J. Agric. Sci. Mansoura Univ., 25 (2): *987 - 999*, *2000.*

EFFECT OF PROMALIN AND PACLOBUTRAZOL APPLICATIONON GROWTH AND FRUITING OF HIGH DENSITY APPLE TREES

Bahan M. Khalil
Horticultural Research Institute, Agricultural Research Center

ABSTRACT

Effect of promalin* and paclobutrazol** were studied on growth and yield of Anna apple tress in meadow orchard during two seasons (1996-1997) and (1997-1998) . Vegetative growth was stimulated, when promalin applied at beginning of September with concentrations 200, 400 and 600 ppm.

The application of 1000 ppm paclobutrazol (PBZ) at benginning of October on the trees treated with different concentration of promalin inhibited shoot growth, and increased spur number and increased the yield per tree Paclobutrazol increased the percentrage of total carbohydrate in leaves. Best results were obtained from treatments of 600 ppm promalin followed by 1000 ppm PBZ.

The treatment of PBZ alone increased weight, size and color of the fruits.

INTRODUCTION

Apple is one of the most widely planted deciduous fruit in Egypt . During the last years, Anna apple cultivar on MM.106 was markedly quickly spread and was planted at high density, In order to increase productivity. The main target of using meadow orchard is method obtain a good small trees with high number of spurs.

Joosse, 1986 postulated that treatment with promalin (GA_4+GA_7+BA), markedly increased the numbers of feathers per tree for apple cultivars (Rode Boskoop, Jonagold, Benont and Winston). Promalin also increased the number of trees with side shoots (number and length), but slightly limited the growth of the leader and sometimes limited the number of shoots with narrow angles (Basak and Soczek, 1986).

Anna apple graftes treated with 600 ppm promalin gave suitable number of branches and stem diameter (Makarem *et al*., 1990). Shaltout and Unrath, (1983a) found that Promalin at concentrations 300 to 500 ppm has been reported to be an efficient dormancy release chemical for Delicious apple estimulate both vegetative and floral bud break of Delicious apples. The observations of Lloyd and Firth (1993) also showed that promalin to be effective in stimulating vegetative budbreak of Flordaprince peaches, and had little primitive effect on floral budbreak and deleterious side effect of greatly increasing floral bud abscission. Wismer and Proctor (1995) supported the hypothesis that Benzyladenine induced fruit size “Empire”

---

* **Promalin : (6-benzylaminopurine + gibberelic acids $_{4+7}$)**

** **Paclobutrazol (PBZ) : (2RS,3RS) -1- (4-chlorophenyl -4,4- dimethyl- 2- (1+ H - 1,2,4-triazol -1-y1) pentan - 3-ol) (trade mark Cultar) a systemic growth regulator**

apple results from greater numbers of cells in the fruit cortex. This great number was from the capacity of BA to increase cell division in the apple fruitlet when applied as a thinner has significant implications for commercial apple production.

Concerning the action of GA, it has at least three important obvious actions. The first one is that GA. intensifies an organ ability to function as a nutrient sink. The second is ability of GA to increase the synthesis of IAA in plant tissues , while third action involves accelerated synthesis of hydrolytic enzymes as amylase and other hydrolytic enzymes in aleurone cells (Addicott and Addicott, 1982).

Luckwill, (1969) cleared that the amount of flowering was determined by the balance of flower-promoters (Cytokinines) and flower-inhibitor hormones (gibberellins).

The concept of the meadow orchard was described by Hudson (1971) and Lukwill and child (1973). It is an experimental system of apple growing in which trees are induced to initiate flowers in their first year of growth by treatment with growth retardants. In the second year the trees, flower and fruit, after which they are cut back to a stump from which a new shoot is regenerated to repeat the bienniel cycle. Albert and Aguado (1985) had modified the original meadow orchard concept, by planting the trees at some what wider spacing, and instead of de-heading every two years, it attempted to control growth and cropping by application of cultar and light winter pruning.

Yoshikawa *et al.* (1988) cleared that Paclobutrazol reduced overall vegetative growth, decreasing length between nodes of one year old peach wood, compared with control shoots. They found that vigorous watersprouts arising from lower scaffolds of treated trees were significantly shorter than on controls.

Cox, 1991 stated that GA3 effective clearly is in reversing the effects of excessive Paclobutrazol (at 0.06 mg a.i pot or as a single foliar spray at 100 mg /liter) on geranium, but timing of GA3, application is important . He showed that a single foliar spray of GA3 at 100 mg/liter applied, the same day, 7, 14 or 21 days after PBZ reversed the growth supression caused by PBZ. Plants treated with GA3 or 7 days after PBZ were as tall or taller and flowered at the same time as or later than the untreated (control). Plants treated with GA3 14 or 21 days after PBZ were shorter and flowered earlier than untreated controls, but laller than plants treated with PBZ alone.

Paclobutrazol significantly increased fruit weight in persimmon by 7% compared with control but did not increase fruit set (George *et al.*, 1995). Irrespective of treatment, fruit weight was not correlated with shoot length, number of nodes per shoot, fruit nodal position, shoot dry weight, leaf area per shoot and number of leaves per shoot.

Foliar spray of paclobutrazol (PBZ) reduced pre-harvest drop and flesh firmness loss on apples if applied within 5 weeks after fullbloom , while fruit soluble solids content was reduced by a double application of PBZ, and reducing flesh firmness loss. (Elfving *et al*., 1990)

Costa *et al*., (1995) postulated that the application of 1000 or 2000 mg paclobutrazol at full bloom or when shoots were 25 cm long, to Blanquilla pear trees carrying on crop, inhibited shoot growth, the effect was increased linearly with the concentration applied. However, when it was applied in conjunction with GA_3, the effect was overcome and a normal crop was obtained. They cleared that growth of trees treated at bloom time with paclobutrazal was greater than that of trees either sprayed with paclobutrazol and GA3 or left unsprayed. This was attributed to the loss of crop. Paclobutrazol also reduced fruit size in spite of the very small crop, flattened its shape, and altered other fruit quality parameters.

As regards the action of paclobutrazol as a growth regulator chemical, it offers the opoortunity to further increase in the efficiency of orchard management and fruit crop production (Lever and Luckwill, 1985).

The objective of this investigation was to study the effect of promalin, used as a growth regulator for meadow orchard to give a suitable number of lateral branches and following excessive application of paclobutrazol to obtain a good number of spurs.

MATERIALS AND METHODS

The present investigation was carried out for two successive seasons (1996-1997 and 1997-1998), on apple meadow orchard trees budded on MM.106. Tress were planted in 1994 with high density (90 cm x 180 cm), 2590 trees per feddan, in sandy soil, irrigated by drip irrigation, at Asher of Ramadon, El-Sharkia Governorate.

One hundred and twenty trees were sprayed during seasons of 1996-1997 and 1997-1998 with promalin at three concentrations, 0.0 & 200, 400, 600 ppm on the first of September of each season. (thirty trees per treatment). Fifteen trees of each treatment were sprayed with 1000 ppm of paclobutrazol at the first of October of each season. Treatments were replicated three times (five trees for each replicate), and a complete randomized design was used. Trees were nearly equal and treated with normal agricultural practices. The following parameters were determined at the end of each season.

1. Length of one year old shoots.
2. Number of nodes.
3. Leaf area and dry weight of leaves.
4. Total carbohydrates in leaves A dried sample of 0.1 gm was subjected to acid hydrolysis for six hours in boiling water bath using H_2 So_4. Total carbohydrates were assayed using the phenol sulfuric acid method (Smith *et al*., 1956), and calculated as 1 gm. glucose per 100 gms of the dry matter.
5. Number of spurs per tree.
6. Yield per tree (Number of fruit/tree and kg./ tree).
7. Fruit characters, including physical properties, fruit weight (gm.), fruit size (cm3.) , fruit dimensions (height, diameter and circumference in cm), and chemical properties (Juice T.S.S% by hand refractometer and

juice acidity according to AO.A.C (1965). Fruit skin colour was recorded for all treatments by using colour chart part I and II (Robert, 1938).

Data were statistically analyzed according to Snedecor and Cochran (1990), and L.S.D. test was used for comparing between treatments.

RESULTS AND DISCUSSION

Growth measurements

In the first season (1996-1997) the growth measurements presented in Table (1) and Fig (1). It shows that all treatments with paclobutrazol gave a marked decrease in length shoot comparing with treatment of spraying promalin only or control. It was ranged between 15.00 cm to 6.73 cm, while spray treatment with promalin only ranged between 51.00 cm to 43.20 cm, and control gave the highest shoot length (61.33 cm). Trees sprayed with 1000 ppm of paclobutrazol only gave the lowest number of nodes (13.86), and least leaf area (12.9 cm2). Leaves dry weight of was affected by spraying paclobutrazol only which gave 15.47 percentage. Data presented in Table (2) illustrates the same growth measurements. Trees sprayed with 1000 ppm paclobutrozal only or 1000 ppm paclobutrazol plus any concentration of promalin gave the least length shoot ranged between 15.43 cm to 8.23 cm. The tallest shoots were for untreated trees 55.76 cm. The effect of spraying 1000 ppm paclobutrazol only on number of nodes has been extensively decreased (14.00 nods) , untreated trees gave the high number of nodes (39.70). Leaf area was affected by spraying with paclobutrazol only or combined with promalin (ranged between 9.47 cm2 to 17.63 cm2. The lowest percentage of dry weight of leaves was 15.53% for trees treated with 1000 ppm paclobutrazol only, while the highest percentage was for trees treated with 600ppm of promalin only (34.87%) Control gave 19.47% of dry weight of leaves. Many reports emphasized a significant reduce on shoot extension growth by application of paclobutrazol (Costa *et al*. 1995 on pear; George *et al*., 1995 on persimmon; Yoshikawa, *et al*., 1988 on peach and Cox, 1991 on geranium). Concerning the best branches, some reports pointed out that promalin at 600 ppm concentration gave suitable branches for Anna apple grafts (Makarem *et al.,* 1990).

Carbohydrate accumulation in leaves

The highest percentage of total carbohydrate were found leaves of trees treated with 1000 ppm of paclobutrazol alone in the two successive seasons (10.647% and 10.086% respectively), while the lowest for Control (6.341% and 6.047%, respectively). Differences of the total carbohydrate percentage of the other treatments were not great and ranged between 6.397% 8.8557% for the first season, and between 6.898% and 8.895% for the second season (Tables 1 and 2 and Fig 1). Okuda, *et al.*, 1996 stated that total carbohydrate were increased in roots and decreased in leaves by the soil application of paclobutrazol for Satsuma mandarin. The same results had been reported by Mehouachi, *et al*. (1996) who mentioned that gibberellins stimulated growth and increased carbon supply in shoots, whereas paclobutrazol delayed growth, reduced sucrose, and enhanced storage sugars, on citrus rootstock seedlings.

Table 1: Effect of Promalin and Paclobutrazol (PBZ) application on shoot length, number of nodes, leaf area, leaves dry weight and total carbohydrate in (1996- 1997) season

Treatments	shoot length (cm)	Number of nodes	Leaf area (cm2)	leaves Dry weight (%)	Total carboh-ydrates (%)
Promalin 200 ppm	50.50	18.51	18.27	32.92	6.397
Promalin 400 ppm	43.20	48.47	24.27	32.69	7.031
Promalin 600 ppm	51.99	48.27	21.53	34.24	7.453
PBZ 1000 ppm	15.00	13.86	12.90	15.47	10.647
Promalin 200 ppm + PBZ 1000 ppm	6.73	16.97	13.17	26.00	7.590
Promalin 400 ppm + PBZ 1000 ppm	8.76	21.00	16.27	29.89	8.857
Promalin 600 ppm + PBS 100 ppm	9.74	20.49	14.90	32.80	8.575
Control	61.33	48.4	26.61	18.80	6.341
L.S.D at 0.05	1.89	0.802	0.932	1.157	0.204

Table 2: Effect of Promalin and Paclobutrazol application on shoot length number of nodes, leaf area, leaves dry weight and total carbohydrates in (1997-1998) seasons

Treatments	shoot length (cm)	Number of nodes	Leaf area (cm2)	leaves Dry weight (%)	Total carbohydrate %
Promalin 200 ppm	49.13	16/53	21.17	32.92	6.898
Promalin 400 ppm	38.23	32.17	29.57	33.34	7.349
Promalin 600 ppm	48.57	33.33	23.63	34.87	7.869
PBZ 1000 ppm	15.43	14.00	9.47	15.53	10.086
Promalin 200 ppm + PBZ 1000 ppm	9.87	17.27	14.37	25.07	7.822
Promalin 400 ppm + PBZ 1000 ppm	8.23	19.30	17.63	30.43	8.895
Promalin 600 ppm + PBZ 1000 ppm	8.23	18.33	12.63	33.47	8.569
Control	55.76	39.70	25.10	19.47	6.047
L.S.D at 0.05	1.21	0.661	0.638	0.643	0.189

Number of spurs per tree

Tables (3 and 4), showed that number of spurs was increased by the application of 1000 ppm paclobutrazol alone or combining with different concentrations of promalin in the two seasons. It is worth mentioning that the lowest number of spurs was for trees treated with 400 ppm of promalin only, followed by untreated trees (control) for the two seasons. The number of spurs per tree increased on treatments spraying with 1000 ppm paclobutrazol alone or combined with any concentration of promalin. These results are in agreement with the results reported by Albert and Aguado (1985) and Buban (1984).

Fig 1: Effect of promalin sprays at different concentrations (0.0, 200, 400 and 600 ppm) and 1000 ppm of paclobutrazol (PBZ) on

shoot length, leaves dry weight and total carbohydrate of leaves at the end of seasons (1996-1997) and (1997-1998).

Yield per tree.

Data recorded in Tables 3 and 4 revealed that yield increased by increasing the number of spurs in the two seasons. The number of fruits per tree treated with paclobutrazol combined with any concentration of promalin was high comparing with the number, for trees treated with any concentration of promalin only. In the first season, the highest yield was for the trees treated with 200 ppm promalin plus 1000 ppm PBZ (10.77 kg/tree), while the lowest one for untreated trees (4.30kg/tree), in the second season, Difference between yield of trees treated with 1000 ppm PBZ only or trees treated with 400 ppm promalin + 1000 ppm PBZ was not significant. The lowest yield for control (4.87 kg/tree) in the same season.

Table 3: Effect of Promalin and Paclobutrazol (PBZ) application on number of fruits and yield per tree (1996- 1997) season

Treatments	No of spurs per tree	Fruit No per tree	Yield kg per tree
-Promalin 200 ppm	47.13	63.33	6.70
-Promalin 400 ppm	39.90	53.67	4.80
-Promalin 600 ppm	65.52	61.33	5.31
-PBZ 1000 ppm	61.37	82.00	9.50
-Promalin 200 ppm + PBZ 1000 ppm	78.43	106.33	10.77
-Promalin 400 ppm + PBZ 1000 ppm	58.69	76.67	6.64
-Promalin 600 ppm + PBZ 1000 ppm	86.63	116.00	9.11
Control	44.43	51.00	4.3
L.S.D at 0.05	1.391	25.51	0.412

Table 4: Effect of Promalin and Paclobutrazol (PBZ) application on spurs, number of fruits and yield per tree (1996- 1997) season

Treatments	No of spurs per tree	Fruit No per tree	Yield kg per tree
-Promalin 200 ppm	52.77	99.67	6.97
-Promalin 400 ppm	41.40	93.00	9.45
-Promalin 600 ppm	66.50	60.67	6.06
-PBZ 1000 ppm	70.43	74.00	10.13
-Promalin 200 ppm + PBZ 1000 ppm	81.33	108.33	9.73
-Promalin 400 ppm + PBZ 1000 ppm	57.30	104.33	10.40
-Promalin 600 ppm + PBZ 1000 ppm	78.37	104.50	9.98
Control	46.90	60.33	4.87
L.S.D at 0.05	2.172	24.67	0.476

It could be concluded from the previous results that PBZ at concentration 1000 ppm plus any concentration of promalin, had a marked effect on number of spurs per tree. Highest yield was recorded for trees, which had high number of spurs in the two seasons. These results were

similar to that of Buban, 1985 and Zaki *et al*., (1989). who found that PBZ increased yield and suppressed shoot growth of apple and pear.

Fruit characters

Data presented in Tables 5 and 6 showed the effect of different treatments on physical and chemical fruit characteristics of Anna apple in the two successive seasons of study.

I. Physical fruit characters.

Fruit weight and size

The weight and size of fruits were clearly affected by spraying 1000 ppm PBZ alone in both seasons, and highly significant as compared with unsprayed trees. It was 1187, gm and 125.47 gm for weight and 116.13 cm3 and 133.03 cm3 for size while , control was 75.27 gm and 89.27 gm for weight and 88.43 cm3 and 101.03 cm^3 for size in 1996/1997 and 1997/1998, respectively.

Fruit dimension

Fruit diameter, height and circumference were affected by all treatments. Data in Tables (5 and 6) showed significant increase of these measures as compared to untreated trees (control).

Fruit firmness

Fruit firmness was decreased by spraying 1000 ppm PBZ only in the two seasons (11.87 and 11.27 pound/in^2 respectively). Untreated trees gave highest values (18.73 and 19.30 pound/in2 respectively), while other treatments gave intermediate values. It is obvious that all treatments significantly different comparing with control in the two successive seasons.

II. Chemical fruit characters

Fruit Juice T.S.S. %

percentage of total soluble solids (T.S.S) indicated light differences between all treatments and control in the two seasons.

Fruit Juice Acidity

Data in tables 5 and 6 cleared that no significant differences in fruit juice acidity % between resulted from all treated and untreated trees (control). The treatment of 1000 ppm PBZ alone gave fruits with good red color comparing with fruits of all other treatment and control.

These results of physical and chemical fruit characters are in line with those of Albert and Aguado, (1985) in apple and Yoshikawa, *et al*., (1988) in peach.

Promalin (a proprietary mixture of 6-benzyaldenine and gibberellic acid $_{4+7}$) at concentrations of 300 to 500 ppm has been reported to stimulate both vegetative and floral budbreak of “Delicious” apple (Shaltout and Unrath, 1983a). Makarem *et al*., 1990 postulated that 600 ppm of promalin gave suitable number of branches. Data of this study also indicated that

promalin at 600 ppm, concentration was effective in stimulating vegetative growth of Anna apple trees in meadow orchards. It has been reported that

benzyladenine affects cell division and cell size in plant tissue (Wismer and Proctor, 1995 on apple) .

On the other hand, the application of paclobutrazaol at 1000 ppm reduced shoot extension growth. This effect occurred when shoot growth had started and were around 10 cm long. These results are in agreement with the findings of Albert and Aguado, 1985; Budan, 1985; Costa *et al*., 1995 and Okuda, *et al*., 1996.

Generally, it could be concluded that spraying promalin at 600 ppm to stimulate the shoot growth of apple trees. After one month, the application of 1000 ppm of paclobutrazol when shoots were 10 to 25 cm long, inhibited shoot growth, and its effect can be reversed on the number of spurs, carbohydrate accumulation and yield.

REFERENCES

Addicott, F.T. and A.B. Addicott (1982): Abbscission. un GA Press Ltd. London, England . P 130-135.

Albert, F.G. and M. T. Aguado (1985): Results of high denisty apple orchards treated with growth retardant in Spain. Acta Horticulturae 179 (C.F cultar-its application in fruits growing 91-94).

A.O.A.C. (1965): Association of official analytical chemists official methods of analysis published by O.A.C. Washington D.C.USA.

Basak, A. and Z. Soczek (1986): The influence of promalin on branching of one- year-old apple nursery trees. Acta Horticulturae 1 (179): 279-280.

Buban, T (1985): Changes in growth properties of young apple trees treated with paclobutrazol, PP 333. Growth regulators in fruits production . Acta Horticulturae 179.

Costa, J.; Basch, M. and . Blanco (1995): Growth and cropping of “Blanquilla” pear trees treated with paclobutrazol. J. Hort. Sci. 70 (3) : 433-443.

Cox, D.A. (1991): Gibberellic acid reverses effects of Excess. Paclobutrazal on Geranium. Hort science 26 (1) : 39-40.

Elfving, D.C.; Lougheed, E.C.; Chu, C.L. and R.A. Cline (1990): Effects of Daminozide, Paclobutrazol and Uniconazole treatments on “Mcintosh” apples at harvest and following storage. J. Amer. Soc. Hort. Sci. 115 (5) : 750 - 756.

George, A.P.; Nissen, R.J.; Collins, R.J. and T.S.Rasmussen (1995): Effects of fruit thinning pollination and paclobutrazal on fruit set and size of persimmon (*Diospyros Kaki* K.) in subtropical Australia. J. Hort. Sci. 70 (3): 477- 484.

Hudson, J.P. (1971) : Meadow orchards. Agriculture 78: 157-160.

Joosse, M.L. (1986): Growth regulator and tree quality: more branching and more profit. Fruitteclt 76 (22): 663-664.

Lever, B.G. and L.C. Luckwill (1985): Cultar-its applicaton in fruit growing. Growth Regulators in Fruit Production Acta Horticulturae. 179 (pp 250).

Lloyd, J. and D.J. Firth (1993): Effect of hydrogen cyanamide and promalin on flowering, fruit set and harvest time of “Flordaprince” peach (prunus persica (L.) Batsch) in subtropical Australia. J. Hort. Scie. 68(2) 177-182.

Luckwills, L.C. (1969) : The control of growth and fruitfulness of apple trees, P 237-254, In : L.C.Luckwill and C.V. Cultting (eds), physiology of tree crops. Academic New York.

Luckwill, L.C. and R.S. Child (1973): The meadow orchard. A new concept of apple production based on growth regulators. Acta Horticulturae, 34: 213-220.

Makarem, M.M; Abdel Aziz, E; El-Fakharani, EM and B. M.Khalil (1990): Effect of Promalin on Anna apple grafts. Egypt\. J. Apple. Sci., 5 (7) : 610-623.

Mehouachi.J; Tadeo, F.R.; zaragoza, S.; Primo-Millo, E. and M. Talon (1996): Effects of gibberellic acid and paclobutrzol on growth and carbohydrate accumulation in shoots and roots of citrus rootstock seedlings. J. Hort. Sci. 71 (5) 747-754.

Okuda, H.; Kihara, T and I.Iwagaki (1996): Effects of paclobutrazol application to soil at the beginning of maturation on sprouting, shoot growth, flowering and carbohydrate contents in roots and leavces of satsuma mandarin. J. Hort. Sci. 71 (5) 785 - 789.

Robert, F.W. (1938) : Colour Chart of Royal Horticuural Society, London.

Shaltout, A.D and C.R. Unrath (1983): Effect of some growth regulators and nutritional compounds as substitutes for chilling of cultivar delicious apple Malus- *Domestica* leaf and flower buds. J.Amer. soc. Hortic. Sci. 1908 (6) 898-901.

Smith, F.; Gilles, M.A. and P.A. Godess (1965) : Colourimetric method for determination of sugar relatd substances Ann. Chem.m 28: 350-60.

Snedecor, G.W. and W.G. Cochran (1990): Statistical methods. 7 th ed The Iowa State. Univ. Pres. Ames. Iowa. USA P. 593.

Wismer, P.T. and J.T.A. Proctor (1995) : Benzyladenne effects cell division and cell size during apple fruit thinning. J. Amer. Hort. Sci. 120 (5) : 820 - 807.

Yoskikawa, F.T.; Mortin, G.C and J.H. Larue (1988) : Chemical growth regulator for peaches . California agriculture, July- August.

Zaki, M.M; Abd El- Aziz, E.; Makarem, M.M.; El-Shekh, A.R. and K.A. khalil (1989) : Effect of paclobutrazol on growth and yield of “Le-Conte” pear trees. Agric. Rese. Rev. 67 (3): 339-346.

Zaki, M.M., Abd El- Aziz, E.; Makarem, M.M.; El- Shekh, A.R. and K.A. khalil (1989): Vegetative growth control and improved yield of “Anna” apple cultivar with growth retardant paclobutrazol. Agr. Res. Rev., 67(3) : 347-352.

J. Agric. Sci. Mansoura Univ., 25 (2), February, 2000.

تـأثير اسـتخدام مـادة البرومـالين ومـادة البكلـوربترازول علـى النمـو والأثمـار فـى أشجار التفاح بالمزارع الكثيفة

بهان محمود خليل
معهد بحوث البساتين - مركز البحوث الزراعية

اجرى هذا البحث خلال موسمى (1997-1996) و (1997 - 1998) على اشجار التفاح الآنا بالمزارع الكثيفة المنزرعة عام 1994 فى ارض رملية مستصلحة بالعاشر من رمضان - محافظة الشرقية
تم رش 30 شجرة فى أول سبتمبر بالبرومالين بتركيزات صفر 200 ،400، 600 جزء فى المليون لتشجيع نمو الأفرع وفى أول أكتوبر رشت نصف الاشجار المعاملة بمادة بكلوبترازول بتركيز 1000 جزء فى المليون .
أدت المعاملة 600 جزء فى المليون من البرومالين واتبعها الرش بمادة الباكلوبترازول بتركيز 1000 جزء فى المليون الى زيادة فى عدد الدوابر للشجرة وبالتالى زيادة فى المحصول بالعدد والوزن.
أدت المعاملة 1000 جزء فى المليون من البكلوبترازول فقط الى تراكم الكربوهيدارات الكلية فى الأوراق .
كانـت أفضـل متوسـط وزن وحجـم للثمـرة فـى المعاملـة بتركيـز 1000 جـزء فـى المليـون مـن الباكلوبترازول فقط مع تلوين للثمار جيد .

*** برومالين : جبرلينات $_{4+7}$ + بنزيل آدنين**
****بكلوبترازول : مادة لتثبيط النمو**

Table 5: Effect of Promalin and Paclobutrazol (PBZ) application on fruit characters in (1996-1997) season.

Treatments	Fruit weight (gm3)	Fruit size (cm)	Fruit diameter (cm)	Fruit height (cm)	Fruit circum (cm)	T..S.S %	Firmness (pound/in2)	Acidity %	Skin colour
Promalin 200 ppm	104.87	118.17	7.1	6.8	19.13	11.47	14.13	0.503	Delft Rose page 108 020/3
Promalin 400 ppm	89.40	98.30	5.2	6.2	15.83	12.00	17.53	0.496	" " "
Promalin 600 ppm	86.57	96.73	5.6	5.9	15.90	12.17	12.57	0.471	" " "
PBZ 1000 ppm	111.87	116.13	7.3	7.2	19.23	12.53	11.87	0.450	Delft Rose page 108 020/1
Promalin 200 ppm + PBZ 1000 ppm	102.67	108.23	6.4	6.5	18.40	11.50	16.93	0.523	Delf Rose page 108 020/2
Promalin 400 ppm + PBZ 1000 ppm	86.63	96.70	6.4	5.8	16.23	12.50	14.97	0,444	" " "
Promalin 600 ppm + PBZ 1000 ppm	78.50	96.67	5.3	5.6	15.17	12.50	12.33	0.495	" " "
Control	75.27	88.43	5.3	5.1	16.47	11.13	18.73	0.512	" " " 020/3
L.S.D at 0.05	2.303	1.576	0.263	0.127	0.172	0.239	0.325	0.011	

Table 6: Effect of Promalin and Paclobutrazol (PBZ) application on fruit characters in (1997-1998) season

Treatment	Fruit weight (m)	Fruit size (cm3)	Fruit diameter (cm)	Fruit height (cm)	Fruit circum (cm)	T..S. S %	Firmness (pound/in2)	Acidity %	Skin colour
Promalin 200 ppm	119.93	123.60	6.3	7.0	20.13	11.87	14.57	0.508	DelftRose page 108 020/3
Promalin 400 ppm	101.57	109.63	6.4	6.4	16.00	12.53	17.77	0.516	" " "
Promalin 600 ppm	99.80	108.50	6.6	6.1	16.07	12.30	1203	0.513	" " "
PBZ 1000 ppm	125.47	103.03	7.4	7.4	19.27	12.37	11.27	0.518	Delft Rose page 108 020/1
Promalin 200 ppm + PBZ 1000 ppm	118.03	124.53	6.7	6.5	18.63	11.60	17.50	0.567	DelftRose page 108 020/2
Promalin 400 ppm + PBZ 1000 ppm	100.00	85.10	6.9	6.0	16.47	12.80	16.03	0.496	" " "
Promalin 600 ppm + PBZ 1000 ppm	101.57	99.30	6.5	5.9	15.33	12.90	13.00	0.493	" " "
Control	89.27	101.03	64	6.6	16.43	11.3	19.30	0.564	" " " 020/3
L.S.D at 0.05	2.448	2.124	0.147	0.128	0.136	0.205	0.220	0.008	

J. Agric. Sci. Mansoura Univ., 25 (2): *987 - 999*, *2000.*