourth position in area and production of cotton in world but ranks 9th in average yield amongst the top cotton producing countries of the world[1].

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[1]. 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 yield. 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 abscission of fruiting forms but yield was not affected[2], increased cotton yield[3]. Application of triacontanol, NAA, Atonik, Recine and Cytocyme significantly increased seed cotton yield[4].

Micronutrients are essential for normal growth and development processes of plants because these work as mediators or activators of many enzyme systems, for example, the carboxylase of *Proteus vulgaris* catalyse oxidative decarboxylation of pyruvic acid to acetic acid. Iron is not constituent of chlorophyll but is essential for its formation. Manganese is related to oxidation reduction balance in plants specially in connection with iron and nitrogen metabolism. Zinc is needed by plants in some of their enzyme systems[5,6]. Micronutrients disorder is known to be a widespread and serious problem in Pakistan soils[7-11]. Further, under adverse conditions of water stress due to high temperature even with good irrigation system, cotton may need additional supply of micronutrients to realize the yield potential. High soil pH and low level of organic matter further limits the availability of nutrients to cotton crop[12]. The deficiency or biological unavailability of nutrients/micronutrients adversely affects the growth and development of plants for example, effects of nutrient elements on fruiting efficiency has been reviewed by Joham[13] and has divided into two groups with respect to fruiting index. A deficiency of one group of elements (P, K, Ca, Mg, B and Zn) limits fruit production to a greater extent than vegetative growth; whereas the deficiency of a second group of elements (N, S, Mo and Mn) restricts vegetative

Corresponding Author: G.H. Abro, Department of Entomology, Sindh Agriculture University, Tandojam, Pakistan

and fruiting growth to an equal extent. Most of the elements in first group may affect fruiting efficiency because they function in the control of carbohydrate translocation[14]. Application of micronutrients increased the seed cotton yield[15,16].

Since average yield of cotton in Pakistan is low compared with other countries. There exists an enormous potential to increase yield through adaption of modern production technologies. One of technologies might be application of plant growth regulators and micronutrients. Present investigations reports the results of application of plant regulator, Planofix (Naphthaline acetic acid) and micronutrients Bonus chelated and Bonus nonchelated on insect infestation and yield component of cotton.

MATERIALS AND METHODS

A plot was earmarked at Integrated Pest Management (IPM) Section, Agriculture Research Institute, Tandojam during the kharif season of 2001. The purpose of present study was to know the effect of a hormone and micronutrients on cotton plant growth and insect infestation. The experiment was laidout in randomized complete block design (RCBD) with four treatments including control (check) and was replicated four times. Cotton variety TH-3/83 was sown on 15th May 2001 by drilling method. The distance between row to row was 75 cm and plant to plant was 30 cm. Most of the agriculture practices i.e., thinning, weeding, irrigation, fertilizer etc. were carried out from sowing till harvest as per recommendation.

The application of a hormone and micronutrients viz., Planofix, Bonus non chelated and Bonus chelated was made at recommended doses with the shoulder mounted knapsack sprayer. The first application was made on 20th August, 2001 and the subsequent two sprays were carried out weekly intervals. The pre-treatment observation was recorded one day before the application of chemicals and post treatment observations were made at weekly intervals. Among sucking insects data were recorded for whitefly, *B. tabaci*, Jassid, *A. devastans* and thrips, *S. dorsalis*. Bollworm infestation was also observed.

For recording plant growth and yield components and insect infestation of cotton, five plants were observed at random per treatment. Plant height was recorded in centimeters, number of bolls was counted and volume of bolls (cm) was measured with the help of vernier caliper. The crop maturity was observed on opening of bolls as the method described by Fry[17]. Insect infestation by bollworms viz., American, pink and spotted bollworm was also observed. No insecticide application was carried out in the experimental plot. The data were statistically analysed.

RESULTS AND DISCUSSION

Growth and yield components

Plant height: The effect of application of hormone and micronutrients on cotton plant height (Table 1) indicate that there was significant ($P<0.05$) effect of application of plant growth regulator and micronutrients on plant height. The maximum plant height of 114.6±6.3 cm was recorded in planofix applied plants, followed by Bonus non-chelated micronutrients, whereas, the control treatment plants attained the minimum height in present study.

Fruiting bodies (bolls): Application of plant growth regulator and micronutrients significantly ($P<0.01$) increased the number of fruiting bodies (bolls) of cotton compared with control. The maximum number of bolls (155.8±93.4 plant^{-1}) was recorded in planofix treated plants followed by Bonus chelated micronutrient applied plants (Table 1).

Volume of bolls: The results revealed that there was a significant ($P<0.05$) effect of application of plant growth regulator and micronutrients on the development of boll size in cotton. The maximum boll size of 2.84 cm was found in cotton applied with planofix followed by Bonus chelated with boll size of 2.78 cm. The cotton plants which did not receive any treatment had the minimum boll size (Table 1).

Maturity of cotton: Application of plant growth regulator and micronutrients significantly ($P<0.05$) delayed the maturity of cotton. The minimum days to maturity (43.01) was found in control plants followed by Bonus (non-chelated) (Table 1). Whereas, planofix treatment significantly delayed the maturity of cotton plants which was 55.7±3.0 days as determined with Fry[17] method.

Yield: There was significant effect of application of plant growth regulator and micronutrients on yield of cotton. The maximum yield was recorded with the application of Planofix followed by Bonus (chelated) (Table 1) and minimum yield was recorded in control plot receiving no treatment.

Present study clearly demonstrated that application of plant growth regulator and micronutrients increased the number and volume of bolls resulting in the significantly enhancement of yield. There are many studied reported in

Table 1: Effect of micronutrients and hormone on yield components of cotton X±SD

Treatments	Plant height (cm)	No. of bolls	Boll volume (cm)	Crop maturity (days)	Yield (kg) Plot^{-1}	Yield (kg) Acre^{-1}
Bonus non-chelated	110.4±4.5ab	123.9±62.2bc	2.7±0.09ab	48.6±5.4b	2.2±0.1b	565.2
Bonus chelated	109.4±6.5ab	135.7±71.9b	2.8±0.08a	53.7±1.6a	2.4±0.07c	619.7
Planofix	114.6±6.3a	155.8±93.4a	2.8±0.05a	55.7±3.0a	2.9±0.04d	741.5
Control	106.7±3.0b	104.5±62.2c	2.6±0.08b	43.0±4.4c	2.0±0.06a	521.2

Means followed by same letter(s) in the column are not significantly (P<0.05) different from each other

Table 2: Effect of application of micronutrients and hormone on infestation of A) *A. devastans*, B) *S. dorsalis*, C)*B. tabaci* and D) bollworm infestation (%) in cotton

Date	Bonus non-chelated	Bonus chelated	Planofix	Control
A.devatans				
20.8.2001	0.45	0.48	0.42	0.58
27.8.2001	0.64	0.65	0.71	0.73
03.9.2001	0.94	1.03	1.02	1.32
10.9.2001	0.42	0.48	0.43	0.57
17.9.2001	0.52	0.53	0.55	0.63
27.9.2001	0.49	0.45	0.56	0.59
4.10.2001	0.45	0.44	0.40	0.50
19.10.2001	0.33	0.37	0.41	0.46
26.10.2001	0.38	0.48	0.48	0.60
S.dorsalis				
20.8.2001	0.43	0.35	0.48	0.42
27.8.2001	0.64	0.71	0.70	0.67
03.9.2001	0.94	0.94	0.89	0.98
10.9.2001	0.53	0.48	0.60	0.66
17.9.2001	0.40	0.51	0.52	0.53
27.9.2001	0.50	0.45	0.38	0.59
4.10.2001	0.43	0.43	0.37	0.56
19.10.2001	0.40	0.28	0.32	0.73
26.10.2001	0.44	0.40	0.40	0.52
B.tabaci				
20.8.2001	0.39	0.31	0.31	0.37
27.8.2001	0.58	0.48	0.48	0.51
03.9.2001	0.62	0.82	0.80	0.72
10.9.2001	0.69	0.62	0.61	0.73
17.9.2001	0.55	0.59	0.59	0.58
27.9.2001	0.53	0.56	0.65	0.58
4.10.2001	0.44	0.44	0.41	0.44
19.10.2001	0.32	0.31	0.42	0.34
26.10.2001	0.30	0.32	0.29	0.39
bollworm infestation(%)				
20.8.2001	14.29	18.40	17.71	45.51
27.8.2001	17.29	20.16	23.00	39.24
03.9.2001	18.81	17.87	18.42	28.98
10.9.2001	22.24	15.69	18.90	19.41
17.9.2001	23.15	17.70	18.00	17.67
27.9.2001	24.31	20.63	19.54	22.83
4.10.2001	25.92	22.88	21.34	22.29
19.10.2001	35.55	29.87	36.97	33.99
26.10.2001	30.34	29.23	31.11	30.31

Table 3: Effect of application of micronutrients and hormone on insect pest infestation in cotton

Treatments	Seasonal X±S.D. pest population leaf^{-1}) Thrips	Jassid	Whitefly	Bollworm infestation(%)
Bonus non-chelated	0.52±0.18a	0.51±0.18a	0.49±0.13a	23.5±6.5a
Bonus chelated	0.51±0.20a	0.55±0.20a	0.50±0.17a	21.4±5.1a
Planofix	0.52±0.18a	0.56±0.20a	0.51±0.17a	22.8±6.8a
Control	0.60±0.16a	0.67±0.26a	0.48±0.22a	28.9±9.4a

Means followed by same letter(s) in the column are not significantly (P<0.05) different from each other

literature which support findings of present study. Application of micronutrients increased the seed cotton yield[15,16]. Khandagave *et al.* [18] reported that application of zinc sulphate at 25 mg ha^{-1} significantly increased that dry matter, harvested bolls and seed cotton yield per plant. Zn application increased yield and yield components in cotton[19], application of P, Ca and Zn increased the uptake, open bolls per plant, boll weight and seed index[20]. Khan and Arain[12] and Khan *et al.*[21] found combination of Mg, Zn and B increased the yield of seed cotton by 18% which was mainly due to increase in the number of bolls per plant.

Plant growth regulators are used in many countries of world to control undesirable vegetative growth of crop plants, enhance fruiting bodies and increasing yield. Plant growth regulators are reported to have improved plant water relationships and rate of photosynthesis. Application of plant growth regulators, ethephon caused significant abscission of fruiting form but yield was not affected[2], increased cotton yield in the first harvest ,[3] application of triacontanol, NAA, atonik, Recine and cytocyme significantly increased seed cotton yield[4]. The application of pix (mepiquate chloride) has enhancing effects on fruiting bodies of cotton which increased yield[22-26]. Nobreqa *et al.*[27] found highest cotton yield with application of 60 g ha^{-1} mepiquat chloride 50 days after seedling emergence. Thakar *et al.*[28] tested different growth regulators on cotton and found thiadiazuran to increase harvestable bolls per plant, boll opening percentage, yield, earliness index, fiber fineness and decreased days to maturity. Application of cytokinine and gibberellic acid significantly increased the cotton yield compared with control[29]. Mepiquat chloride improves boll retention and reduces vegetative growth[30]. Lamas[31] reported greater cotton boll weight with the application of mepiquat chloride and chlormequat chloride. Bioregulators pix and cytokine enhanced the boll number, size and retetion power of plant and increase the seed cotton yield[32].

Pest infestation

Thrips, *Scirtothrips dorsalis*: There was no significant effect of application of plant growth regulator and micronutrients on the multiplication of thrips in cotton

(Table 2 and 3). However, the maximum thrip population of 0.59 insects leaf^{-1} was recorded in control plot followed by planofix and Bonus non-chelated treated plants with an average population of 0.521 insects leaf^{-1}.

Jassid, *Amrasca devastans*: Population fluctuation of Jassid after application of planofix and micronutrients in cotton (Table 2 and 3). The results indicated that on overall seasonal mean basis, there was no significant effect of plant growth regulator and micronutrients on Jassid multiplication. However, maximum population of 0.67 insects leaf^{-1} was recorded in control plants. Plant growth regulator and micronutrients treated plants harboured less jassid population compared with control.

Whitefly, *Bemisia tabaci*: There was no significant effect of application of plant growth regulator and micronutrients on the population development of whitefly on cotton (Table 2 and 3). The maximum whitefly population of 0.509 insects leaf^{-1} was recorded in Planofix treated plot followed by Bonus non-chelated and Bonus chelated plots with average population of 0.49 and 0.49 insects leaf^{-1}, respectively.

Bollworm infestation: The results of infestation of bolls by bollworms (Table 2 and 3) which indicated that on overall mean basis, there was no significant effect of application of plant growth regulator and micronutrients on infestation. However, maximum percent (28.86) infestation was recorded from control plots compared with treated plots. While the minimum percent infestation (21.39) was recorded from Bonus chelated treated plot.

The changes incurred in crop plants due to the application of micronutrients and 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 increasing gibberellic acid concentration[33]. Campbell *et al.* [34]reported significant reduction in the population of green bug, *Schizaphis graminum* (Rond.) and its reproduction in sorghum crop and induced resistance against *H. zea* in tomato plants after application of plant growth regulators. Application of bioregulators pix and cytokine significantly reduced infestation of pink and spotted bollworm and were also effective in checking infestation of jassid, thrips and whitefly in cotton[32]. Almost similar observations were recorded in the present study. Ettipibool *et al.*[35] conducted experiments on the effect of mepiquat chloride on leaf characteristics of cotton and incidence of jassid, *Amrasca biguttula* infestation. Mepiquat chloride reduced mid-vein and hair length on lamina but increased lamina thickness and hair density. The growth regulator did not show significant effect on jassid infestation, however, injury was higher on treated plants. Similarly, the effect of plant growth regulators on other insects have also been reported by Zummo *et al.*[36], Henneberry *et al.*[37], Heddin *et al.*[38], Coffelt and Schultz[39].

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