

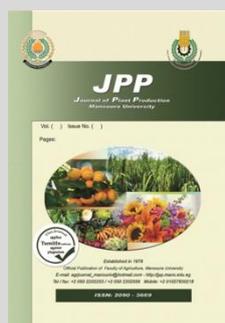
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Response of Cotton Plants to Low Concentrations of Ethrel and their Effect on the Development Opening Percentage of Bolls

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ABSTRACT

A field trial was conducted at Sakha Agricultural research station farm, Kafr El-Sheikh governorate to study the effect of Ethrel at low concentration (5 cm / litre) as foliar application at different stages of bolls maturity (35, 50, 65 and 80 %) after 120 days after sowing in addition of control (untreated plants) on yield and its parameters of cotton Giza 97 cultivar during 2019 and 2020 seasons. Complete randomized block design was applied with three replicates were used with five treatments. There are significant differences between all treatments by using Ethrel at the most of studied characters. Foliar application of Ethrel with 5cm/litre at 50% bolls maturity significantly increased number of fruiting branches, total chlorophyll, number of open bolls, earliness percentage, lint percentage, boll weight and seed cotton yield / fed. On the other hand, spraying cotton plants with Ethrel in this stage obtained the lowest values of boll retention %, boll shedding in opposite of untreated plants which obtained the highest values. There are not any significant differences between all treatment in some characters as plant height and seed index which not affected by the application of Ethrel. To further improve the boll opening percentage for better yield performance same experiment was conducted using 5 cm / litre of ethrel at 50 % maturity at four times, 10 days between them (beginning with 120, 130, 140 and 150 DAS).

Keywords: cotton, *Gossypium barbadense*, Ethrel, maturity stages, cotton bolls.

INTRODUCTION

Preparing cotton for harvest is a very important part of the production management system. In-season cultural practices have a big impact on defoliation success, as a result of the condition of the cotton dictates its response to harvest-aid treatments. Early harvesting of cotton during ideal weather conditions increases higher lint quality and quantity of cotton yield. Application of harvesting tips assures more benefits, while neglecting of these tips reduces yield and quality of cotton plants

Ethrel is a plant growth modulator used which to promote fruit ripening, abscission, flower induction, breaking of apical dominance and other plant responses. And it can be uptaken by various plant organs and degraded within the tissues and organs releasing ethylene as an end product. Ethylene affects plants. As a natural product of plant metabolism. Ethylene in turn considered as plant hormone characterized by its effective role on leaf abscission with high concentration, while, induction of flowering and fruit ripening with low concentration play as promoter hormone (Leopold and Kriedemann, 1980). Ethrel is the key hormone that provokes abscission by boosting the production of various cell wall hydrolysis in the abscission zone to promote cell wall break down and ovicell shedding; Roberts, *et al.* (2002). Sawan, *et al.* (1984) and Abdel Aal, *et al.* (1987) found that spraying ethrel at various concentrations (*i.e.*, 5, 10, 20 and 40 Ppm) after 90 days from planting, lead to increase numbers. of flowers, number. of opened bolls, earliness lint percentage, seed index, and seed cotton yield, while, lower concentration as (5 and 10 ppm) increased micronaire value and chemical characters.

Ethrel has customarily been used to hurry the maturing of natural products and nuts, such as, walnuts, melons, and tomatoes. Others studies found that Ethrel causes a boll opening response in cotton, particularly when the crop has been cultivated late and is maturing slowly. Three investigations conducted in 1980 and 1981 appeared expanded build up yields from the treatments conjointly appeared that it is important to apply ethrel when the crop has approximately 50 percent open bolls and not more than 10 percent juvenile bolls. (Leopold and Kriedemann, 1980).

The aim of this study is to elucidate the effect of Ethrel in helping the cotton bolls to opening and maturity to get high yield by using one concentration at different stages of progress of the bolls.

MATERIALS AND METHODS

A field trial was executed out in a clayey textured soil at Sakha Agricultural Research Station farm, Kafr El-Sheikh Governorate, Egypt (30° 56' N latitude and 31° 05' E longitude) to study the impact of foliarly applied Ethrel in one concentration (5 cm / litre) at different stages of cotton bolls maturity (Giza CV 97) on yield and components during two seasons of 2019 and 2020.

Chemical overview of ethephone.

The following active ingredient is covered by this Reregistration Eligibility

Document:

Common Name: Ethrel

Chemical Name: (2-chloroethyl) phosphonic acid

Chemical Formula: C₂ H₆ ClO₃ P, Ethrel [(2-chloroethyl) phosphonic acid] is a plant growth regulator that promotes fruit

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ripening, abscission, flower induction, and other responses by releasing ethylene gas, a natural plant hormone.

Pure Ethrel is a white waxy solid with a melting point of 74-75 C. Ethrel is very soluble in water, alcohol, acetone, and propylene glycol, only slightly soluble in aromatic solvents such as benzene and toluene, and insoluble in kerosene and diesel oil.

Trade and other names: Bromeflor, Ethepon, Florel, Cerone, Prep, Flordimex

Use for cotton in general:

- To promote early boll opening, foliar spray when desired number of bolls have matured (aerial or ground spray).
- To precondition cotton for defoliation, foliar spray 4-7 days before defoliant application (aerial or ground spray).
- To defoliate prior to boll opening, foliar spray with a defoliant 4-7 days before boll opening application (aerial or ground spray).
- To hasten maturing process, foliar spray about 1-3 days before harvest, to remaining leaves ground (spray, over-the-top).

Experimental design randomized complete block design were assigned with three replicates (foliar at four stages of maturing 35, 50, 65 and 80%) in addition to the control treatment. The experimental plot consisted of six rows, 3.5 m long and 0.6m width (plot area=12.6 m²). The seeds were sown on 27th and 29th April in the first and second seasons, respectively. Phosphorus fertilizer was applied during soil preparation in the form of Calcium supr phosphate (15.5% P₂O₅) at the rate 30 kg P₂O₅.fed. All plots were soil fertilized with nitrogen fertilizer at a rate of 60 kg N.fed-1 in the form of urea (46.5%) in two equal doses, the first dose was added after thinning (before the first irrigation), while the second dose was applied before the second irrigation. Potassium at the rate of 24 kg K₂O/fed in the form of potassium sulphate (48% K₂O) which adding after 30 days from sowing the seeds.

Ethrel was applied at 5cm/L at three times begening of 120 DAS between every applied is ten days. So we can say:

- At 35% maturity: Spraying at 120,130 and 140 DAS.
- At 50% maturity: Spraying at 150,160 and 170 DAS.
- At 65% maturity: Spraying at 160, 170 and 180 DAS.
- At 80% maturity: Spraying at 185,195 and 205 DAS.

Growth and yield parameters:-

- Ten cotton plants were chosen randomly from each plot at harvest to determine Plant heights were measured using a measuring tape to measure from the ground to the apex of the plant.
- The number of reproductive branches and bolls per plants were counted by harvest, in addition to 20 bolls that were randomly harvested at the middle third of the plants. The measurements were randomly obtained on five plants in the useful area of the plots.
- Total chlorophyll was determined by sum of chl.a + chl.b, Chlorophyll a and b concentration were determined spectrophotometrically by measuring the absorbance (optical density-OD) at 662 and 644 nm respectively. The concentrations of Chlorophyll a and Chlorophyll b (µg. g-1FW) in leaf tissues were measured using the following formulla (Cha-Um *et al.*, 2006), Chlorophyll a= 9.784*D662- 0.99*D644 and Chlorophyll b= 21.426*D644- 4.65*D662
- **Shedding bolls / plant % =**

$$\frac{\text{No. of setting bolls / plant} - \text{No. of bolls at harvest}}{\text{No. of setting bolls / plant}} \times 100$$

$$\times 100$$

Yield and its components:-

- At first pick, random sample of ten guarded plants was taken and labeled from each plot to determine the following characters.

- 1- No. of open polls / plant.
- 2- Boll weight (g)
- 3- Seed index (100-seed weight)
- 4- Earliness % = seed cotton yield of the first pick / total seed cotton yield x 100
- 5- Lint %= weight of lint / plant / weight of seed cotton / plant x 100
- 6- Seed cotton yield / fed (Kentar, *i.e* 157.5 kg)

Statistical analysis:

The experimental design was a completely randomized block design with three replications in each treatment. The results were pooled and the means were taken. ANOVA was performed using the Student's t-test (JMP8 software, SAS Institute, Cary, 1987, NC) for the analysis of data. Means were considered significantly different at $\alpha \leq 0.05$.

RESULTS AND DISCUSSION

All studied growth and yield components were significantly affected by spraying Ethrel in different maturity stages which observed in the results as follows:

Effect on growth characters:

Plant height

Data appended in Table 1 revealed that, foliar application with Ethrel in different stages of boll maturity had insignificant effect on plant height in both seasons. In this concern Earley and Slife, 2007 found that, the plant height not affected by spraying Ethrel.,

Number of fruiting branches / plant:

Foliar application with Ethrel had significant effect in all treatments in both seasons for the number of fruiting branches. the high number of fruiting branches were obtained when the plants were sprayed by Ethrel in 50% maturity compared with other treatments. These results are agreement with Anne Costa *et al.* (2016).

Table 1. Effect of foliar spraying of Ethrel on vegetative growth of cotton plants during 2019 and 2020 seasons.

Characters Treatments	Plant height (cm)		No. of fruiting branches / plant		Total chlorophyll Mg/g fresh weight	
	2019	2020	2019	2020	2019	2020
Control (untreated plants)	171.83	141.07	16.63	13.25	7.10	6.34
Spraying Ethrel at 35% maturity	171.42	141.37	17.14	13.98	7.22	7.00
Spraying Ethrel at 50% maturity	173.32	143.42	18.10	14.41	8.23	7.54
Spraying Ethrel at 65% maturity	171.76	141.67	17.19	13.90	8.00	6.45
Spraying Ethrel at 80% maturity	172.56	142.77	17.47	14.21	7.54	6.99
LSD at 5%	N.S	N.S	0.51	0.63	0.11	0.65

Total chlorophyll (mg/g dry weight):

The results generally indicated that total chlorophyll content was significantly increased as result of foliar application of Ethrel comparing with the control in both seasons as shown

in Table 1. Spraying Ethrel in 50% maturity of bolls gave highest values compares with other treatments. It could be stated that Eth. increased plant productivity as a result of the sum of its morphological, biochemical, physiological effects on plants. Induction of flowering may be a form of Ethrel induced aging. However, (Schwerz and Mendel, 2006) stated that Ethrel induced biochemical composition such as accumulation of amino acids and organic acids in addition of of carbohydrate in cotton plants.

Effect on yield and its components.

No. of open bolls / plants.

Significant increase of boll opening was observed with the foliar application of Ethrel 5 cm / litre in 50% maturity of bolls on plant. (SARLACH, SOHU AND GILL, 2010) Increases ethylene production; used primarily for boll opening. And the data presented in figuer 2 the curves of the development of the number of open bolls / plant after treatment with Ethrel during both seasons.

When roughly 50-60% of total boll load is open, the opening of remaining bolls is protracted because the ethylene concentration in the plants decreases. Ethephon (PREP®) application’s maintain ethylene concentration in the plant at appropriate levels to promote the opening of all physiologically mature bolls (Szöke, 1995).

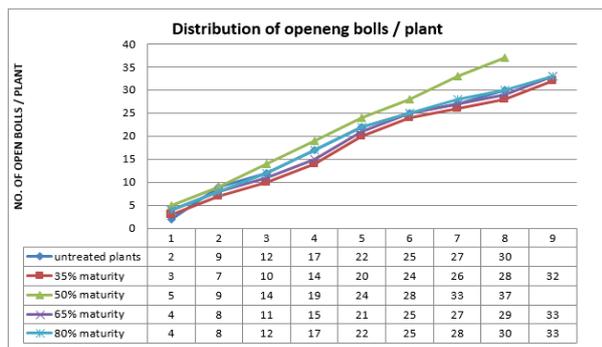


Fig. 1. Distribution of opening bolls / plant which affected by the time of spraying Ethrel.

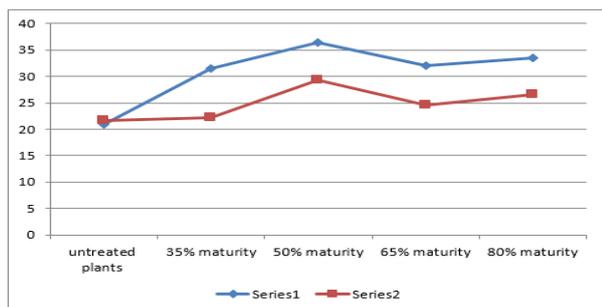


Fig. 2. Means of total number of open bolls / plant in the first and second season.

Boll retention percent:

Data in table 2 showed that, there are a significant differences between treatments in boll retention, untreated plants obtained the highest values of boll retention and it is reducing gradual by spraying Ethrel in different maturity which it helps the plants to facting to opening bolls compared with untreated plants. Spraying with Ethrel can increase the concentration of Ethelen. In contrast, Ethylene is a plant growth regulators that has multiple uses as it releases ethylene- another plant hormone responsible for ripening and senescence upon application. It can be used to suppress stem diameter, reduce

apical dominance, causing an increase in branching and lateral growth. Respectively Singh and Rathore (2015) also observed significantly increased of boll retention in untreated plants compared with the planted were treatment by Ethrel.

Boll shedding %.

The data obtained from Table (2) showed that a significant effect of all treatments on shedding %. Untreated plants (control) had the highest values of shedding percentage compared with other treatments. On the other hand, spraying Ethrel at 50 % maturity gave the lowest values of shedding %. (Muhammad Tariq *et al.*,2017) who found that, The potential of plant growth regulators can also be used for reducing shedding losses by keeping vegetative and reproductive development in harmony.

Table 2. Effect of foliar spraying of Ethrel on the number of bolls (open bolls, boll retention and boll shedding) of cotton plants during 2019 and 2020 seasons.

Characters Treatments	No. of open bolls /plant		Boll retention %		Boll shedding %	
	2019	2020	2019	2020	2019	2020
Control (untreated plants)	29.91	21.65	35.88	40.23	28.59	29.56
Spraying Ethrel at 35% maturity	31.40	22.13	34.67	38.90	28.01	28.34
Spraying Ethrel at 50% maturity	36.38	29.32	30.15	35.23	25.22	26.65
Spraying Ethrel at 65% maturity	32.07	24.58	33.56	38.12	27.44	27.43
Spraying Ethrel at 80% maturity	33.54	26.65	32.34	37.43	27.34	28.00
LSD at 5%	1.48	0.48	2.15	2.20	2.10	0.78

Earliness %.

Spraying with Ethrel was an effective way to get early opening bolls as well as more seed cotton yield. In our study spraying at different stages of bolls maturity gave a significant increases in earliness % specially at 50% of bolls maturity compared with untreated plants. These results are in line with Deol, Rajni and Ramanjit Kaur (2018). These results due to It improves coloration and accelerates uniform ripening of fruits and induces profuse flowering. It penetrates into the plant tissues, and is trans located and progressively decomposed to ethylene, which positively affects the growth process. To promote early boll opening, foliar spray when desired number of bolls have matured, To hasten maturing process, foliar spray about 1-3 days before harvest, to remaining leaves.

Seed index (g).

Data in table 2 revealed that, there are no differences between the treatments in seed index in both seasons.

Boll weight (g).

The difference in boll size between the treatments were clear specially after Ethrel treatments. We observed that the are a significant differences between the treatment and the highest values were obtained by spraying cotton plants with Ethrel at 50% maturity compared with other treatments.

Lint %

Data in table (3) show that, the highest values of lint% obtained by 50% maturity of the bolls compared with control and other treatments.

Seed cotton yield kentar / feddan.

Highest values of these traits were obtained from Ethrel 5 cm/litre (treatment 3), while the lowest values were obtained

from the control. The increase percentage in seed cotton yield/fed. over control amounted to 19.37% in 1st season and 16.28% in 2nd. increase in seed cotton yield/fed. which may due to spraying of Ethrel application is mainly attributed to significantly increased plant growth traits, earliness and seed

cotton yield components. In this concern, Gebaly *et al.* (2008) found that No. of open bolls/plant, boll weight and seed cotton yield/fed. Were increased significantly by spraying Etherl as compared with control.

Table 3. Effect of foliar spraying of Ethrel on yield and its parameters of cotton plants during 2019 and 2020 seasons

Characters Treatments	Earliness %		Seed index (g)		Boll weight (g)		Lint %		Seed cotton yield / fed. / kentar	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Control (untreated plants)	55.20	54.90	10.34	9.12	2.05	2.00	36.98	36.12	8.00	7.00
Spraying Ethrel at 35% maturity	56.73	55.12	10.45	10.23	2.54	2.37	37.25	37.00	8.21	7.21
Spraying Ethrel at 50% maturity	59.86	58.23	11.76	10.33	2.82	2.66	39.45	38.90	9.55	8.14
Spraying Ethrel at 65% maturity	58.25	56.00	11.06	9.77	2.61	2.45	38.00	37.23	8.43	7.65
Spraying Ethrel at 80% maturity	58.08	56.78	10.33	9.56	2.71	2.51	38.12	37.56	9.00	8.00
LSD at 5%	1.50	1.10	N.S	N.S	0.38	0.36	0.25	1.10	0.20	0.18

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استجابة نباتات القطن للتركيز المنخفض من الاثريل ومدى تأثيرها علي نسبة التفتح التدريجي للوز القطن أماني أحمد الاشموني* وعصام عبد العزيز الورقي معهد بحوث القطن – قسم بحوث فسيولوجي القطن – مركز البحوث الزراعية - مصر

أجريت تجربتان حقليةتان بالمزرعة البحثية بمحطة بحوث سخا خلال موسمى الزراعة 2019 و 2020 وذلك لدراسة تأثير إضافة مادة الاثريل كمادة مساعدة فى التفتح التدريجى للوز عند درجات نضج مختلفة من اللوز علي نبات القطن. وتم استخدام مادة الاثريل بتركيز 5 جم / لتر عند درجات نضج مختلفة (35-50-65 و 80 %) من اللوز الاخضر علي نبات القطن بالإضافة الى النباتات الغير معاملة (الكنترول). دراسة العديد من الصفات الفسيولوجية والمحصولية الهامة التي تعتبر كمؤشر لمدى استجابة نباتات القطن للرش بتلك المادة. وكانت أهم النتائج الهامة التي تم التوصل اليها كالآتي : أدى الرش بمادة الاثريل عند درجات نضج مختلفة الي حدوث تأثيرات معنوية في أغلب الصفات موضع الدراسة. الرش بمادة الاثريل بتركيز 5جم / لتر عند درجة نضج 50 % أدى الحصول علي أعلى القيم في أغلب الصفات تحت الدراسة. وجود زيادة معنوية في عدد الأفرع الثمرية / نبات و نسبة الكلوروفيل الكلى وعدد اللوز المتفتح / نبات و وزن اللوزة ونسبة التبكير ونسبة الشعر ومحصول القطن الزهرقنطار / فدان وذلك عند الرش بمادة الاثريل بتركيز 5 سم / لتر عند 50% من نضج اللوز مقارنة بالرش بنفس المادة والتركيز عند درجات النضج الاخرى موضع الدراسة. بالنسبة لعدد اللوز المتبقى علي النبات ونسبة تساقط اللوز علي النبات كانت أعلى نسبة تم الحصول عليها من النباتات الغير معاملة مقارنة بباقي المعاملات يليها الرش بمادة الاثريل عند نسبة نضج 35%. لذا يوصي برش نباتات القطن بمادة الاثريل بتركيز 5 سم / لتر ثلاث مرات بين المرة والاخرى 10 ايام عند درجة نضج 50% من اللوز / نبات (120 يوم من الزراعة) وذلك لضمان نسبة تفتح مثالية والحصول على أعلى محصول.