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STUDIES ON ALTERNATE BEARING OF PICUAL OLIVE TREES

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ABSTRACT

This study was carried out during four successive seasons of 2006, 2007, 2008 and 2009 on Picual olive trees 12 years old growing planting in a sandy soil spacing at a 5x6 m. at a private farm on Cairo Alex. Road to investigate the effect of different thinning chemicals (Ethrel at100ppm,200ppm, 300ppm, NAA at100ppm,150ppm and urea at 2%,3%)on biennial bearing index, fruit quality and vegetative growth of Picual olive trees in both "On" and "Off" years. The obtained results indicated that all tested treatments reduced alternate bearing severity as compared with the control during the four seasons of study through thinning fruits of on-years (2006&2008) and increasing flowering and fruiting in off-years(2007&2009). In addition, the treatment produced fruits with good quality sinceit increased fruit weight, flesh/stone ratio, fruit dimensions and oil content, The most effective treatments were, ether at300 ppm and NAA at. 150 ppm. Besides, vegetative growth parameters , shoot length and thickness, number of leaves per shoot and number of internodes per shoot were promoted.

The experiment led to the conclusion that fruit thinning of olive with ethrel at 300 ppm or NAA at 150 ppm in on-years of biennial bearing cycle reduce alternate bearing severity and improved fruit quality in both "On" and "Off" years

Keywords: Olive- fruit thinning- alternate bearing- Ethrel- NAA- Urea- flowering- fruiting- fruit quality- vegetative growth- biennial bearing index

INTRODUCTION

The Olive is one of the most widely cultivated and economically important fruit crop for several subtropical and Mediterranean countryes. In Egypt olive trees play an important role in new established orchards, especially in the reclaimed soil because of its ability to grow under the stress conditions. Olive is notorious for alternate bearing which characterise by high crop in one year(On-year) and low or no crop in subsequent year (Off- year),. Several trails were carried out to study the use of different plant growth regulators for the control of flower and fruit numbers on olive tree so as to diminish the alternate bearing (Eris &Barut, 1993 and Cuevas *et al*., 1994). Olive fruit thinning has an important impact on both fruit quality during the on-year and the fruiting potential for the following one. The amount of developing fruit on each tree is directly correlated with its size (Martin *et al.,* 1980).The balance between the amount of developing fruit and the vegetative growth in any given growing season will effect and control the potential fruit production for the following season (Lavee, 2007). Moreover, Fernandez *et al.* (1992) reported that fruit removal were effective in improving return bloom in Manzanillo olive when done before endocarp sclerification (7-8 weeks after full bloom) and these results supports the hypothesis that olive flower induction occurs around the time of endocarp sclerification. Chemical thinning has certain advantages over hand or mechanical thinning: low thinning cost, greater size of olives, earlier maturation and better quality and decrease in biennial bearing (Loonnis, 2008). Chemical thinning is the most useful tool

available to olive growers for crop control.Post-bloom application of naphthalene acetic acid (NAA) can regulate crop size to improve fruit quality and result in shoot growth for return bloom for the next year. (Martin *et al*.,1980). Steven et al (2006) and Philip Schwallier (2009) on apple they found that NAA or ethrel sprays in previous year resulted in an additive return bloom, they added that NAA or ethrel sprays in on -years of biennial bearing cycle may provide a strategy for achieving more consistent flowering and cropping.Various concentrations (2, 4, and 6%) of urea as chemical thinner were applied to 'Nocellara Del Belice' at full bloom (FB), FB+10, FB+20. Urea reduced fruit set only when applied at FB+20, at fruitlet stage. Final fruit set was reduced by about 50% as compared to the control plants treated with 6% urea at FB+20 (Barattà *et al.,* 1990). Therefore, the present study was undertaken to investigate and throw some light on the effect of different chemical thinning i.e. NAA, Ethrel and urea on biennial bearing index, fruit quality and vegetative growth of Picual olive trees in both On and Off years of study.

MATERIALS AND METHODS

This investigation was carried out during four successive seasons of 2006, 2007, 2008 and 2009 on Picual olive trees 12 years old planted at 5x6 m. in asandy soil in aprivate farm on the desert Cairo Alex. Road. The tested trees were almost uniform in growth vigor, healthy, subjected to drip irrigation and received the same culture practices adapted in the region such as fertilization, irrigation, pruning, and hoeing as well as pest and deseise management.

The present experiment included the following 8 treatments:

1. Spraying Ethrel at 100ppm
2. Spraying Ethrel at 200ppm
3. Spraying Ethrel at 300ppm
4. Spraying NAA at100ppm
5. .Spraying NAA at150ppm
6. Spraying Urea at 2%
7. Spraying Urea at 3%
8. control (water spray only)

The tested spray treatments were applied 15 days after full bloom.

The treatments were arranged in a randomize block design, each treatment was presented with 3 replicate, each replicate was one tree.

The obtained data were handled as follow:

Flowering:

Number of inflorescences per meter: twenty shoots of one year old for every replicate were labeled, measured and average number of inflorescences per meter was calculated.

Number of flowers per inflorescence: thirty inflorescences were randomly taken from each replicate and total number of flowers per inflorescence was calculated.Perfect flowers percentage: the percentage of

perfect flowers to the total number of flowers was calculated in previously thirty inflorescences for each replicate.

Fruiting:

Yield: On st of November of each season, fruits were picked, weighted and counted.Biennial bearing index: biennial bearing index was calculated according to Wilcox (1944) as follow: biennial bearing index= differences in yield between successive x 100

Sum of yield of successive years

Fruit quality:

Thirty fruits from each treated tree were randomly sampled and tested for both physical and chemical properties (fruit weight (g); flesh/stone ratio and fruit dimensions)

As for fruit oil and moisture content; samples of fruits were dried using electric oven at 70◦c until constant weight, then fruit moisture content was calculated. The dried samples were used to determine fruit oil content using soxhlt apparatus as described in the A.O.A.C. (1980).

Vegetative growth parameters:

The previously tagged shoots were measured for length and thickness, besides, number of nodes and leaves were counted.

Statistically analysis: the obtained data in the four seasons were subjected to statistical analysis according to Snedocor and Cochran (1980). Means were separated using Duncan's multiple range (Duncan, 1955).

RESULTS AND DISCUSSION

Flowering:

Table, (1) presented the flowering characteristics (no. of inflorescences per meter; number of flowers per inflorescence and perfect flowers percentage.

The data showed that all tested treatments succeed in enhancing number of inflorescences per meter in both On years (i.e. 2006 & 2008) and Off years (2007 & 2009) as compared with the control. The treatment of 150 ppm NAA was superior to other treatments; followed by 300 ppm Ethrel, Other treatments came in between. As for number of flowers per inflorescence, data revealed that there were slight differences between the treatments in this concern. Treatments of urea at 2% or 3% and NAA at 100 ppm recorded higher values of number of flowers per inflorescence, while, other treatments induced similar results. Also, perfect flowers percentage was affected significantly by thinner chemicals. Treated trees exerted higher values of perfect flowers percentage in comparison to control in Off- years (2007 & 2009). Ethrel treatment at 300 ppm was superior to others, followed by 150 ppm NAA and 100 ppm NAA, while, other treatments came in between.

The obtained results of tree flowering are conferred with those founds of El-Sharkawy (1999) on olive; Steven *et al* (2006) and Philip Schwallier (2009) on apple . They found that NAA or ethrel sprays in previous year resulted in an additive return bloom, and added that NAA or Ethrel sprays in

On -years of biennial bearing cycle may provide a strategy for achieving more consistent flowering and cropping. Besides, Yeshitela *et al* (2005) mentioned that urea spraying increased tree flowering of "Tommy Atkins" mango; they added that the supplementation of nitrogen through the spraying urea is believed to be the reason for the observed greater flowering and yield results.

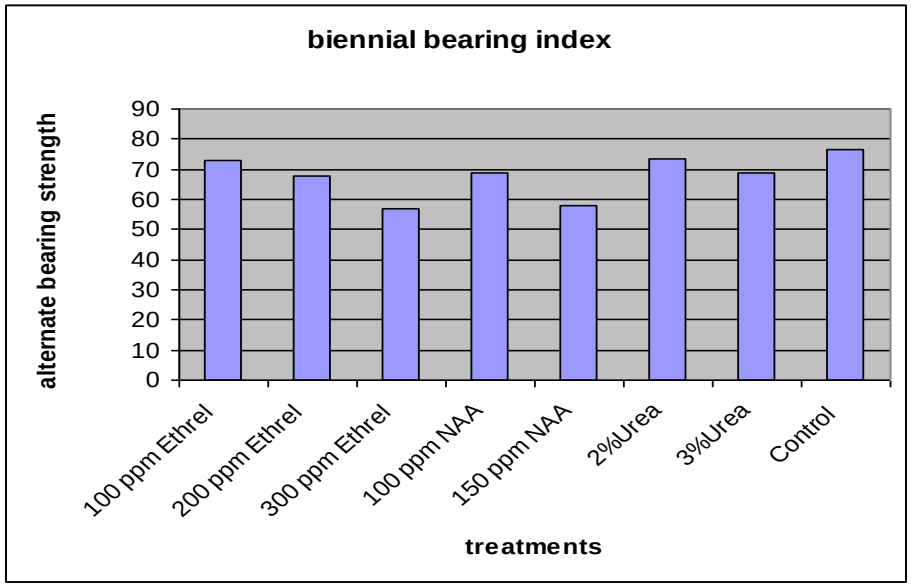

Diagram (1): effect of thinner substances on biennial bearing index

Fruiting: Yield (kg/tree), number of fruits per tree and biennial bearing index are presented in Table (2).It is obvious that the tested treatments succeeded in reducing yield of olive trees as kg per tree or as number of fruits per tree in On-years of biennial bearing cycle (2006&2008). In the same time, increased productivity of trees in Off-years (2007& 2009) as compared with the control. The treatment of 300ppm ethrel induced the highest effects in this concern, followed by 150ppm NAA. Meanwhile, the treatments of 200ppm ethrel, 100ppm NAA and 3%urea exerted intermedium effects. The least effect came from the control. In regard to biennial bearing index, the tested treatments reduced alternate bearing intensity as compared with the control. Ethrel at 300 ppm recorded the least value of biennial bearing index(57), followed by NAA at 150 ppm(58); 100ppm NAA and 3% urea exerted similar values (68.6); 100 ppm ethrel recorded(73); 2%urea(73.2). On the other hand, the highest value of biennial bearing index was recorded by the control.

The results of tree fruiting confirmed by those of Gupta and Brahmachari (2004) on Mango, who found that foliar application of urea or NAA increased fruit retention; Stover et al(2006)on Mandarin, who found that NAA sprays in On-year reduced number of fruits per tree. Besides, Lenny Wells *et al* (2009) mentioned that fruit thinning of "Sumner" and "Cape fear" pecan reduced alternate bearing strength.

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Fruit quality:

Fruit weight, flesh/stone ratio, fruit length and diameter are presented in Table (3).The obtained results indicated that the tested fruit thinning chemicals produced heaver fruits in both On- years (2006&2008) and Off-years (2007 & 2009) as compared with the control. The pronounced treatment in this concern was 300 ppm Ethrel, followed by 150ppm NAA, while, the least values were recorded from control. Other treatments came in between. As for flesh/stone ratio, all treatments increased flesh/stone ratio as compared with the control with the same pattern of fruit weight., Mentioned to fruit length; in on-years of biennial bearing cycle (2006&2008), tested treatments induced largest fruit as compared with the control. The treatment of 300ppm Ethrel was superior to other treatments, followed by 150 ppm NAA, and while; unthinning trees (control) exerted the latest values. Other treatments came in between. On the other hand, in Off-years (2007&2009), the treatments and control gave similar results except the treatments of 100ppm ether and 100ppmNAA gave less value as compared with other treatments. Also, thinning treatments exerted fruits of more diameter compared with unthinning trees (control), In both on- years (2006&2008) and Off- years (2007&2009). Ethrel at 300 ppm was superior to other treatments, followed by 150ppm NAA Meanwhile, other treatments and control exerted similar results with slight differences between each other.

The results of fruit physical characteristics are in line with the findings of Brent *et al* (1993) and Schupp (2000) on apple. They found that fruit thinning increased fruit size and width.

Fruit moisture and oil content:

As for moisture content, in the four seasons of study, both the control and 100 ppm e

Ethrel induced the highest values of fruit moisture content, while, 300ppm Ethrel and 150ppm NAA recorded the least values of fruit moisture content and other treatments came in between

The tested treatments increased fruit oil content as compared with the control in both On- years (2006 & 2008)and Off-years (2007 & 2009), 150 ppm NAA induced the highest values of fruit oil content, followed by 300ppm Ethrel, followed by 100ppm Ethrel. Meanwhile, the least values came from control and other treatments came in between.

The results of fruit oil content are in agreement with the findings of Rotundo & Pugliano (1981) on olive who found that Ethrel treatments increased fruit oil content.

Also, El-Sharkawy(1999) mentioned that thinning with NAA increased oil percentage of olive fruits. Moreover, Inglese *et al* (2002) reported that urea foliar sprays increased fruit oil content of olive fruits.

Vegetative growth parameters:

Shoot length, shoot diameter, number of leaves per shoot and number of internodes per shoot are presented in Table (5).

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Shoot length was affected significantly with the tested treatments. In On- years of study (2006&2008), 150ppm NAA or Ethrel at 300ppm produced the longest shoots, followed by Ethrel at 100 or 200ppm and NAA at 100ppm without significant differences between each other. In Off- years (2007&2009),2%urea induced the highest values, followed by 3%urea, followed by 100ppm Ethrel and 100ppmNAA without significant differences between each other. On the other hand, 300ppm Ethrel exerted the least values, followed by 200ppm Ethrel. Other treatments came in between.

In regard to shoot thickness, in On- years of biennial bearing cycle (2006&2008), 100 and 200ppm Ethrel and3%urea produced thicker shoots than the other treatments, without significant differences between each other, while the least values of shoot thickness were exerted by 200ppm Ethrel. Other treatments came in between.

As for number of leaves per shoot, it is obvious that in On- years (2007&2008), 100ppm NAA induced the highest number of leaves per shoot, while the least values came from the control. Other treatments came in between without significant differences between each other. Meanwhile, in Off- years(2007&2009), urea at 2% or NAA at 150ppm induced the highest values of number of leaves per shoot. On the other side , Ethrel at 300ppm exerted the least values in this concern, while other treatments came in between.

In regard to the number of internodes per shoot, the obtained results indicated that the treatments gave the same trend of number of leaves per shoot.

The results of vegetative growth are in agreement with those of Cheon-Young Song (1999) who found that urea stimulates large shoot growth: Debnath &Kundu (2001) on mango reported that urea; NAA and Ethrel significantly affect the new shoot production. Besides, Wood (1995) on pecan and Freddy *et all* (2007) on olive mentioned that vegetative growth affected with alternate bearing habit.

Conclusions

The experiment led to the conclusion that fruit thinning of olive with ethrel at 300 ppm or NAA at 150 ppm in On-years of biennial bearing cycle reduce alternate bearing severity and improved fruit quality in both "On" and "Off" years

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دراسات على تبادل الحمل فى اشجار الزيتون "صنف بيكوال"

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اجريت هذة الدراسة خلال اربعة اعوام متتالية هى ٢٠٠٦،٢٠٠٧،٢٠٠٨،٢٠٠٩ على الترتيب على اشجار الزيتون صنف بيكوال عمر ١٢سنة منزرعة فى ارض رملية على مسافة٥ × ٦ متر وتروى بالتنقبط فى مزرعة خاصة على طريق القاهرة اسكندرية الصحراوى بغرض دراسة تاثير بعض الكيماويات المستخدمة فى خف الثمار وهى الاثريل بتركيزات ١٠٠،٢٠٠،٣٠٠ جزء من المايون ، نفثالين حمض الخليك بتركيزى ١٠٠و١٥٠ جزء فى المليو ن واليوريا بتركيزى ٢و٣% على النمو الخضرى والتزهير،والاثمار وشدة تبادل الحمل لاشجار الزيتون

وتشير اهم النتائج الى:

نجحت المعاملات المختبرة فى زيادة عدد النورات الزهرية فى سنة الحمل الخفيف وكذللك نسبة الازهار الخنثى مقارنتا بالاشجار غير المعاملة

قللت معاملات الخف من شدة تبادل الحمل من خلال تقليل عدد الثمار فى سنة الحمل الغزير وزيادتها فى سنة

الحمل الخفيف تحسنت صفات جودة الثمارمتمثلة فى وزن ,طول وعرض الثمرة ونسبة اللحم الى البذرة ونسبة الزيت بالثمرة

كانت معاملتى الايثرل بتركيز ٣٠٠جزء فى المليون ونفثالين حمض الخليك بتركيز ١٥٠ جزء فى المليون هما الاكثر تاثيرا على التزهير والاثمار وصفات جودة الثمار

ادت المعاملات المختبرة الى تنشيط النمو الخضرى فى كل من سنتى الحمل الغزير وسنتى الحمل الخفيف

توصى الدراسة بخف ثمار الزيتون فى سنة الحمل الغزير بالايثرل بتركيز ٣٠٠ جزء فى المليون او نفثالين حمض الخليك بتركيز١٥٠ جزء فى المليون لتقليل شدة تبادل الحمل وتحسين جودة الثمار فى كل من سنتى الحمل الغزير والحمل الخفيف

قام بتحكيم البحث

أ. د/ عبد العال حجازي حسن — **كلية الزراعة – جامعة المنصورة**
أ. د/ إكرام سعد الدين أبو شنب — **مركز البحوث الزراعيه**

Table (1): Effect of some thinning chemicals on flowering of Picual olive trees during 2006, 2007, 2008 and 2009 seasons.

Characteristic	No. of inflorescences per meter				No. of flowers /inflorescence				Prefect flowers (%)			
Treatment	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009
Ethrel100ppm	30.9a	26d	65.4ab	21.8d	15.9c	11.6ab	14.4b	14.7bc	35.6a	26.5d	34.6ab	19.8d
Ethrel200ppm	30 b	31.1c	55.bc	41.2a	16.5b	10.4b	14.3b	15.1a	35.4a	26.6d	22.3c	21 d
Ethrel300ppm	29.4bc	34.2b	72.9a	41.1a	16.4b	12.3a	14.5b	14.7bc	35.4a	44.3a	34.5b	39.3a
NAA100ppm	29.6bc	31.8c	62.9b	31.6c	17 a	11.1b	14.2b	14.3bc	35.9a	40.3b	36.1a	27.2b
NAA150ppm	29.1bcd	49.3a	73.5a	45.1a	16.5b	10.9b	13.5c	14.2bc	35.7a	40.7b	35.8a	28b
Urea2%	30.2b	29.8c	52.2c	38.6ab	17a	10.9b	14.1b	15ab	36a	22.9e	32.1c	18.5de
Urea 3%	30.2b	30.1c	63.2b	25.5d	17a	11.2b	14.7b	15.6a	36a	38.6c	32.5c	22.7c
Control	29.7bc	23.2e	70.7a	26.3d	16.5b	12.7a	15.7a	15.3a	35.6a	22.3e	32.2c	18e

Means followed by the same letter (s) are not significantly at 5% level.

Table (2): Effect of some thinning chemicals on fruiting of Picual olive trees during 2006, 2007, 2008 and 2009 seasons.

Characteristic	Yield (kg) / tree				Number of fruits / tree				Biennial bearing index
Treatment	2006	2007	2008	2009	2006	2007	2008	2009	
Ethrel100ppm	65.7e	12.7c	44.7d	10.1e	10039.2d	1382.3c	6482.3c	1197.7e	73
Ethrel200ppm	67.2d	13c	44.3d	14.4b	9277.3d	1616.4b	6335.7d	1356.2d	68
Ethrel300ppm	55.8 g	15.7 a	34.2 g	16.3 a	7622 g	1641.5 b	4379.3 f	1648.5 a	57
NAA100ppm	65.2 e	13 c	47.5 b	11.4 d	9184.5 d	1626 b	6878.7 b	1359.	68.6
NAA150ppm	58.4 f	16.7 a	38.4 f	14 b	7791.4 f	1959.4 a	5121.7 e	1477.4 b	58
Urea2%	70 b	12.7 c	49.6 a	12.7 c	10405.8 b	1288.9 e	7079.7 a	1414.9 c	73.2
Urea 3%	68.9 c	15.3 ab	43.4 e	12.7 c	8585.1 e	1450.6 c	6381.3 d	1334 d	68.6
control	71.4 a	11.7 d	46.3 c	9.7 e	10443.1 a	1263.1 e	6922 b	1067.8 f	76.3

Means followed by the same letter (s) are not significantly differences at 5% level.

Table (3): Effect of some thinning chemicals on fruit physical characteristics of Picual olive trees (2006, 2007, 2008 and 2009 seasons)

Characteristic		fruit weght(g)			flesh/stone ratio				fruit length(cm)				fruit diameter(cm)			
Treatment	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009
100ppm ethrel	7c	9.2d	6.9c	8.4e	7.8c	7.5c	7e	7.8c	2.7c	2.8d	2.8c	3d	2.17d	2.3c	2.2c	2.3b
200ppm ethrel	7.1c	8f	7c	9.5c	8c	8.6b	7.2d	7.8c	2.8b	3.1a	2.9b	3.2b	2.25c	2.3c	2.3b	2.5a
300ppm ethrel	8.3a	10.5a	7.8a	10.6a	9.2a	8.11a	8.1a	8.1b	2.9a	3.1a	3a	3.3a	2.36a	2.5a	2.4a	2.5a
100ppm NAA	7.1c	7.9f	6.9c	8.4e	7.5d	7.5c	7e	8.2b	2.6cd	2.9c	2.7d	3d	2.18d	2.3c	2.3b	2.3b
150ppm NAA	7.5b	9.8b	7.5b	10b	8.5b	8.3b	7.8b	8.5a	2.8b	3b	2.9b	3.2b	2.3b	2.4b	2.4a	2.5a
2%urea	6.9cd	9.8b	7c	9d	8.4b	7.9bc	7.6c	7.2d	2.7c	3.1a	2.8c	3.1c	2.28c	2.4b	2.3b	2.5a
3%urea	6.5e	9.6c	6.8cd	9.5c	7.4d	7.9bc	6.7f	8.1b	2.7c	3.1a	2.8c	3.2b	2.18d	2.4b	2.3b	2.3b
control	6.6e	9.3d	6.7d	9.1d	7.4d	7.1c	6.7f	6.6e	2.6cd	3.1a	2.6e	3.2b	2.16d	2.3c	2.2c	2.3b

Means followed by the same letter(s) are not significantly at 5% level.

Table (4): Effect of some thinning chemicals on fruit chemical characteristics of Picual olive trees (2006, 2007, 2008 and 2009 seasons)

Characteristic	Fruit oil content (%)				Fruit moisture content (%)			
Treatment	2006	2007	2008	2009	2006	2007	2008	2009
100ppm ethrel	18.3c	18.6c	19.4c	19.1c	40.5ab	40.6a	39.9b	40.5a
200ppm ethrel	18.3c	18.7c	19.2cd	18.9b	40.4ab	40.2bc	39.9b	40.6a
300ppm ethrel	18.5b	19.8b	20.8b	19.9b	40.5ab	39.1e	38.7e	39.8c
100ppm NAA	18.2d	18.6c	19.3c	18.4f	40.5ab	40.4b	39.8bc	40.3ab
150ppm NAA	18.6a	20.7a	21.4a	20.1a	40.7a	39.4d	38.9b	39.8c
2%urea	18.3c	20b	19e	18.6e	40.6a	40.3b	40.1a	40.5a
3%urea	18.1e	18.4c	18.8f	18.3f	40.3ab	40.1bc	40ab	40.4ab
control	18.3c	17.9cd	18.7f	18.4f	40.4ab	40.6a	40.2a	40.6a

Means followed by the same letter(s) are not significantly at 5% level.

Table (5): Effect of some thinning chemicals on vegetative growth parameters of Picual olive trees (2006, 2007, 2008 and2009 seasons)

Characteristic	Shoot length(cm)				Shoot thickness(cm)				No. of leaves / shoot				No. of internodes/ shoot			
Treatment	**2006**	**2007**	**2008**	**2009**	**2006**	**2007**	**2008**	**2009**	**2006**	**2007**	**2008**	**2009**	**2006**	**2007**	**2008**	**2009**
100ppm ethrel	17.9a	13.1b	12.6b	12.3b	0.19ab	0.22c	0.16c	0.2c	22.7b	18.7c	21.4b	18.b	11.4c	10.3c	10.4b	8.7c
200ppm ethrel	17.1ab	10.5c	12.6b	10.4d	0.2a	0.25a	0.18a	0.23a	22.6b	16.7cd	19.1b	16b	11.7c	10.2c	9.5d	8.1d
300ppm ethrel	18.4a	9.6c	13.2a	9.5e	0.22a	0.19g	0.18a	0.16e	26.3a	12.5e	19.4b	11.3c	12.9b	8.6e	9.6d	7.9e
100ppm NAA	16.5b	9.7c	12.6b	9.7e	0.2a	0.18f	0.16c	0.19d	26.9a	18c	24.5a	13c	13.7a	12.3a	11.4a	7f
150ppm NAA	20a	12.6b	13.5a	12b	0.21a	0.2d	0.17b	0.21b	28.9a	22.8b	21b	21.5a	13.4a	11.7ab	9.4d	9.3b
2%urea	16b	15.5a	11.9c	13.5a	0.22a	0.21e	0.16c	0.2c	24.2ab	24.5a	21.3b	22.5a	12.6b	12.1a	10.7b	9.9a
3%urea	16b	14.3ab	11.8c	13.3a	0.22a	0.21e	0.17b	0.2c	22.8ab	21.4b	21.3b	20.5a	11.5c	10.3c	10.7b	9.3b
control	15.7bc	12.3b	10.7d	11.9bc	0.19ab	0.23b	0.16c	0.23a	22b	18.1c	16.5c	17.3b	11.5c	9.8cd	10.2c	5.4g

Means followed by the same letter(s) are not significantly at 5% level.