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Effect of Foliar Application of Specific Growth Activator on Cotton Plant

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Abstract

Two field experiments were conducted during 2016 and 2017 seasons at Sids Agricultural Research Station to investigate the influence of foliar application of a commercial compound challenger (contain 20% K_2O, 15% N, 5%, P_2O_5, 2.5% Zn and 0.1% Fe, Mn, Mg) on agronomic characters and some leaves chmical components of cotton Giza 95 cultivar. Two rates of the commercial compound (0.75 g/L and 1.5 g/L) were used and sprayed on plants, at different stages of growth, i.e., start of squaring and start of flowering, start of squaring and peak of flowering, start of flowering and peak of flowering and start of squaring + start of flowering + peak of flowering. A randomized complete block design with four replecats was used in both seasons. The application of the commercial compound resulted in significant effect on leaves chemical composition (chlorophyll a, b and carotenoids)), growth characters (plant height, no. of fruiting branches/plant), earliness %, yield components (No. of open bolls/plant, boll weight, seed cotton yield, and seed index), while fiber properties did not affect. The best results were obtained under application of the commercial compound at the rate of 1.5 g/L three times, i.e., at squaring, beginning of flowering and peak of flowering, with no significant differences by using the commercial compound at the rate of 0.75 g/L three times.

Key words: Cotton, commercial compound, NPK, growth characters, yield and its components, chlorophyll a, b and carotenoids and fiber properties.

Introduction

Nitrogen is one of the most important nutrients for plants. Although, nitrogen is an essential nutrient for cotton that effect on plant growth, fruiting and yield. The response of cotton plant to nitrogen application is widely varied due to cotton varieties, soil fertility and environmental conditions. Makram *et al*. (1994) found that nitrogen doses had little effects on plant growth, number of open bolls, boll weight, seed cotton yield/plant, lint% and seed index, while earliness % was increased due to lower nitrogen doses.

Phosphorus is one of the major nutrients necessary for crop growth and development (Mengel and kerby, 1987). It is the second most limiting nutrient in cotton production after nitrogen. Soil phosphorus availability for crop uptake is dependent on PH, while alkalinity can adversely affect its uptake (Tisdale and Nelson, 1975). The availability of phosphorus will be improved by organic matter (Amberger, 1993).

Potassium is an important element in plant nutrition. It affects on, enzyme activation, water relations, translocation of assimilates nitrogen uptake, protein and starch synthesis. Many workers studied the effect of potassium application such as Abou El-Nour et al. (2000), El-Dosouky *et al.* (2001), El-Tabbakh (2001), Aneela and Asheraf (2003) and Mohsin *et al*. (2004) who observed positive response of cotton plants to potassium application. Sharma and Singh (2007) showed that foliar application of 2% K_2O increased No. of open bolls/plant, boll weight and seed cotton yield.

Many authors reported the response of cotton plant to nutrient foliar application such as Abd El-Gayed *et al*. (2014) for nitrogen, potassium, manganese and zinc, Eleyan *et al*. (2014) and Yin *et al.* (2011) for Zinc.

The aim of this study was to evaluate the effect of commmercial compound on the quantity and quality of cotton plant grown under the conditions of clay alluvial soil of Beni-Suef Governorate.

Materials and Methods

Two field experiments were conducted, successifully on clay soil in Sids Agricultural Research Station, Agric. Res. Center, Beni-Suef Governorate, Egypt during two seasons of 2016 and 2017 to evaluate the effect of foliar application of a commercial compound on plant growth, earliness, yield and its components fiber properties and some leaves chemical composition of Egyptian cotton (*Gossypium barbadense*, L), cultivar Giza 95.

Soil sample were taken randomly from the experimental soil sites before sowing, to determinie some physical and chemical soil properties according to A. O. A. C. (1995), and shown in Table (1).

Table 1. Chemical and physical properties of the studied soil before planting.

Soil properties	2016	2017
Physical properties:		
Particle size distribution:		
Clay (%)	**53.13**	**54.26**
Silt (%)	**27.16**	**26.12**
Sand (%)	**19.71**	**19.62**
Texture grade	**Clay**	**Clay**
Chemical properties:		
pH (1:2.5 soil-water suspension)	**8.12**	**8.29**
EC, Soil paste (dS m^{-1})	**1.01**	**1.07**
Organic matter (%)	**1.70**	**1.73**
Available N (ugg^{-1})	**22.25**	**21.19**
Available P (ugg^{-1})	**14.20**	**15.07**
Available K (ugg^{-1})	**165.17**	**171.33**

The chemical analysis of the namely Challanger is shown in Table (2) according to Agric. Com. for agric commercial compounds.

Table 2. Chemical analyses (%) of the commercial compound are.

N	P2O5	K2O	Zn	Fe	Mn	Mg
15%	**5%**	**20%**	**2.5%**	**0.1%**	**0.1%**	**0.1%**

The preceding crop was maize in both seasons. The experimental plot size was 12 m^2 (4m x 3m). Each plot included 5 rows 60 cm apart. Phosphrous fertilizers was applied during soil preparation in the form of superphosphate (15.5 % P2O5) at the rate of 22.5 kg/fed. Sowing date was 5th of Apirl in both seasons. Seeds of cotton cultivar Giza 95 were sown in hills 25 cm apart with two plants/hill after thinning. Nitrogen fertilizer was applied in the form of ammonium nitrate (33.5% N) at the rate of 60 N/fed twice in two equal doses, before first irrigation and before the second irrigation. Potassium fertilizer was applied as foliar spraying of potassium sulphate at the rate of 5kg/fed, at the beginning of flowering. The other cultural practices were carried out as recommended for convential cotton seeding in the local production district. A randomized complete block design with 4 replicates was used in both seasons.

Treatments were evaluated as follows:

1- Untreated plots as control.
2- Foliar application with 0.75 g/L of the commercial compound twice at squaring stage and beginning of flowering.
3- Foliar application with 0.75 g/L of the commercial compound twice, at squaring stage and peak of flowering.
4- Foliar application of 0.75 g/L of the commercial compound twice, at beginning of flowering and peak of flowering.
5- Foliar application of 0.75 g/L of the commercial compound three times, at squaring stage, beginning of flowering and peak of flowering.
6- Foliar application of 1.5 g/L of the commercial compound twice, at squaring stage and beginning of flowering.
7- Foliar application of 1.5 g/L of the commercial compound twice, at squaring stage and peak of flowering.
8- Foliar application of 1.5 g/L of the commercial compound twice, at beginning of flowering and peak of flowering.
9- Foliar application of 1.5 g/L of the commercial compound three times, at squaring stage, beginning of flowering and peak of flowering.

Studied characters:

After seven days from the last foliar application, leaf sample was taken from the fully maturated leaves (4th leaf from the apex of the main stem) from ten plants, to determine chloroplast pigments (chlorophyll a, chlorophyll b, carotenoids) by spectro-photometer as described by A.O.A.C. (1995).

In both seasons, five representative hills (10 plants/plot) were taken as random, at harvest to study the following traits: growth characters (plant height (cm) and No of fruiting branches/plant), earliness percentage and yield components (No. of open bolls/plant, boll weight g), lint percentage, seed index (gm) and seed cotton yield (kentar/fed). At harvest and some fiber parameters (Micronair reading and pressly index) were detetrimend according to A.S.T.M., (2012).

- The statistical analysis of data was done according to Snedecor and Cochran, (1980).

Results and Discussion

Leaves chemical composition:

The data in Table (3) clearly show that application of the commercial compound had a positive effect on chlorophyll a, chlorophyll b, and carotenoids in both seasons comparing with control.

Foliar application of 1.5 g/L of the commercial compound three times, (at squaring stage, beginning of flowering and peak of flowering) seems to be the most affective on leaves chemical composition of cotton. The positive effect of the commercial compound to enhance the chlorophyll synthesis may be due to its high percentage of N, K, and Mg. (Pandy and Sinha, 1978). Mg is one of the key elements in chlorophyll synthesis; it plays a great role as the central atom in the porphyrin structure of the chlorophyll molecule (Tucker, 1999). In addition, N is essintial constituent forming chlorophyll and it has an important role in the vital process of photosynthesis. Also, the commercial compound contains Mn which helps in chlorophyll formation although it does not a constituent of chlorophyll through its assistant iron in chlorophyll synthesis (Lohry, 2007). Moreover, iron is required in the formation of the precursor of chlorophyll synthesis, despite that it is not constituent of chlorophyll molecule (Curie and Briat, 2003).

Table 3. Effect of foliar application of the commercial compound on leaves pigments**.**

Treatments characters	**Chlorophyll a (mg/g dry W.)**		**Chlorophyll b (mg/g dry W.)**		**Carotenoids (mg/g dry W.)**	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**
Control	3.59	3.55	2.66	2.55	0.49	0.45
0.75 g/L squring + start of flowering	3.71	3.60	2.70	2.61	0.50	0.46
0.75 g/L squring + peak of flowering	3.75	3.63	2.73	2.63	0.48	0.47
0.75 g/L start flowering + peak of flowering	3.77	3.65	2.75	2.65	0.47	0.49
0.75 g/L squring + start of flowering + peak of flowering	3.82	3.70	2.77	2.66	0.51	0.50
1.5 g/L squring + start of flowering	3.85	3.73	2.79	2.67	0.50	0.51
1.5 g/L squring + peak of flowering	3.90	3.75	2.81	2.69	0.52	0.53
1.5 g/L start flowering + peak of flowering	3.93	3.77	2.85	2.70	0.53	0.52
1.5 g/L squring + start of flowering + peak of flowering	3.99	3.78	2.89	2.73	0.54	0.54
L. S. D. at 0.5	**0.13**	**0.11**	**0.05**	**0.03**	**0.02**	**0.01**

Growth characters:

Results in Table (4) reveal that the tested treatments had a significant effect on growth characters (plant height at harvest and No. of fruiting branches/plant) in both seasons comparing with control. Foliar application of the commercial compound at the rate of 1.5 g/L three times (at squaring stage, beginning of flowering and top of flowering) gave the tallest plants in both seasons, and gave the highest numbers of fruiting branches/plant, which may be due to its positive effect on several biochemical processes related to plant growth, such as stimulating the chlorophyll synthesis the commercial compound contains several macro elements which necessary to improve plant growth. Similer results were obtained by Abd El-Gayed et al (2014).

Table 4. Effect of foliar application of the commercial compound on growth characters and earliness**.**

Treatments characters	Plant height cm		No. of fruiting branches/plant		Earliness%	
	2016	2017	2016	2017	2016	2017
Control	121.2	124.4	15.1	16.0	65.04	65.07
0.75 g/L squring+start of flowering	122.8	120.2	15.4	15.9	72.64	80.41
0.75 g/L squring+peak of flowering	123.4	122.8	15.6	16.4	72.48	83.43
0.75 g/L start flowering+peak of flowering	124.6	124.3	15.7	15.4	74.32	82.04
0.75 g/L squring+ start of flowering+peak of flowering	130.9	122.6	17.4	15.7	75.06	81.61
1.5 g/L squring+start of flowering	125.6	120.2	15.4	15.7	78.51	81.40
1.5 g/L squring+peak of flowering	127.1	124.3	15.7	15.5	75.56	78.53
1.5 g/L start flowering+peak of flowering	127.9	124.5	16.7	14.9	77.51	78.29
1.5 g/L squring+ start of flowering+peak of flowering	134.1	126.8	17.4	17.1	75.87	76.46
L. S. D. at 0.5	4.36	3.21	1.19	1.16	2.82	2.34

Earliness percentage:

With regard to earliness percentage as affected with the application of the commercial compound, data presented in Table (4) showed that the tested treatments significantly affected earliness percentage in favour of application of the commercial compound two times at rate of 1.5 g/L (at squaring stage and beginning of flowering), at the first season, while at the second season the application of the studied commercial compound two times at the rate of 0.75g/L (at squaring and peak off flowering) gave the highest value. The results are in line with those obtained by Eleyan et al (2014).

Yield and its components:

Data in Tables (5 and 6) revealed that foliar application of the commercial compound three times (at squaring, beginning of flowering, and peak of flowering) increased yield parameters, No. of open bolls/plant, boll weight, seed index and seed cotton yield/fed) in both seasons, compared with control. On the other hand, lint% did not affect by the tested treatments.

Table 5. Effect of foliar application of the commercial compound on yield components**.**

Treatments characters	No. of open bolls/plant		Boll weight (g)		Seed cotton yield (ken/fed)	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**
Control	17.7	17.8	2.80	3.0	9.31	9.86
0.75 g/L squring+start of flowering	18.0	19.0	2.96	2.96	10.06	10.64
0.75 g/L squring+peak of flowering	18.3	20.0	3.00	3.01	10.14	10.78
0.75 g/L start flowering+peak of flowering	18.8	21.2	3.01	3.09	10.62	11.10
0.75 g/L squring + start of flowering + peak of flowering	20.7	21.7	3.06	3.13	11.26	11.28
1.5 g/L squring + start of flowering	19.1	19.9	3.03	2.86	10.10	11.26
1.5 g/L squring + peak of flowering	19.9	20.2	3.06	2.86	10.55	11.56
1.5 g/L start flowering + peak of flowering	19.6	22.4	3.06	3.05	10.98	11.78
1.5 g/L squring + start of flowering + peak of flowering	21.3	23.5	3.11	3.12	11.62	12.08
L. S. D. at 0.5	**2.96**	**2.19**	**0.23**	**0.21**	**0.82**	**1.06**

Table 6. Effect of foliar application of the commercial compound on lint%, seed index (g) and fiber properties.

Treatments characters	Lint %		Seed index (g)		Micronair reading		Pressly index	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Control	41.38	41.17	10.45	10.12	5.0	4.7	9.01	8.85
0.75 g/L squring+start of flowering	41.14	40.25	10.89	10.51	4.8	4.5	9.00	9.22
0.75 g/L squring+peak of flowering	42.37	40.14	10.91	10.31	4.8	5.0	8.83	9.11
0.75 g/L start flowering+peak of flowering	41.69	40.20	10.07	10.00	4.6	4.7	9.17	9.05
0.75 g/L squring+ start of flowering+peak of flowering	41.47	41.21	10.94	9.79	4.9	4.8	9.33	9.17
1.5 g/L squring+start of flowering	41.05	41.00	10.30	10.45	4.8	4.9	8.53	9.14
1.5 g/L squring+peak of flowering	41.83	41.66	10.65	10.03	4.7	4.5	8.90	9.50
1.5 g/L start flowering+peak of flowering	42.33	41.69	10.72	10.12	4.9	4.7	9.20	8.19
1.5 g/L squring+ start of flowering+peak of flowering	41.60	40.71	10.80	10.20	4.8	4.9	8.80	8.92
L. S. D. at 0.5	**N. S.**	**N. S.**	**0.49**	**0.32**	**N. S.**	**N. S.**	**N. S.**	**N. S.**

It seemed from the obtaind results that sprying plants with the commercial compound at the rate 1.5g/L three times significantly produced seed cotton yield exceeded the yield of control treatment by 24.81 and 22.52% in 2016, 2017 seasons respectively.

Using the commercial compound three times at the rate of 0.75g/L gave better seed cotton yield as compared with using the commercial compound twice by 20.94 and 14.40% in 2016, 2017 seasons respectively.

The effect of spraying the commercial compound three times at the rate of 0.75g/L or at the rate of 1.5g/L did not significantly differ. Therefore, it can be recommended the use of rate 0.75g/L for the economic use.

Fiber properties:

Results in Table (6) showed that the tested treatments had insignificant effect on fibers quality (Micronaire reading and pressly index) in both seasons.

In genieral the enhancement of the commercial compound in cotton growth and cotton productivity as well as chemical leaf cotton content is mainly due to the commercial compound contains many of vital and important elements needed for plant growth improvement, concequently increased seed cotton yield and its components.

Nitrogen affects plant growth, fruiting parameters, yield components. There is no doubt that nitrogen application enhances seedling growth, increases boll positions on the fruiting branches, provides plant leaves by chlorophyll and carotenoids, increases boll formation and cellulose precipitation in bolls (Makram *et al*., 1994). Phosphorus is one of the major nutrients, necessary for crop growth and development. It is essential for the biosynthesis of green pigments of plant, P is a constituent of nucliec acids, phospholipids, DNA, NADP and ATP. It is also involved in energy transfer processes in both photosynthesis and respiration. Potassium, promotes the vital processes such as photosynthetic production for plant growth CO_2 and through producing ATP, enzyme activation, water relations, energy conversion, CO2 fixation, controling the bad effects of ROS by synthesis of NADPH oxidase and at the end K plays an important role in the translocation of storage products (Mohsin *et al.*, 2004 and Sharma and Singh, 2007). Zinc is envolved as a cofactor for the enzymes, and it is necessary to convert tryptophan into IAA. Iron is important for chlorophyll synthesis and as a content of some respiratory enzymes. Manganese takes place in synthesis of enzymes associated with protein metabolism. Magnesium is a constituent of chlorophyll which is involved in photosynthesis processes. For the previous important modification roles of these elements that are found in the commercial compound compound, great effects on the productivity of cotton plants were evident in the present study.

Conclusion

It could be concluded to use this commercial compound as foliar spraying at rate 1.5 g/L at squaring, beginning of flowering and peak of flowering stages to improved seed cotton productivity under Middle Egypt, Beni-suef conditions.

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تأثير الرش بمنشط النمو علي نبات القطن

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معهد بحوث القطن – مركز البحوث الزراعية– مصر .

أجريت تجربتان حقليتان في ارض طينية بمحطة البحوث الزراعية بسدس اثناء موسمي الزراعة ٢٠١٦ , ٢٠١٧م لبحث تأثير الرش الورقي بمركب تجاري (شالنجر) يحتوي على ٢٠% بو٢أ , ١٥% ن , ٥% فو٢أ٥ , ٢.٥% زنك , ٠.١% حديد , ٠.١% منجنيز , ٠.١% ماغنسيوم علي بعض المكونات الكيميائية لاوراق القطن , صفات النمو , التبكير , المحصول ومكوناتة وجودة تيلة القطن لصنف جيزة ٩٥. أستخدم معدلين من (٠.٧٥جم/لتر و ١.٥جم/لتر) رشا على النبات عند مراحل مختلفة من النمو (بداية الوسواس وبداية التزهير , بداية الوسواس وقمة التزهير , بداية التزهير وقمة التزهير , بداية الوسواس وبداية التزهير , قمة التزهير) وأستخدم تصميم القطع الكاملة العشوائية فى أربعة مكررات فى كلا الموسمين.

ويمكن تلخيص النتائج المتحصل عليها كما يلي:

– ادت اضافة المركب التجارى الي نبات القطن الي تأثيرات معنوية علي كل من المكونات الكيميائية للاوراق , (كلوروفيل أ , ب , كاروتينيدات) , صفات النمو (طول النبات , عدد الافرع الثمرية/النبات) , صفة التبكير , صفات مكونات المحصول (عدد اللوز المتفتح/نبات , وزن اللوزة (جم) , محصول القطن قنطار/فدان , كذلك معامل البذرة (جم) بينما لم يكن لة تأثير معنوى علي صفات التيلة (ميكرونير , بريسلى) مع الافضلية لاستخدام المركب التجارى بمعدل ١.٥ جم/لتر ٣ مرات عند بداية الوسواس وبداية التزهير وقمة التزهير, مع عدم الأختلاف معنويا عن معدل ٠.٧٥ جم/لتر ثلاث مرات.

من نتائج الدراسة يمكن التوصية باستخدام المركب التجارى بمعدل ١.٥ جم/لتر ثلاث مرات من بداية الوسواس وبداية التزهير وقمة التزهير لزيادة محصول القطن تحت ظروف منطقة مصر الوسطى بمحافظة بنى سويف.