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JOINT ACTION OF PLANT GROWTH PROMOTOR AND MICROELEMENTS ON COTTON PLANTS NUTRITION AND ON INFESTATION RATES WITH BOLLWORMS.

Mansour, E. S. and G. H. Ebaid,
Plant Protection Research Institute, A.R.C . Dokki . Giza

ABSTRACT

Experiments were carried out at Aghour region, Qalubia Governorate, during two successive years 2002 and 2003. Mixture of some chelated microelements (Zn 12 %, Mn 12 % and Fe 12%), a plant growth promoter namely Easterna super biofert (N 6%, P2O5 4%, K2 O 8%, Zn 500 p.p.m., Fe 1000 p.p.m., Mn 250 p.p.m., Cu 100 p.p.m., Mg 1%, carbohydrates 6% and amino acids 10%) a mixture of both materials were used in field trials to study the effect of such treatments on cotton plants and rates of infestation with bollworms. The treatments were microelements (400 gm. / feddan), plant growth promoter (400 cm3 / feddan) and their mixture, at the same rates. All treatments, which were, applied 45 and 60 days after sowing caused earliness in the first opening boll comparing with control. Mixture treatment was the most effective one, induced an earliness by 13.04 and 13.77 % and the highest ratios of opened bolls by 81.62 and 86.61 % showing increases by 37.38 and 42.17 % in 2002 and 2003 cotton seasons, respectively. Such treatments induced % reductions in bolls infestation with *P. gossypilla* and *E. insulana* by 10.64, 28.68 and 31.66 % in 2002 and by 13.76, 24.82 and 31.75 % in 2003 for the three treatments, respectively. Reduction percentages of infestation reflected finally in decreasing the yield loss. Treatments could be arranged according to their efficacy as follows: mixture was the highest followed by plant growth promotor treatment and finally the microelement treatment. Mixture proved to be a good nutritive to cotton plants and decreased the bollworms infestation rates.

INTRODUCTION

Several authors investigated the nutrition effect of macro and microelements either as soil or foliar treatment on cotton plants. Thorne (1957) stated that, Zinc (Zn) is required for normal plant growth. It is necessary in the synthesis of indole acetic acid, an important growth hormone in plant (Meyer and Anderson 1961), and it accelerates protein synthesis and has relation with tryptophan synthesis and encourages phosphorlization and green plastids enzymes (Tsui 1948). The application of Zn to cotton plants increases seed cotton yield and the number of open bolls per plant (Amin *et al.*, 1981). Concerning Fe, it is an indispensable element for the synthesis of chlorophyll in green plants and as a part of the porphyrin compounds, cytochrome enzyme system (Ferry and Ward 1969). Spraying of iron (Fe) was found to be more effective than Zn it increasing seed cotton yield and maturity. Concerning manganese (Mn), it acts as, an activator of many enzymes and it is essential for formation of chlorophyll (Pandy and Sinha 1978). Spraying cotton plant with Fe, Mn or Zn increased number of bolls per plant (Kadry et al., 1984). The number of flowers and open bolls / plant also increased by application of micronutrients Fe, Mn or Zn to cotton plants (Hosny *et al.*, 1984).

Plant Growth Regulators, are often used to suppresse vegetative growth of cotton plants and enhance cotton fruit production. Pix (1,1- dimethyl piperidinium chloride) and Ethephon (2-chloroethyl) are two plant growth regulators that cause square abscission and affect insect pest population when applied to cotton. Pix applications increased boll set on fruiting branches by six through ten (Burmester and Adams 1990). Single or multiple pix treatments effectively reduced plant height and increased chlorophyll per unit leaf area (Thein Han and Hans 1990), enhanced maturity and yield in all tested varieties of cotton (Parvin and Cox 1989) and enhanced earliness 7 to 8 days and increased yield by 10 to 17 % (Parvin and Cox 1988). Pinkas (1972) indicated that spraying of Ethephon at various concentrations and timings resulted in raising the node level of the first flower farther up the main stem. Sheng *et al.*, (1988) reported that ethephone applied to pre-flowering cotton at rates of 300 to 1000 p.p.m. caused initial boll set to be delayed by fruiting at higher rate than untreated plants. In some cases, ethephon treated plants had higher lint yields, higher boll weight and higher micronaire. Sheng *et al.*, (1988) speculated that early season ethephon application may have potential for increasing yield, improving lint quality concentrating boll age (maturity), reducing boll rat and reducing plant height.

As for the effect of Growth Regulator and macro and microelements on insect pest population, Bariola *et al.*, (1988) stated that number of pink bollworm, *Pectinophora gossypiella* (Sounders) infested flowers was significantly reduced in the ethephon treatments. Bariola *et al.*, (1989) applied ethephon to cotton during early squaring and stated that this early season methodology for reducing the reproductive potential of the overwintering population of pink bollworm could compliment the use of ethephon and other regulants to remove late season host material necessary for the diapausing generation of pink bollworm. Ilango and Uthomasamy (1992) indicated that infestations of *Helicoverpa armigera* Hubner and *P. gossypiella* in cotton bolls were lowest when nitrogen, phosphorus and potassium were applied at a rate of 40: 40: 120 NPK kg/ ha., and the damage caused by *Earias vittella* (Fab.) was the lowest at 40: 40: 80 NPK kg/ha. In general, incidence of the bollworm complex and boll rat was lowest when the fertilizers were added at 25 and 35 days after sowing. Mohamed *et al.*, (2001) studied insecticidal activity of three micronutrient foliar fertilizers (chelated zinc, citric acid and urea) and two mixed nutrient elements (Growmore and Stimufol) against 2nd instar larvae of *Spodoptera littoralis* (Boised.) as they stated that all tested fertilizers showed slightly initial toxic effect and high latent toxic effect against larvae specially in cases of growmore and stimufol enough to broke its life cycle also they showed high developmental effect against pupae and moths emergency. Abdel-Aziz (2002) indicated that, Potassium foliar fertilizer and Potasin-F resulted in significant effect in reducing the percentages of bollworm infestation in cotton plants.

The present work aims to study the toxic effect of some macro and microelements nutrients on the cotton bollworms infestation, which finally reflects on cotton yield loss.

MATERIAL AND METHODS

Material used

- Mixture of some chelated microelements (Zinc 12%, Manganse 12% and Iron 12%) chelating on EDTA (ethylene diamine tetra acetic acid) used at rate of 400 gm./ feddan.
- Easterna super biofert: plant growth promotor (N 6%, P2O5 4%, K2 O 8%, Zn 500 p.p.m., Fe 1000 p.p.m., Mn 250 p.p.m., Cu 100 p.p.m., Mg 1%, carbohydrates 6% and amino acids 10%) chelating on citric acid, used at rate of 400 cm3 / feddan.
- Mixture of chelated elements and Easterna super biofert were used at the same rate mentioned.

All these materials are produced by Easterna Company for agricultural and industrial development.

The present study was carried out at Aghour region, Qalubia Governorate, during two successive cotton seasons 2002 and 2003. An area of one feddan was divided into 24 equal plots that received 3 treatments and control of 6 replicates each. Plots were distributed in randomized block design. In the two cotton seasons, seeds of the cultivar Giza 85 were planted on March 13th and 17th in 2002 and 2003, respectively. All plots received the normally recommended agricultural practices of land preparation, thinning, irrigation and mechanical weed control, and kept free from any insecticidal application.

Sprays were applied by means of 20 L-knapsack sprayer using a total volume of 200 L/ feddan. All plots were sprayed for two times, the first after 45 days of sowing while the second was applied 2 weeks after the first

Effect of different treatments on some characters as yield components:

Flowering and opening bolls:

in each treatment a period of time between sowing date and appearance of first flower or first opening boll were estimated. Percentages of earliness of flowering and opening were calculated.

Mean numbers of bolls / plant:

fifty randomly chosen plants in each treatment were examined. Number of opened bolls and those non-opened were counted.

Chemical analysis for dry bolls wall was carried out at general organization laboratory for soil studies.

Rate of damage caused by bollworms in different treatments:

Weekly samples of 120 bolls were randomly chosen in each treatment, inspected in the field and the percentage of infestation was consequently calculated.

Loss in yield due to infestation by bollworms at the end of the season

According to the methods described by Hosny *et al.*, (1967), fifty randomly chosen plants of each treatment were examined.

1-The following characters were estimated in numbers

a-Full opened non infested bolls

b-Non full opened bolls include (⅓ & ⅔ opening)

c-Non opened dry bolls include (uninfested and those infested by bollworms larvae)
d-Non opened green bolls include (uninfested and those infested by bollworms larvae)
e-Mean weight of full opened boll in each treatment.

2-Total number of opening bolls / 50 plants in case of uninfested by bollworms = Σ (a + b + (c + d infested bolls)
3-Number of actually opened bolls = a + b
4- Number of non opened bolls / 50 plants = difference in number between step 2 and 3
5- The percentages of loss in yield of 50 plants due to infestation = {number of non opened bolls (step 4) ÷ total number of bolls (step2)}× 100
6- Loss in yield in kg = (percentages of loss in yield (step 4) × mean weight of boll) ÷ 1000

The analysis of variance adopted and the L.S.D. values were used to determine the significance between means of treatments.

RESULTS AND DISCUSION

Effect of different treatments on first flowering and first opened boll:

Data presented in Table (1), clearly, indicate that the period required for appearance of the first flower was shortened due to different treatments compared with control. In the untreated cotton plants, these periods were (88 and 87 days) for flowering, while, the plants which were sprayed by mixture had the lowest period required for appearance of the first flower than those required in the two remaining treatments (72 days; 18.18 %earliness and 71 days; 18.39 % earliness), followed by treatments with plant growth promotor (74 days; 15.91 % earliness; 15.91 % earliness and 73 days; 16.09 % earliness), and the microelements (77 days; 12.5 % earliness and 77 days; 11.49 % earliness) in 2002 and 2003 cotton seasons, respectively.

Table (1): **Influence of different treatments on percentages of earliness in flowering and bolls opening in 2002 and 2003 seasons.**

Treatment	2002				2003			
	Flowering		Boll opening		Flowering		Boll opening	
	Period to 1st flower in days	% earliness than control	Period to 1st opening boll in days	% earliness than control	Period to 1st flower in days	% earliness than control	Period to 1st opening boll in days	% earliness than control
Control	88	0.0	139	0.0	87	0.0	138	0.0
Micro-Elements	77	12.5	127	8.63	77	11.49	125	9.42
Plant growth promoter	74	15.91	124	10.79	73	16.09	121	12.32
Mixture	72	18.18	121	13.04	71	18.39	119	13.77

In both years of study, period required for opening first boll, in different treatments was also shortened than that of the control. Mixture, plant growth promoter and microelements treatments caused earliness than control by 13.04, 10.79 and 8.63 % in 2002 cotton season and by 13.77, 12.32 and 9.42 % in 2003 cotton season, respectively.

These results agree with the finding of (Ashour, (1981); Kadri, *et al.*, (1984); Abo-Ahimed, (1985) and Girgis (1992) where they indicated that the foliar spraying with Zn, Fe and Mn resulted in high number of flowers and promoted percentages of earliness in cotton.

Effect of different treatments on bolls opening:

From data in Table (2), it could be observed that the mixture treatment recorded the highest mean total bolls/ plant, (27.2 and 24.4) followed by plant growth promotor (25.0 and 22.8); microelements (22.8 and 19.4) and control (20.2 and 17.4) in 20002 and 2003 cotton seasons, respectively.

Among the different treatments, the highest percentages of bolls opening (81.62 and 86.61 %) was also observed in mixture treatment showing increase than control by 37.3 and 42.17 %, while plant growth promotor came in the second order (74.4 and 77.1 %) showing increases by 25.23 and 26.71 %, while the microelements treatment came in the third order (67.54 and 70.1 %) showing increases by 13.68 and 15.07 % in 2002 and 2003 cotton season, respectively.

Regarding to the L.S.D. values, for both years of study, treatment of cotton plants by mixture showed significant increases in the total opening bolls/plant than that of the 3 remaining treatments. Plant growth promotor came the next than microelements and control treatments (18.6 and 17.6 mean opening bolls/plant), respectively.

Table (2): Impact of different treatments on mean total bolls, opened bolls, rate of opened boll / plant and % opened bolls in 2002 and 2003 cotton seasons.

Treatment	2002				2003			
	Mean total bolls / plant	Mean total opened bolls / plant	% Opened bolls / plant	% Opened boll compared to control	Mean total bolls / plant	Mean total opened bolls / plant	% Opened bolls / plant	% Opened boll compared to control
Control	20.2	12.0	59 41	0.0	17.4	9.8	60.92	0.0
Micro-Elements	22.8	15.4	67.54	13.68	19.4	13.8	70.1	15.07
Plant growth promoter	25.0	18.6	74.40	25.23	22.8	17.6	77.19	26.71
Mixture	27.2	22.2	81.62	37.38	24.4	21.0	86.61	42.17
L.S.D.		2.16				1.95		

These results agree with Ismail *et al.*, (1989), who stated that the microelement applications, generally, increased the number of bolls / plant and boll opening percentage. Also, Sorour *et al.*, (1989) found that foliar fertilizer application to cotton Giza 80 (include Urea or Calcium super phosphate with trace elements) twice during the vegetative period or twice during flowering period increased the number of open bolls / plant. Abd El-Rheem *et al.*, (1991) mentioned that number of opened bolls / plant increased by increasing phosphorus rates up to 40 kg P2O2 / feddan, and they, also found that raising Zn rate from 100 to 200 gm. Zn / feddan with or without the phosphorus rates resulted in increase in number of opened bolls / plant than control. Ziadah (1991) reported that spraying cotton plants with trace elements had a significant effect on number of opened bolls and earliness percentages. Parvin and Cox (1990) mentioned that the growth regulator, Pix enhanced earliness 7 to 8 days.

Chemical analysis of dry wall of bolls in different treatments:

Data presented in Table (3) show the chemical analysis of dry bolls wall. Macro and microelements were found in the samples of different treatments but in different ratios. Results of Tables (1 and 2), which, indicated that such treatments led to earliness of flowering& opening boll and increasing the number of bolls / plants may be due to the action of macro and microelements. These results agree with the findings of Kadry *et al.*, (1984), Hosny *et al.*, (1984), Ismail *et al.*, (1989) and Sorour (1989), as they indicated that (Fe, Mn, Zn) and N.P.K.) increased, number of flowers, number of bolls and opened bolls / plant. Also Eid and Abd El-Samie (1958) stated that phosphorous cause rapid growth and produced earlier. Macro and microelements applications to cotton plants increased growth, seed cotton yield, seed yield and yield per unit area (Abd El-Hadi *et al.*, 1987; Makram, 1988 and Gindy *et al.*, 1991).

Table (3): Chemical analysis of Macro and Microelements of bolls wall in different treatments.

Treatment	Quality of elements in p.p.m.						
	Macro elements			Micro elements			
	N	P	K	Fe	Zn	Mn	Cu
Control	14.0		2.66	18.3	13.15	1.06	0.27
Micro-Elements	11.9		2.66	25.6	13.81	1.27	0.48
Plant growth promoter	7.7	0.56	2.27	24.5	19.07	1.29	0.48
Mixture	9.1	1.76	2.85	29.3	15.26	1.36	0.38

Rate of damage caused by bollworm larvae in different treatments:

As shown in Table (4), in both seasons of study, the untreated cotton plants received, significantly, the highest infestation rates with *P. gossypilla* and *E. insulana* (25.84 and 25.95 infested bolls in 2002 and 2003 seasons, respectively) followed by the other treatments. Among the different treatments, similar trend of efficacy was detected in the two seasons of study, as mixture of microelements and plant growth promotor was the most effective. Cotton plants treated with this mixture led to 17.66 and 17.71 %

mean number of infested bolls, respectively. In 2002 season, the seasonal mean was17.66 %, being insignificantly lower that that of plants treated with plant growth promoter (18.43 %), but significantly lower than that of cotton plants treated by microelements (22.09 %). In the subsequent season, this average (17.71%) was significantly lower than those recorded from cotton plants treated by plant growth promotor (19.51 %) and microelements (22.38 %).

Regarding the reduction in percentages of infestation with the two pest species due to different treatments it is clear that, in both years, all treatments caused reductions in the rate of infestation. Treatments by mixture, plant growth promoter and microelements caused reduction in the infestations than control by 31.66, 28.68 and 10.64 %, respectively in 2002 and by 31.75, 24.82 and 13.76 %, respectively in 2003 cotton season.

The observed reductions in percentages of infestation may be due to escaping from infestation according to the early maturity of bolls avoiding the dangerous generation of bollworms larvae, the direct effect of one or more of the following reasons; losing a part of body water content of pests as a result of osmotic force (Steward, 1958); toxicity and high latent effect of some elements or groups that cause death of surviving individual (Tomlin 1994 and Mohamed *et al.*, 2001). Also by indirect effect; foliar fertilizer led to increase the natural immunity through improving the plant nutritional status (Nowasielski *et al.*, 1988); suppressing the vegetative plant growth which affects the pests egg laying as moths prefer to lay their eggs on taller plants rather than on shorter ones (Breen *et al.*, 1999)

Loss in yield due to infestation by bollworms at the end of the season:

The aim of these estimations was to study the effect of microelements, plant growth promotor and their mixture on the yield loss caused to cotton due to bollworms infestations to cotton bolls.

The high efficacy of mixture treatment to cotton plants on boll weight or reductions in the infestation by bollworms, normally, reflected finally on the yield loss, which was decreased in this treatment than in all other treatments (Table, 5). Among the different treatments, mixture had the lowest loss in the yield (0.637 and 0.601 kg/ 50 plants) in 2002 and 2003 cotton seasons, respectively. It is clear from these results that mixture may be considered as good biocontrolling agent against bollworms. On the other hand, the highest yield loss was detected in control treatment, which was (0.813 and 0.808 kg / 50 plants) in both seasons of study, respectively. The two remaining treatments came in the moderate order in the two seasons of study, as spraying of cotton plants by plant growth promotor caused loss in the yield by 0.658 and 0.733 kg / 50 plants, while microelement treatment caused 0 787 and 0.784 kg / 50 plants, respectively.

Table (4): Damage caused to cotton bolls due to infestation by the bollworms larvae in different treatments in 2002 and 2003 cotton seasons.

2002 sampling date	Mean No. of infested bolls				2003 sampling date	Mean No. of infested bolls			
	Control	Micro-Elements	Plant growth promoter	Mixture		Control	Micro-Elements	Plant growth promotor	Mixture
June,17th	0.0	1.0	1.0	1.3	June,21st	0.0	1.7	1.3	1.0
24th	3.0	3.0	2.7	2.3	28th	3.7	3.3	3.0	1.7
July, 1st	3.7	3.3	3.3	3.7	July, 5th	4.3	3.7	3.7	2.3
8th	5.7	6.0	6.3	5.7	12th	6.3	5.0	4.3	3.7
15th	8.7	8.7	8.3	9.0	19th	9.7	7.3	6.0	5.3
22nd	14.7	13.0	13.7	13.3	26nd	13.7	11.3	9.3	8.7
29th	25.3	23.7	21.0	23.7	August,2nd	21.3	18.0	14.7	12.3
August,5th	29.7	24.3	24.3	24.0	9th	30.7	23.3	20.3	17.7
12th	35.3	33.3	25.7	25.3	16th	34.3	29.7	26.3	23.3
19th	38.7	36.3	27.3	26.7	23th	39.0	36.7	30.7	27.7
26th	43.0	38.0	29.7	27.3	30th	44.3	41.3	35.3	31.3
Sep., 2nd	46.7	38.7	31.0	28.0	Sep., 6th	47.0	43.0	38.0	36.0
9th	50.0	39.3	31.7	28.3	13th	52.3	43.7	39.3	37.7
16th	57.3	40.7	32.0	28.7	20th	56.7	45.3	41.0	39.3
Total	361.8	309.3	258.0	247.3	Total	363.3	313.3	273.2	248.0
Mean	25.84	22.09	18.43	17.66	Mean	25.95	22.38	19.51	17.71
% Reduction	0.0	10.64	28.68	31.66	% Reduction	0.0	13.76	24.82	31.75
L.S.D.	1.69				L.S.D	0.67			

Table (5): Loss in final yield in different treatments due to infestation by bollworms in 2002 and 2003 cotton season.

Treatment	Mean numbers of boll / plant at the end of season 2002										
	Total	Non opened				Opened			Mean weight of boll (grm)	% Loss in the yield due to infestation	Loss in the yield kg / 50 plants
		Green		Dry		3/3	⅔	⅓			
		Unifested	infested	unifested	infested						
	2002										
Control	20.2	2.6	2.6	1.6	1.4	6.8	2.6	2.6	2.465	41.25	0.813
Microelements	22.8	2.4	2.4	1.4	1.4	11.0	2.4	2.0	2.654	30.89	0.787
Plant growth promoter	25.0	2.6	1.4	1.4	1.4	14.6	2.2	1.8	2.783	22.1	0.658
Mixture	27.2	1.4	1.4	1.4	1.4	18.6	2.2	1.4	2.852	17.88	0.637
	2003										
Control	17.4	1.6	3.0	1.0	1.2	6.0	2.2	2.4	2.475	44.12	0.808
Microelements	19.4	2.2	1.8	0.0	1.8	8.8	2.6	2.2	2.643	34.48	0.784
Plant growth promoter	22.8	2.2	1.0	2.0	0.0	12.2	3.2	2.2	2.794	23.11	0.733
Mixture	24.4	1.4	1.0	0.0	1.0	16.2	3.0	1.8	2.861	18.26	0.601

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التأثير المشترك لمنشط النمو النباتي والعناصر الصغرى على تغذية نباتات القطن ومعدلات الإصابة بديدان اللوز

عريان شحاتة منصور وجورج حلمى عبيد

معهد بحوث وقاية النباتات- مركز البحوث الزراعية – الجيزة – مصر.

اجريت دراسة حقلية بقرية اجهور الصغرى – مركز القناطر الخيرية – محافظة القليوبية على محصول القطن لموسمى 2002، 2003 لدراسة التأثير المشترك لمنشط النمو النباتي الحيوي (ايسترنا سوبر بيوفيرت) الذى يحتوى على (ازوت 6 %، فوسفور 4 %، بوتاسيوم 8%، ماغنسيوم 1%، كربوهيدرات 6%، احماض امينية 10%، حديد 1000 جزء في المليون، زنك 500 جزء في المليون، منجنيز 250 جزء في المليون ونحاس 100 جزء في المليون) وثلاثة من العناصر الصغرى (حديد مخلبى 12%، زنك مخلبى 12% ومنجنيز مخلبى 12%) ممخلبة على ادينا وخليط منهما.

تم إجراء رشتان على بادرات القطن بعد 45 و 60 يوم من الزراعة لدراسة التاثير على كل من الصفات النباتية للقطن ومعدلات الاصابة بديدان اللوز وفيما يلى ملخص لأهم النتائج:

1. المعاملات الثلاث احدثت تبكير فى مدة ظهور أول زهرة عن المقارنة، وكانت افضل معاملة هى الخليط حيث ظهرت أول زهرة بعد 72 يوم محدثة تبكير عن الغير معامل بنسبة 18.18 % فى موسم 2002 ، 71 يوم بنسبة 18.29 % فى موسم 2003.
2. أعطت معاملة الخليط أعلى نسبة تفتح لوز عن الغير معامل حيث كانت 81.62، 86.61 % خلال موسمي 2002، 2003 على التوالي.
3. كانت اقل نسبة اصابة فى اللوز الاخضر بدودتى اللوز القرنفلية والشوكية فى معاملة الخليط حيث كانت 17.66 و 17.71 % فى موسمى 2002، 2003 على التوالى.
4. كانت اقل نسبة فقد فى المحصول نتيجة الاصابة بديدان اللوز فى معاملة الخليط حيث كانت 0.637 و 0.601 كجم / 50 نبات فى موسمي 2002، 2003 على التوالي.

أظهرت النتائج المتحصل عليها ان خلط منشط النمو النباتى (ايسترنا سوبر بيوفيرت) ببعض العناصر المغذية الصغرى (حديد، زنك و منجنيز) برهنت على انها افضل معاملة فى تغذية نباتات القطن كما إنها خفضت نسبة الإصابة بديدان اللوز وقللت نسب الفقد في محصول القطن الزهر نتيجة الاصابة بديدان اللوز مما انعكس بالإيجاب على المحصول لذا نوصى باستخدامها كمعاملة ذات هدف مزدوج في التغذية وفى مكافحة ديدان اللوز.