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EFFECT OF ETHEPHON AND NPK FERTILIZATION ON GROWTH, FRUITTING AND CHEMICAL CONSTITUENTS OF CHRISTMAS PEPPER

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ABSTRACT

Two pot experiments were conducted to evaluate the efficacy of foliar spray of ethephon at 0, 100, 200 or 300 ppm, NPK fertilization as Kristallon (13 N: 40 P: 13 K) at F_0 (unfertilized control), F_1 (1.5 g/l), F_2 (3 g/l) and F_3 (4.5 g/l), respectively and their interactions for controlling christmas pepper (*Capsicum annuum* L.) growth and fruiting as a pot plant.

All ethephon treatments suppressed plant height, but enhanced branches number/plant and fresh weight of shoot and root/plant and root length. Total and coloured fruits numbers/plant and fruits weight/plant were increased with 100 ppm ethephon treatment. All used ethephon concentrations increased N (%) in leaves, but did not significantly affect P and K percentages. Spraying plants with ethephon at 200 or 300 ppm increased total carbohydrate (%), while 100 ppm decreased it.

Kristallon specially at F_2 or F_3 was more effective in increasing vegetative and root growth, while F_3 enhanced fruitting characters. These increases were associated with increasing total N,P,K and total carbohydrate percentages in leaves.

Interaction treatments between ethephon and NPK fertilization exhibited synergetic effect for enhancing growth and fruitting characters. The interaction treatment between ethephon at 100 ppm and Kristallon at F_3 was most suitable for christmas pepper production as ornamental pot plant.

INTRODUCTION

Ornamental pepper (*Capsicum annuum* L.) is promising pot plant. It mainly used during the christmas period for its coloured fruits (Larson, 1980).

Ethephon and NPK fertilization are widely used to regulate growth and flowering of many pot plants.

Nilimesh and Roychowdhury (1989) stated that ethrel at 100 or 200 ppm inhibited gladiolus growth. Also, Kang *et al.* (1998) reported that ethephon at 1500 ppm reduced chrysanthemum shoots length. On the other side, Abd El-Fatah (1995) found that ethrel at 100 ppm increased fresh weight of flower stem with leaves of hybrid tea rose.

As for flowering, ethephon increased flowers number/plant in *Calendula officinals* (Pal *et al.,* 1986), geranium (Tayama and Carver, 1990) and hybrid tea rose (Abd El-Fatah, 1995). In addition, ethephon accelerated fruit ripening in 3 *Capsicum annuum* L. cultivars grown as ornamental pot plants when used at rates of 150 and 300 μ1/l at 3 to 6 weeks after anthesis (Armitage, 1989). Similarly, Perucka (1996) established that spraying *Capsicum annuum* L. seedlings with ethephon at 0.1, 0.2 or 0.3% (v.v) stimulated fruit maturation through its effect on pigments accumulation in fruits. Also, ethephon promoted early appearance of flower spike of tuberose (Preeti *et al.,* 1997) and advanced flowering time of poinsettia (El-Khayat and Attoa, 1998).

Chemical fertilization played vital roles in plant growth. Peppers growth as: green and dry matter yield (Kocevski *et al.,* 1995 using 140 kg N + 140 kg P + 210 kg K/ha) and plant height and branches number/plant (Maya *et al.,* 1997 using 150 kg N + 100 kg P/ha; Ombodi *et al.,* 1998 using polyolefin coated fertilizer) was enhanced by fertilizer applications. Regarding root growth, Saeid (1997) determined roots dry weight of croton plant and Khalil and Helal (1998) noticed root length of geranium, they found that fertilizers enhanced root growth.

As for peppers Fruitting, Neary *et al.* (1995), Russo (1996), Ram *et al.* (1996) and Nigri *et al.* (1999) found that fruit yield was increased by NPK fertilizers. Also, Shrivastava (1996) stated that the highest fruits number and fruit yield/plant were observed in capsicum cv. Hybrid Bharat plants treated with 250 kg N + 200 kg P + 200 kg K/ha.

Considering the above mentioned investigations which indicated promising effects of ethephon or NPK fertilization each alone on growth and fruiting of pepper, the question raised how much ethephon, NPK fertilization and their combinations affect the growth, fruiting and chemical constituents of christmas pepper as ornamental pot plant which have good appearance when carrying more coloured fruits and that was the objective goal of this study.

MATERIALS AND METHODS

This investigation was carried out at the Experimental Farm of Efficient Productivity Institute, Zagazig University during the two successive seasons of 1998 and 1999 to study the effect of ethephon, NPK fertilization and their interactions on growth, fruiting and chemical constituents of christmas pepper (*Capsicum annuum* L.) as ornamental pot plant.

Christmas pepper seeds were sown on May 1st, the uniform seedlings were transplanted one plant/10 cm plastic pot (as recommended by Larson, 1980) on June 1st. The pots were filled with sandy loam soil. The chemical and physical properties of the used soil were 32.3% coarse sand, 19.6% fine sand, 25.8% silt, 20.9% clay, 1.02 organic matter, sandy clay loam texture class, 2.3 m.mhos/cm E.C., 900 ppm available N, 12 ppm available P, 800 ppm available K and 7.8 pH.

Factorial experiment between ethephon at concentrations of 0, 100, 200 or 300 ppm and NPK fertilization (F) as Kristallon (13 N: 40 P: 13K) at rates of F_0 (unfertilized as control), F_1 (1.5 g/l), F_2 (3 g/l) and F_3 (4.5 g/l), each as foliar spray, was conducted. Ethephon levels were twice sprayed at vegetative growth stage to avoid the ethylene adverse effects on flowering (as mentioned by Aguirre *et al.,* 1995). The first ethephon spray was on July 1st, and the second on July 15th,. Kristallon were sprayed weekly beginning July 1st, till the end of experiment (December 15th). Nestapon as wetting agent at 1 ml/l in all spray applications was used, control plants were sprayed with tap water containing the wetting agent.

The experimental design was completely randomized block design with 16 combination treatments and three replicates/treatment, each replicate contained 5 pots. All plants received the normal agricultural practices whenever needed.

Recorded data:

Vegetative and root growth:

Growth responses were recorded at December 15th as: plant height (cm), branches number/plant, shoot (leaves + stems) and roots fresh and dry weights (gm)/plant and root length (cm).

Fruiting:

Total fruits number/plant (cumulative numbers throughout the experimental period) and red coloured fruits number/plant and fruits fresh weight (gm)/plant were determined.

Leaf chemical composition:

Random leaves sample was taken on November 15th, dried at 70°C for 72 hours, finely ground and wet digested to determine total N (%) according to A.O.A.C. (1980), P (%) according to Hucker and Catroux (1980), K (%) according to the method described by Jackson (1970) and total carbohydrate (%) according to Dubois *et al.* (1956).

Statistical analysis:

The collected data were subjected to statistical analysis of variance according to Steel and Torrie (1980) and means separation was done using Duncan's multiple range test at 5% level (Duncan, 1958).

RESULTS AND DISCUSSION

1. Effect of ethephon:

1.1 Vegetative and root growth:

As shown in Table 1, ethephon treatments significantly decreased christmas pepper plant height comparing to control. Increasing ethephon concentration up to 300 ppm during both seasons increased the reduction. Some enhancement in branching and shoot and root fresh and dry weights/plant was observed as ethephon applied and reached to significant range in most cases. On the other side root length did not show any significant response. In general, the highest values in this respect were recorded under 100 ppm ethephon treatment. Nilimesh and Roychowdhury (1989) on gladiolus and Kang *et al.* (1998) on chrysanthemum recorded similar results regarding plant height. However, Awad and El-Bahr (1986) found that activity of auxins and gibberellins were decreased and the inhibitors were increased in the extract of gladiolus corms soaked in ethephon. So, the result regarding plant height might be due to the effect of ethephon on the endogenous hormones balance. As for branching, ethephon treatments may enhanced branching through its direct or indirect role on the apical dominance. However, Abd El-Fatah (1995) found that ethrel enhanced fresh weight of flower stem with leaves of hybrid tea rose. The increments in root fresh and dry weights/plant might be due to ethephon enhancing effect on the formation of secondary roots and root hairs as reported by Krishnamoorthy (1981).

1.2. Fruiting:

Generally, ethephon treatments especially at the low concentration (100 ppm) promoted christmas pepper fruiting as total and coloured fruits numbers/plant and fruits fresh weight/plant comparing to control plants or those treated with the two high ethephon concentrations (200 or 300 ppm) during the two seasons (Table 1). The promotive effect of 100 ppm ethephon treatment on fruits number/plant might be due to increases of branches number/plant and plant growth under the effect of this treatment, as found in the present work, which may permit more metabolites contributed with the reproductive processes. However, Tayama and Carver (1990) and Abd El-Fatah (1995) recorded increases in flowers production/plant under ethephon treatments effect. Similar findings regarding the acceleration of pepper fruit coloration were found by Armitage (1989) and Perucka (1996). Increasing fruits weight/plant was acceptable as a result of the ethephon enhancing effect on fruits production/plant.

1.3 Chemical constituents:

Total N% (Table 1) was increased in leaves of ethephon treated plants. This increment was significant in the first season. Regarding P and K percentages, ethephon did not exhibit any significant effect during the two seasons. Also, Table 1 clears that the high ethephon concentration (300 ppm) significantly increased total carbohydrate (%) in leaves, but the low concentration (100 ppm) reduced it. This hold true for both seasons. Helal (1987) on *Coriandrium sativum* L. and Abd El-Fatah (1995) on rose recorded similar results respecting total N (%). The increments of total carbohydrate under 300 ppm ethephon treatment effect are in accordance with the results of Rashad (1987) on *Ocimum basilicum* L. and Abd El-Fatah (1995) on rose. While, the reduction in total carbohydrate in leaves of 100 ppm ethephon treated plants might be due to the promotive effect of this concentration on fruitting processes, as found in this research, which may associated with transportation of carbohydrate from leaves toward the fruiting organs.

2. Effect of fertilization:

2.1 Vegetative and root growth:

Table 2 reveals that all NPK fertilization treatments significantly, in most cases, enhanced christmas pepper growth as: plant height, branches number/plant, vegetative parts and roots fresh and dry weights/plant and root length. Generally the two high fertilizer levels (F_2 and F_3) recorded the highest growth values in this respect during both seasons comparing to unfertilized plants or those treated with the low fertilizer level (F_1). However, these results are in accordance with those obtained by Kocevski *et al.* (1995), Maya *et al.* (1997) and Ombodi *et al.* (1998), they reported that N,P and k treatments enhanced pepper vegetative growth. Saied (1997) on croton and Khalil and Helal (1998) on geranium obtained similar results respecting root growth.

2.2 Fruiting

In general, fertilizer treatments significantly enhanced fruit production/plant and its coloration and fruits fresh weight/plant comparing to

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unfertilized control plants (Table 2). The highest values in this respect were recorded with the highest fertilizer level (F_3) during the two seasons. Similar results respecting fruits number/plant and fruit yield/plant were established by Shrivastava (1996) on pepper. Also, Nigri *et al.* (1999) found that pepper fruit yield was increased by using NPK fertilizers.

2.3 Chemical constituents:

Total N,P,K and Total carbohydrate percentages in christmas pepper leaves (Table 2) were significantly increased in most cases by fertilization treatments specially at the two high levels (F_2 and F_3) comparing to control plants during the two experimental seasons. El-Desouqi and El-Far (1996) recorded similar increases in N,P and K concentrations in soybean leaves with NPK applications. Also, Paz *et al.* (1996) using K application and Prabhakar and Naik (1997) using N fertilization, they found that the above mentioned used elements were increased in fertilized pepper leaves. Regarding carbohydrate, Authman (1996) recorded increases in total carbohydrate accumulation in leaves and branches of *Araucaria excelsa* R.Br. seedlings with NPK applications.

3.Effect of interaction treatments between ethephon and fertilization:

3.1 Vegetative and root growth:

Data in Table 3 show that, generally, spraying christmas pepper plants with ethephon at any tested concentration under any fertilizer level decreased plant height and increased branching, shoot and root fresh and root fresh and dry weights/plant and root length comparing to control plants during the two seasons. Furthermore, as fertilizer level increased combined with ethephon increased the above mentioned growth parameters. However, the interaction treatment of F_3 combined with ethephon at 100 ppm resulted in the highest values, in most cases, represented vegetative and root growth characters of pepper plant comparing to control and other interaction treatments during the two seasons. In this respect, Kang *et al.* (1998) found that ethephon alone reduced chrysanthemum shoots length. Also, the ethephon enhancing effects on vegetative fresh and dry weights and root growth were previously reported by Krishnamoorthy (1981) and Abd El-Fatah (1995). Simultaneously, the fertilization effects on vegetative growth are in accordance with the results of Kocevski *et al.* (1995), Maya *et al.* (1997) and Ombodi (1998) on pepper. Saied (1997) on croton and Khalil and Helal (1998) on geranium found that NPK fertilization treatments alone enhanced dry weight of roots and root length.

3.2 **Fruiting*:***

Table 4 shows that ethephon specially at 100 ppm under any fertilizer level, generally, increased total production and coloured fruits numbers/ plant and fruits weight/plant as compared to control and other interaction treatments. Also, fertilization under any ethephon level increased total and coloured fruits number/plant and fruits weight/plant comparing to the same ethephon level without fertilization. In general, the highest values of total fruits and coloured fruits numbers/plant and fruits weight/plant were recorded under the effect of F_3 X 100 ppm ethephon interaction treatment comparing to control or other interaction treatments. Armitage (1989) and Perucka (1996)

found that ethephon without fertilization enhanced pepper fruit coloration . Furthermore, Shrivastava (1996) and Nigri *et al.* (1999) found that pepper fruits number and weight/plant were increased by fertilization treatments alone. So, interaction of ethephon and fertilization may had a synergetic effect for enhancing fruits production and coloration.

3.3 Chemical constituents:

As shown in Table 4 increasing the used fertilizer level under the same ethephon concentration, mostly, increased total N,P,K and total carbohydrate percentages in leaves. Also, increasing ethephon concentration under the same fertilizer level increased N (%) but did not exhibit clear trend regarding P and K percentages. Total carbohydrate (%) was decreased by spraying the low ethephon concentration (100 ppm) under any fertilizer level as compare to unsprayed plants or those sprayed with the two high concentrations (200 or 300 ppm) under the same fertilizer level. However, the interaction treatment of F_3 X 100 ppm ethephon which enhanced vegetative and root growth as wall as fruiting characters, as mentioned above, also increased total N,P and k percentages, but decreased total carbohydrate (%) comparing to control and most of the other interaction treatments. Helal (1987) found that ethephon treatments alone increased N (%) in *Coriandrium sativum* L. leaves. Also, El-Desouqi and El-Far (1996) on soybean and Paz *et al.* (1996) and Prabhakar and Naik (1997) on capsicum plants recorded increases in N,P and K concentrations by using fertilization treatments alone.

It could be concluded that spraying christmas pepper plant with ethephon at 100 ppm was suitable for suppress plant height and enhancing the other vegetative and fruiting characters. Weekly foliar spray with NPK elements as Kristallon (13 N: 40 P: 13 K) at the two high levels (F_2 and F_3) enhanced plant growth and fruiting, but F_3 had superior effect on fruiting. However, the interaction treatment between the high fertilizer level F_3 and ethephon at 100 ppm was the most suitable for christmas pepper production as ornamental pot plant.

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تأثير الايثفون والتسميد بالنيتروجين والفوسفور والبوتاسيوم على النمو والإثمار والتركيب الكيماوي لنبات فلفل عيد الميلاد

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أجريت تجربتان حقليتان لتقييم فعالية الرش بالايثفون بتركيزات صفر، ١٠٠، ٢٠٠، ٣٠٠ جزء فى المليون والتسميد بالنيتروجين والفوسفور والبوتاسيوم على صورة سماد كرستالون (١٣ ن:٤٠ فو: ١٣بو) بأربع تركيزات الأول (بدون تسميد للمقارنة)، والثانى (١,٥ جم/لتر)، والثالث (٣ جم/لتر)، والرابع (٤,٥ جم/لتر) على التوالى وتفاعلاتهم معاً من اجل التحكم فى نمو واثمار نبات فلفل عيد الميلاد كنبات زينه فى أصص .

أدت كل معاملات الايثفون الى نقص ارتفاع النبات ولكنها أدت الى زيادة كل من عدد الأفرع/نبات والوزن الغض والجاف للأجزاء الخضرية والجذر للنبات وكذلك طول الجذر. ازداد العدد الإجمالى للثمار الناتجة والملونه للنبات وكذلك وزن الثمار الناتجة للنبات نتيجة للرش بالايثفون بتركيز ١٠٠ جزء فى المليون. أيضاً أدت كل تركيزات الايثفون المستخدمة الى زيادة النسبة المئوية للنيتروجين فى أوراق النبات بينما لم تؤثر معنويا على النسبة المئوية لكل من النسبة الفوسفور والبوتاسيوم.أدى استخدام التركيزات العاليه من الايثفون(٢٠٠ ، ٣٠٠ جزء فى المليون) إلى زيادة النسبة المئوية للكربوهيدرات الكلية بينما أدى التركيز المنخفض لنقصها.

كان للكرستالون خصوصا عند رشه بالتركيز الثالث والرابع تأثير فعال فى زيادة قياسات النمو الخضرى والجذرى والثمرى، وصاحب ذلك زيادة النسب المئوية لكل من النيتروجين والفوسفور والبوتاسيوم والكربوهيدرات الكلية بالأوراق.

أدى التفاعل بين الايثفون و التسميد بالكرستالون الى زيادة حث النمو الخضرى والزهرى للنبات. وعموماً كانت معاملة التفاعل بين الايثفون بتركيز ١٠٠ جزء فى المليون والتسميد بالكرستالون بالتركيز الرابع ملائمة جداً لإنتاج نبات فلفل سعيد الميلاد كنبات زينه مزروع فى أصص.

Table 1: Effect of ethephon treatments on growth, fruiting and leaves chemical constituents of potted *Capsicum annuum* L. plant during 1998 and 1999 seasons.

Ethephon Treatments (PPM)	Vegetative and root growth characters							Fruiting characters			Chemical constituents			
	Plant height (cm)	Branches number/ plant	Shoot fresh weight (gm)/ plant	Shoot dry weight (gm)/ plant	Root fresh weight (gm)/ plant	Root dry weight (gm)/ plant	Root length (cm)	Total fruits number/ plant	Coloured fruits number/ plant	Fruits fresh weight (gm)/ plant	Total N (%)	P (%)	K (%)	Total Carbohy-drate (%)
First season (1998)														
0	18.2a	7.39c	12.4b	2.72a	3.26b	0.99b	19.2a	11.4b	8.81b	5.36ab	3.39b	0.34a	3.34a	15.0b
100	15.9b	9.03ab	15.7a	3.43a	4.30a	1.28a	19.9a	17.6a	12.06a	6.85a	3.90a	0.37a	3.13a	12.5c
200	13.7c	8.26bc	14.3a	3.63a	3.94a	1.18a	18.8a	12.6b	5.04c	6.06a	4.25a	0.38a	3.24a	17.5a
300	12.0c	9.34a	15.1a	3.17a	3.30b	0.99b	19.6a	12.1b	4.79c	5.29b	4.04a	0.37a	3.25a	18.5a
Second season (1999)														
0	18.6a	7.43b	13.2c	2.87a	3.82a	0.93c	17.8a	12.8b	9.34a	4.54b	3.52a	0.30a	3.40a	16.2b
100	16.7b	8.44a	16.1b	3.39a	4.21a	1.14ab	19.2a	13.8a	10.16a	5.93a	3.64a	0.33a	3.39a	14.1c
200	15.1b	8.41a	18.8a	3.82a	3.76a	1.24a	19.3a	14.3a	7.15b	5.68a	3.89a	0.33a	3.44a	17.9ab
300	12.5c	9.05a	12.5c	2.74a	3.10b	1.11b	18.4a	11.5c	4.61c	4.95ab	3.84a	0.32a	3.22a	19.4a

Means having same alphabetical letters within each column do not significantly differ at 5% significance level according to Duncan multiple range test.

Table 2: Effect of fertilization treatments as kristallon (13 N: 40 P: 13 K) on growth, fruiting and leaves chemical constituents of potted *Capsicum annuum* L. plant during 1998 and 1999 seasons

fertilization treatments (g/L)			Vegetative and root growth characters							Fruiting characters			Chemical constituents			
			Plant Height (cm)	Branches number/ plant	Shoot fresh weight (gm)/plant	Shoot dry weight (gm)/plant	Root fresh weight (gm)/plant	Root dry weight (gm)/plant	Root length (cm)	Total Fruits Number/ Plant	Coloured fruits number/ plant	Fruits fresh weight (gm)/ plant	Total N (%)	P (%)	K (%)	Total Carbohy-Drate (%)
First season (1998)																
$F_{0\ (control)}$			12.9b	8.12a	10.4c	2.03c	2.69c	0.68d	18.8ab	8.38d	4.38c	3.87c	3.31b	0.33b	3.05b	14.5b
	F_1	1.5	15.6a	8.33a	13.3b	2.76bc	3.37b	0.97c	18.2b	11.7c	7.19b	5.81b	3.84a	0.36ab	3.02b	17.5a
	F_2	3	15.5a	8.60a	16.3a	3.39b	4.18a	1.28b	19.9a	15.2b	8.05b	6.58b	4.31a	0.39a	3.39a	16.3ab
	F_3	4.5	15.8a	8.96a	17.6a	4.78a	4.57a	1.49a	20.5a	18.5a	11.07a	7.30a	4.10a	0.39a	3.51a	15.2ab
Second season (1999)																
$F_{0\ (control)}$			14.0c	7.89b	9.1d	2.12c	3.14b	0.82c	18.5a	8.02d	4.76d	3.91b	3.35b	0.25c	3.09b	15.5b
	F_1	1.5	15.1bc	8.08b	12.6c	2.88b	2.63c	1.12b	17.9a	9.67c	6.02c	4.45b	3.63ab	0.30b	3.38b	18.0a
	F_2	3	16.0ab	9.05a	18.0b	3.60b	4.79a	1.16b	19.6a	16.4b	8.09b	6.57a	3.90a	0.35ab	3.16b	17.6ab
	F_3	4.5	17.7a	8.32ab	20.8a	4.22a	4.33a	1.31a	18.7a	18.3a	12.39a	6.29a	4.01a	0.38a	3.82a	16.5ab

Means having same alphabetical letters within each column do not significantly differ at 5% significance level according to Duncan multiple range test.

Table 3: Effect of interaction treatments between ethephon and fertilization levels kristallon (13 N: 40 P: 13K) on vegetative and root growth of potted *Capsicum annuum* L. plant during 1998 and 1999 seasons.

Interaction treatments Frirt. X Ethephone		Plant height (cm)		Branches/ number plant		Shoot fresh weight (gm) /plant		Shoot dry weight (gm) /plant		Root fresh weight (gm)/plant		Root dry weight (gm)/plant		Root length (cm)	
(g/l)	**(ppm)**	**F.S.**	**S.S.**	**F.S.**	**S.S.**	**F.S.**	**S.S.**	**F.S.**	**S.S.**	**F.S.**	**S.S.**	**F.S.**	**S.S.**	**F.S.**	**S.S.**
0	**0**	s	16.6a	5.53e	6.90fg	8.4g	9.1h	1.28a	2.46efg	2.68fg	2.90ef	0.60e	0.72f	19.1a-e	16.7de
0	**100**	13.1d-g	15.8a	8.56a-d	6.70fg	9.3g	8.2h	1.88a	1.80g	2.30g	3.42de	0.78e	0.94ef	20.1a-d	17.9cde
0	**200**	11.3fg	13.0a	8.83a-d	7.83d-g	8.8g	9.4h	1.96a	2.04fg	2.68fg	2.98ef	0.60e	0.74f	17.9cde	17.4cde
0	**300**	9.9g	10.6a	9.56abc	10.10abc	15.1cde	9.5h	3.00a	2.18fg	3.12fg	3.28e	0.76e	0.88ef	18.2b-e	22.0a
1.5	**0**	17.6abc	17.5a	7.86bcd	8.63b-f	10.9fg	10.2gh	2.40a	2.22fg	2.04g	2.10fg	0.70e	0.72f	17.6cde	16.7de
1.5	**100**	16.1a-e	16.6a	8.33bcd	7.20fg	9.3g	9.6h	2.06a	2.06fg	3.22d-g	1.68g	0.74e	0.86ef	16.7de	17.9cde
1.5	**200**	15.9a-e	13.2a	8.20bcd	8.63b-f	15.0cde	16.2de	3.18a	4.40abc	3.80c-f	3.04ef	1.34c	1.52a	16.3e	18.1cde
1.5	**300**	12.8efg	13.2a	8.93a-d	7.86d-g	17.9bc	14.5ef	3.40a	2.84g	4.42bcd	3.72cde	1.10d	1.40abc	22.2a	18.8bcd
3	**0**	18.3ab	19.9a	7.03de	6.13g	13.3def	18.1cd	3.20a	3.26g	3.72c-f	5.04b	1.14d	1.06de	19.6a-e	18.3b-e
3	**100**	17.6abc	17.4a	9.20a-d	9.50a-e	21.1ab	19.7bc	3.86a	4.10bcd	5.30b	6.70a	1.88a	1.20cd	20.8abc	21.9a
3	**200**	14.4b-f	15.0a	7.60cd	9.66a-d	16.5cde	21.7b	3.46a	4.00b-e	5.08b	4.60bc	1.42bcd	1.46ab	20.6abc	21.3ab
3	**300**	11.6fg	12.0a	10.60a	10.90a	14.3c-f	12.7fg	3.04a	3.04efg	2.62fg	2.82ef	0.66e	0.92ef	18.7a-e	17.2de
4.5	**0**	20.0a	20.5a	9.13a-d	8.06c-g	17.1cd	15.4def	4.02a	3.56b-f	4.62bc	5.24b	1.52bc	1.22cd	20.4a-d	19.5a-d
4.5	**100**	16.8a-e	17.3a	10.00ab	10.37ab	23.4a	26.9a	5.94a	5.60a	6.40a	5.06b	1.68ab	1.56a	21.8ab	19.2a-d
4.5	**200**	13.0d-g	19.0a	8.43a-d	7.53efg	16.9cde	27.8a	5.92a	4.84ab	4.20b-e	4.42bcd	1.32cd	1.22cd	20.4a-d	20.5abc
4.5	300	13.6c-g	14.3a	8.26bcd	7.33fg	13.1ef	13.1f	3.24a	2.90c-g	3.06efg	2.60efg	1.44bcd	1.24bcd	19.3a-e	15.6e

Means having same alphabetical letters within each column do not significantly differ at 5% significance level according to Duncan multiple range test.
F.S. = 1st season (1998) S.S. = 2nd season (1999)

Table 4: Effect of interaction treatments between ethephon and fertilization levels kristallon (13 N: 40 P: 13K) on fruiting characters and leaf chemical constituents of potted *Capsicum annuum* L. plant during 1998 and 1999 seasons.

Interaction treatments Frirt. X Ethep(g/l) (ppm)		Fruiting characters						Chemical constituents							
		Total fruits Number/ Plant		coloured fruits number/ plant		Fruits fresh weight (gm)/plant		Total N (%)		P (%)		K (%)		Total carbohy-Drate (%)	
		0	0	F.S.	S.S.	F.S.	S.S.	F.S.	S.S.	F.S.	S.S.	F.S.	S.S.	F.S.	S.S.
0	100	7.6de	88.3de	5.40ef	6.32def	3.38d	3.78ef	2.85c	3.11a	0.30a	0.29b-f	3.36a	2.72bc	11.5bc	13.5a
0	200	10.2cde	9.4d	7.20de	6.80de	4.30cd	3.24f	3.05bc	3.06a	0.32a	0.25def	2.99a	3.25abc	9.5c	13.8a
0	300	6.1e	6.4e	2.46g	3.12gh	3.52d	3.98ef	3.68abc	3.67a	0.35a	0.24ef	2.85a	3.38abc	18.4a	16.8a
1.5	0	9.6cde	7.9de	2.46g	2.80h	4.30cd	4.66ef	3.68abc	3.54a	0.35a	0.23f	3.02a	3.03abc	18.4a	17.9a
1.5	100	10.8cde	0.6d	9.92c	7.52d	5.98b	4.20ef	2.98c	3.41a	0.35a	0.26c-f	3.09a	3.41abc	18.2a	18.3a
1.5	200	10.8cde	7.8de	8.66cd	4.60e-h	5.92b	3.96ef	4.19ab	3.49a	0.39a	0.32a-f	3.03a	3.42abc	14.5abc	15.7a
1.5	300	10.6cde	9.9d	4.46fg	6.66de	5.82bc	4.20ef	4.25a	3.81a	0.34a	0.32a-f	2.86a	3.19abc	19.0a	18.9a
3	0	14.7c	10.2d	5.72ef	5.32d-g	5.52bc	5.44c-f	3.97abc	3.81a	0.37a	0.31a-f	3.09a	3.50abc	18.3a	19.2a
3	100	12.7cd	14.0c	9.52cd	10.46c	5.70bc	5.96b-e	3.87abc	3.70a	0.37a	0.31a-f	3.33a	3.65ab	13.4abc	16.5a
3	200	22.7ab	17.9b	13.12b	12.46bc	8.20a	7.72ab	4.20ab	3.91a	0.36a	0.38ab	3.19a	3.03abc	15.2abc	13.2a
3	300	13.5c	19.8ab	4.32fg	5.32d-g	6.62b	7.56abc	4.81a	4.00a	0.41a	0.35a-d	3.67a	3.31abc	17.5a	20.4a
4.5	0	12.0cd	14.1c	5.26ef	4.12fgh	5.82bc	5.04def	4.37a	4.01a	0.41a	0.34a-e	3.38a	2.64c	19.1a	20.3a
4.5	100	14.6c	18.5ab	10.40c	13.06b	6.38b	4.58ef	3.85abc	3.87a	0.36a	0.34a-e	3.59a	3.84a	16.8ab	16.6a
4.5	200	26.8a	20.2ab	19.26a	16.80a	9.00a	8.82a	4.16ab	4.11a	0.43a	0.36abc	3.32a	3.85a	10.8c	13.6a
4.5	300	20.4b	21.2a	8.92cd	13.52b	8.30a	7.08a-d	4.25a	4.09a	0.43a	0.42a	3.60a	3.90a	15.1abc	15.5a
		12.2cd	13.8c	5.72ef	6.20def	5.54bc	4.68ef	4.16ab	3.98a	0.36a	0.41a	3.52a	3.71a	18.0a	20.5a

Means having same alphabetical letters within each column do not significantly differ at 5% significance level according to Duncan multiple range test.
F.S. = 1st season (1998) S.S. = 2nd season (1999)