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EFFECT OF SOME SUMMER PRUNING AND PACLOBUTRAZOL TREATMENTS ON SPURS STATE AND FRUIT CHARACTERISTICS OF EL-AMAR APRICOT TREES.

BY

Samera M.Mohamed,[*]; Fayed, T.A.[*], Hussein, A.M.[**] and Safaa M. Maged, [**]

[*] Pomology Department, Faculty of Agriculture, Cairo University
[**] Deciduous Fruits Research Department, Agricultural Research Institute, Agricultural Research Center

ABSTRACT

This study was conducted in Qalubia Governorate (2002-2003/2003-2004), to evaluate the effect of some summer pruning treatments on old branches (two years old or more) [thinning branches (removing $^{1}/_{3}$ branches number) and shortening (topping $^{1}/_{3}$ branches length)] and / or spraying paclobutrazol (PP_{333}) at 1000 ppm in addition to a combination between them, on 15th July and 15th August, besides untreated trees, of El- Amar apricot cultivar as control.. Data showed that the triple-combined treatment (thinning + shortening + PP_{333}) gave the highest significant values recorded for numbers of spurs formed on branches (10.17 and 11.64). Distribution of fruit spurs along the branches in all treatments was highest in the terminal part of the branch followed by the median then the basal part respectively. Yield per tree increased by all the treatments, but the highest yields were obtained from the triple combined treatment in 15 July (7.375 and 8.631) in the two seasons respectively. Fruit physical characters (fruit weight, size and firmness) were significantly increased by the same treatment compared with other treatments and control trees. TSS % was significantly increased but acidity was not affected by all treatments. Chemical analysis revealed a high content of total carbohydrates, C/N ratio, indols and phenols. Generally, all treatments in 15 July were more significant than 15 August.

Key words: *apricots, pruning treatments, summer pruning, paclobutrazol, Cultar, spur formation, endogenous hormones.*

INTRODUCTION

Pruning is one of the most important cultural techniques affecting the quality of apricot fruit (Kuden and Kaska, 1995); and Regular pruning of apricots stimulates shoot and spurs formation (Svoboda, 1996). Summer pruning is a growth reduction procedure (Flore *et al.*, 1992); and Summer pruning of apricot reduces shading within the canopy and stimulates new shoots growth (Jay *et al.*, 1995); it also increases the concentration of growth substances and carbohydrates in shoots of woody plants (Satoh *et al.*, 1977: Yilmas, 1994); it was used as a tool

for increasing spurs formation in apricot trees (Ebied, 2005). Paclobutrazol (pp_{333}), inhibit gibberellin's biosynthesis (Danziel and Lawrence, 1984), is a plant growth regulator used to control the size of fruit trees / growth of field crops (Davies and Carry, 1991). Because of the very strong inhibitory effect on shoot growth in fruit tree; paclobutrazol may enhance crop yield by reducing competition from vegetative growth. In stone fruit orchards, yield was found to increase by paclobutrazol in some studies (Martin *et al.*, 1987: Strydom and Honeyborne, 1986). Also, paclobutrazol decreased shoot length and increased the number of spurs on apricot (Kuden *et al.*, 1995).

MATERIALS AND METHODS

This study was carried out during two successive seasons of 2002/2003 and 2003/2004, on 6-year-old Amar apricot trees budded on apricot seedlings. The trees were planted at 5x5 meters in clay loamy soil at private orchard, in El-Amar village, Kalubia Governorate. The following treatments were applied: summer pruning treatments on old branches (two years old or more) [thinning branches (removing $^1/_3$ branches number), and shortening (topping $^1/_3$ branches length)] and / or spraying paclobutrazol (pp_{333}) at 1000 ppm in addition to a combination between them, on 15th July and 15th August, besides untreated control. Each treatment was replicated three times, where every one represented by nine branches selected and divided into three equal parts in length (terminal, medium and basal).

- Numbers of spurs formed per every selected branch as well as their distribution at different branch parts (terminal, medium and basal) were determined at the end of growing season.
- At the commercials harvesting time of the cultivar, yield / tree in kg was calculated per each treatment (three trees per each treatment). -Ten fruits of each tree were randomly picked and washed with water for determining both physical characteristics (fruit weigh (gm), fruit diameter (cm), fruit length (cm), L/D ratio, fruit size (cm^3) and firmness ($Lb/inch^2$) using pentameter (pressure tester) and chemical characters. fruit juice total soluble solids (TSS%) and total acidity (using a hand refractometer and titration against standard NaOH solution).
- Samples from spurs or buds plus nodal tissues all along branches of each treatment were taken monthly from September 15th till January 15th, they were cleaned and cut into small pieces. A part of each sample was oven dried at 70°C for 48 hours, and (total carbohydrates, nitrogen, C/N ratio, indols and phenols) contents were estimated in the dried samples.
- (Total carbohydrates), was determined according to Smith *et al.* (1956) using the phenol sulphoric acid methods and glucose content was calculated as mg per 100 mg dry weight.
- (Total nitrogen) was determined in samples of 0.5 g dried material by the modified micro-Kjeldahl method mentioned by Pregal (1945).
- (Total indols) P-dimethyl aminobenzaldhyde test (Larsen *et al.*, 1962) and modification of Selim *et al.* (1978), were followed to obtain a stable pink color to be colorimetrically estimated. The concentration was calculated from a standard curve of indoleacetic acid as mg per 100 g dry weight.

- (Total phenols) were determined by using Folin and Ciocalteu colorimetric method (A.O.A.C., 1975). The concentration was calculated from a standard curve of pyrogalol as mg per 100 gm dry weight.
- The obtained data were tabulated and statistically analyzed according to the split plot design (Snedecor and Cochran, 1980). The mean values were compared by using L.S.D method at 5% level. The percentages were transferred to the arcsine to find the binomial percentages according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

1. Spur formation:

1.1. Total No. of spurs per shoot:

Data in Table (1) showed that all treatments significantly increased the number of spurs formed per shoot. The triple combined treatment was more effective in this concern than either double or single ones. The Most effective treatment was the triple combined treatment (thinning + shortening + pp_{333}) (10.17, 11.64) and followed by the double combined treatment (shortening + pp_{333}) (9.060, 10.86) during 1st and 2nd seasons respectively. All treatments applied on July 15th were more effective than on August 15th.

These results agreed with, (Savoboda, 1996) and (Ebied, 2005) on different apricot cultivars.

The superiority of topping over thinning as summer pruning treatments my be due to the effectiveness of former mean rather later one for controlling apical dominance phenomenon i. e., the inhibition of lateral bud growth by auxin emanating from the apical bud (Devlin, 1972). (Nickell, 1982) ascribed the effect of pp_{333} to its retraditional acts by gibberellins production and hence govern vegetative growth.

1.2. Distribution of spurs at shoot parts:

Distribution of spurs at shoot parts (terminal, medium and basal) was affected by all treatments as presented in table (2). Data showed that spurs percentage was higher in the terminal part of the shoot followed by the medium part then the basal part (3.830, 2.070, 0.570) and (4.360, 2.970, 1.030) in the two seasons respectively.

1.3. Yield:

Tables (3, 4) show that yield per tree was significantly affected by all treatments under study compared with the untreated control trees. The highest yield was obtained from the triple combined treatment (thinning + shortening + pp_{333}) (7.375, 8.631 kg) during 1st and 2nd seasons, respectively. Date of treatment also affected the yield, where all treatments applied on July 15th were more effective than the analogous ones on August 15th

These results are in agreement with the data of (Ebied, 2005), (Lichou and Jay, 1996) and (Kuden *et al.*, 1995).

Table (1): Effect of summer pruning and paclobutrazol on total No. of spurs per shoot.

Treatments	Date of treatment	Total No. of spurs / shoot	
		2002-2003	2003–2004
Paclobutrazol	15/7	5.160	7.920
	15/8	4.110	6.390
	Mean	4.620	7.140
Thinning	15/7	3.930	5.730
	15/8	2.850	3.900
	Mean	3.390	4.860
Shorting	15/7	6.660	8.220
	15/8	3.720	6.690
	Mean	5.190	7.470
Paclobutrazol + thinning	15/7	7.680	9.960
	15/8	3.420	5.760
	Mean	5.550	7.860
Paclobutrazol + shorting	15/7	12.18	13.92
	15/8	5.910	7.770
	Mean	9.060	10.86
Thinning+ shorting	15/7	9.390	10.38
	15/8	5.070	6.120
	Mean	7.230	8.250
Paclobutrazol + thinning+ shorting	15/7	13.02	14.52
	15/8	7.290	8.760
	Mean	10.17	11.64
Control		1.320	1.640
General Mean		5.816	7.465
Mean of 15/7		8.288	10.09
Mean of 15/8		4.620	6.480
L.S.D at 0.05			
Treatments(1)		0.9155	0.9886
Date of treatment(2)		0.5231	0.7102
T(1).D(2)		1.6854	1.9687

1.4. Fruit Physical characteristics:

Fruit weigh:

Tables (3, 4) show that fruit weight in all treatments was slightly higher in the second season than in the first one. Generally, the triple combined treatment (thinning + shortening + pp_{333}), gave significantly the heaviest fruits followed in descending order by the double treatments then the single ones. On the other hand application on the earlier date i e July 15th was much more effective than on later date (august 15th)

Fruit size (cm^3):

Tables (3, 4) show that fruit size followed typically the same trend previously detected with fruit weight, where the triple combined treatment (thinning + shortening + pp_{333}) exhibited significantly the greatest fruit size Mean while the earlier date of application (July 15th)was more beneficent than later one (August 15th).

Table (2): Effect of summer pruning and paclobutrazol on spurs distribution along the branches of El-Amar apricot.

Treatments	Date of Treatment	No of spurs per branch							
		2002-2003				2003-2004			
		B	M	T	Mean	B	M	T	Mean
Paclobutrazol	15/7	0.000	1. 900	3.250	1.720	0.000	3.450	4.460	2.640
	15/8	0.000	1 130	2.970	1.070	0.000	2.490	3.890	2.130
	Mean	0.000	1.515	3.110	1.540	0.000	2.970	4.175	2.380
Thinning	15/7	0.000	0.090	3.830	1.310	0.000	3.380	3.340	1.910
	15/8	0.000	0.810	2.040	0.950	0.000	1.300	2.680	1.330
	Mean	0.000	0.450	2.935	1.130	0.000	2.340	3.010	1.620
Shortening	15/7	0.450	2.630	3.590	2.220	1.080	2.850	4.280	2.740
	15/8	0.430	1.000	2.300	1.240	1.000	2.310	3.390	2.230
	Mean	0.440	1.815	2.945	1.730	1.040	2.580	3.835	2.490
Paclobutrazol + thinning	15/7	0.000	1 720	5.950	2.560	0.000	3.990	5.980	3.320
	15/8	0.000	1.340	2.080	1.140	0.000	2.030	3.730	1.920
	Mean	0.000	1.530	4.015	1.850	0.000	3.010	4.855	2.620
Paclobutrazol + shortening	15/7	1.330	4.030	6.830	4.060	2.150	4.970	6.800	4.640
	15/8	0.810	1.880	3.210	1.970	1.700	2.380	3.690	2.590
	Mean	1.070	2.955	5.020	3.020	1.925	3.675	5.245	3.620
Thinning + Shortening	15/7	1.000	2.590	5.810	3.130	2.000	3.800	4.580	3.460
	15/8	0.330	1.740	3.000	1.690	1.520	1.990	2.620	2.040
	Mean	0.665	2.165	4.405	2.410	1.760	2.895	3.600	2.750
Paclobutrazol+ thinning + shortening	15/7	2.310	3.890	6.820	4.340	3.090	4.680	6.760	4.840
	15/8	1.460	2.170	3.670	2.430	1.930	2.500	4.340	2.920
	Mean	1.880	3.030	5.245	3.390	2.510	3.590	5.550	3.880
Control		0.000	0.000	1.010	0.440	0.000	0.500	1.140	0.550
General Mean		0.570	2.070	3.830		1.030	2.970	4.360	
Mean of 15/7		0.730	2.410	5.150	2.760	1.190	3.730	5.220	3.380
Mean of 15/8		0.430	1.440	2.750	1.540	0.880	2.200	3.490	2.190
L.S.D at 0.05									
Treatments(I)				0.5465			0.5933		
Date of treatment(2)				0.2732			0.2966		
Position(3)				0.3346			0.3633		
T(I).D(2)				0.7728			0.8391		
T(I).P(3)				0.99465			1.0276		
D(2).P(3)				0.4732			0.5138		
T(I).D(2).P(3)				1.3385			1.4533		

Fruit firmness (lb/inc^2):

Data concerning fruit firmness revealed similar trend to that of fruit weight (Tables 3, 4) Similarly, Marini (1985), Fathi and Mokhtar (1998) and Ebied (2005), reported that summer pruning increased fruit firmness of peach, apple and apricot respectively

Table (3): Effect of summer pruning and paclobutrazol on yield and fruit characters (1st season):

Treatments	Date of Treatment	Weight Gm	Size Cm3	Firmness (Lb/in2)	Diameter Cm	Length Cm	L/D ratio	T.S.S %	Acidity %	Yield kg / tree
Paclobutrazol	15/7	32.00	31.82	11.91	3.600	3.800	1.056	13.10	0.700	4.000
	15/8	31.50	30.08	10.82	3.500	3.700	1.057	12.60	0.900	3.820
	Mean	31.75	30.95	11.37	3.550	3.750	1.057	12.85	0.800	3.910
Thinning	15/7	30.58	29.91	10.50	3.400	3.600	1.059	12.50	0.800	3.500
	15/8	29.98	29.00	10.00	3.300	3.600	1.090	12.00	0.900	3.000
	Mean	30.28	29.46	10.25	3.350	3.600	1.074	12.25	0.850	3.250
Shortening	15/7	33.63	32..43	12.04	3.700	3.900	1.054	14.11	0.700	4.820
	15/8	32.35	32.96	11.36	3.600	3.700	1.027	13..80	0.800	4.110
	Mean	32.99	32.70	11. 70	3.650	3.800	1.040	13.96	0.750	4.470
Paclobutrazol + thinning	15/7	35.81	34.22	11.82	3.900	4.000	1.025	14.60	0.600	5.080
	15/8	34.12	33.11	11.31	3.800	3.900	1.026	14.50	0.800	4.500
	Mean	34.97	33.67	11.57	3.850	3.950	1.026	14.55	0.700	4.790
Paclobutrazol + shortening	15/7	38.90	37.80	12.48	4.400	4.600	1.045	15.90	0.500	6.200
	15/8	36.98	35.21	12.00	4.300	4.400	1.023	15.00	0.700	5.500
	Mean	37.94	36.50	12.24	4.350	4.500	1.034	15.45	0.600	5.850
Thinning +shortening	15/7	36.61	35.63	12.31	4.100	4.200	1.024	15.30	0.600	5.410
	15/8	35.30	35.26	12.11	3.669	4.090	1.114	15.24	0.729	5.400
	Mean	35.96	35.44	12.21	3.884	4.145	1.069	15.27	0.664	5.405
Paclobutrazol + thinning + shortening	15/7	43.48	42.93	13.5	4.700	4.800	1.021	16.70	0.300	8.500
	1518	39.84	37.95	12.3	4.540	4.555	1.003	15.23	0.535	6.250
	Mean	41.66	40.44	12.9	4.620	4.678	1.012	15.86	0.418	7.375
Control		27.99	26.90	10.0	2.900	3.100	1.068	11.60	0.800	2.210
General Mean		34.19	33.26	11.5	3.769	3.940	1.048	13.90	6.988	4.658
Mean of 15/7		35.86	34.96	12.0	3.971	4.129	1.040	14.60	0.600	5.359
Mean of 15/8		34.30	33.38	11.41	3.816	3.992	1.049	14.02	0.766	4.654
L.S.D at 0.05										
Treatments(1)		1.1860	1.0660	0.7860	0.1860	0.1860		0.0860		0.5487
Date of treatment(2)		0.8421	0.7421	0.5421	0.1421	0.1421	N.S*	0.0421	N.S*	0.3489
T(1).D(2)		1.9671	1.1671	0.9671	0.5671	0.4671		0.6671		1.0162

N.S.* = Not significant.

While on the contrary, Francisconi *et al.* (1996) mentioned that summer pruning had no effect on fruit firmness of peach.

Fruit diameter and length (cm):

Also, Tables (3, 4) show that fruit diameter and length were affected by the triple combined treatments than the other double or single ones during the 1st and 2nd seasons (3.769, 3.940) and (3.900, 4.079) respectively.

Table (4). Effect of summer pruning and paclobutrazol on yield and fruit characters (2nd season):

Treatments	Date of Treatment	Weight Grn	Size Cm3	Firmness (Lb/in2)	Diameter Cm	Length Cm	L/D ratio	T.S.S %	Acidity %	Yield kg/tree
Paclobutrazol	15/7	33.71	32.81	12.50	3.700	3.900	1.054	14.50	0.700	6.000
	15/8	32.15	31.34	11.89	3.600	3.800	1.056	13.20	0.800	4.071
	Mean	32.93	32.08	12.20	3.650	3.850	1.055	13.85	0.750	5.035
Thinning	15/7	31.00	30.01	13.13	3.500	3.700	1.057	13.50	0.700	5.000
	15/8	30.03	29.81	11.31	3.400	3.600	1.059	13.20	0.800	4.500
	Mean	30.51	29.91	12.22	3.450	3.650	1.058	13.35	0.750	4.750
Shortening	15/7	34.60	33.71	13.50	3.800	3.900	1.026	16.10	0.600	6.180
	15/8	33.31	32.42	12.32	3.700	3.800	1.027	14.50	0.700	5.450
	Mean	33.96	33.07	12.91	3.750	3.850	1.027	15.30	0.650	5.815
Paclobutrazol + thinning	15/7	36.00	35.40	13.00	4.000	4.200	1.050	16.50	0.500	6.330
	15/8	35.11	34.90	12.58	3.900	4.000	1.027	15.90	0.600	5.410
	Mean	35.56	35.15	12.79	3.950	4.100	1.039	16.20	0.550	5.870
Paclobutrazol + shortening	15/7	39.20	38.18	13.36	4.500	4.700	1.044	17.30	0.500	7.820
	15/8	37.01	36.62	13.10	4.400	4.500	1.022	16.00	0.600	6.990
	Mean	38.10	37.40	13.23	4.450	4.600	1.033	16.65	0.550	7.405
Thinning + shortening	15/7	36.98	35.81	13.58	4.300	4.500	1.047	16.00	0.500	6.500
	15/8	35.40	35.40	12.03	3.809	4.329	1.137	16.13	0.608	5.025
	Mean	36.19	35.60	12.81	4.054	4.414	1.092	16.07	0.554	5.762
Paclobutrazol + thinning + shortening	15/7	44.58	43.56	14.00	4.900	5.000	1.020	17.32	0.300	9.590
	15/8	40.33	39.32	13.63	4.698	4.735	1.008	15.56	0.521	7.673
	Mean	42.46	41.44	13.81	4.799	4.868	1.014	16.43	0.410	8.631
Control		28.91	28.00	11.12	3.100	3.300	1.064	12.50	0.700	3.300
General Mean		34.82	34.08	12.63	3.900	4.079	1.048	15.04	0.614	5.821
Mean of15/7		36.58	35.64	13.30	4.100	4.271	1.042	15.89	0.542	6.774
Mean of 15/8		34.76	34.26	12.40	3.930	4.109	1.048	14.92	0.661	5.588
L.S.D at 0.05										
Treatments(1)		1.1063	1.0684	0.8594	0.3954	0.3651	N.S*	0.0897	N.S*	0.5964
Date of treatment(2)		0.8972	0.7986	0.6421	0.2546	0.2485		0.0512		0.4103
T(1).D(2)		1.9865	1.1543	0.9985	0.6548	0.5328		0.6983		١,١٥٨٧

N.S.* = Not significant.

L/D ratio:

Tables (3, 4) also show that L/D ratio was not affected by all treatments under study compared with untreated control trees in the two seasons.

1.5. Fruit chemical characteristics:

Data in Tables (3, 4) reveal that fruit juice TSS % was affected by all treatments under study and the highest TSS % was exhibited in fruits of the triple combined treatment (thinning + shortening + pp_{333}) during two seasons. In addition, application on July 15th was more effective than on 15/8 for all treatments.

Fruit juice of total acidity was not affected by all treatments under study Similarly, Chun and Lee (1989) found that application of pp_{333} did not significantly affect total acidity in peach.

3.2. Chemical contents of spurs or buds plus nodal tissues:

Spurs or buds plus nodal tissues of control and treated trees were analyzed for determination of (total carbohydrates, nitrogen, C/N ratio, indols and phenols).

Total carbohydrates (fig. 1), nitrogen (fig. 2), C/N ratio (fig. 3), indols (fig. 4) and phenols (fig. 5) were significantly increased in spurs of treated trees; meanwhile total nitrogen tended to decrease in spurs of the treated trees compared with the untreated control trees. In this respect, (Yilmaz, 1994: Satoh *et al.*, 1977) found that summer pruning increases the concentrations of growth substances and carbohydrates in shoots of woody plants. On the other hand, Maczulajtys *et al.* (1994) found that summer pruning reduced carbohydrates accumulation in sweet cherry leaves. In conclusion, it appeared that high total carbohydrates, C/N ratio, indols and phenols besides low total nitrogen, may favour the production of fruit spurs on El-Amar apricot trees. Therefore, the treatments that could drive the chemical content in this direction may stimulate formation of fruiting spurs.

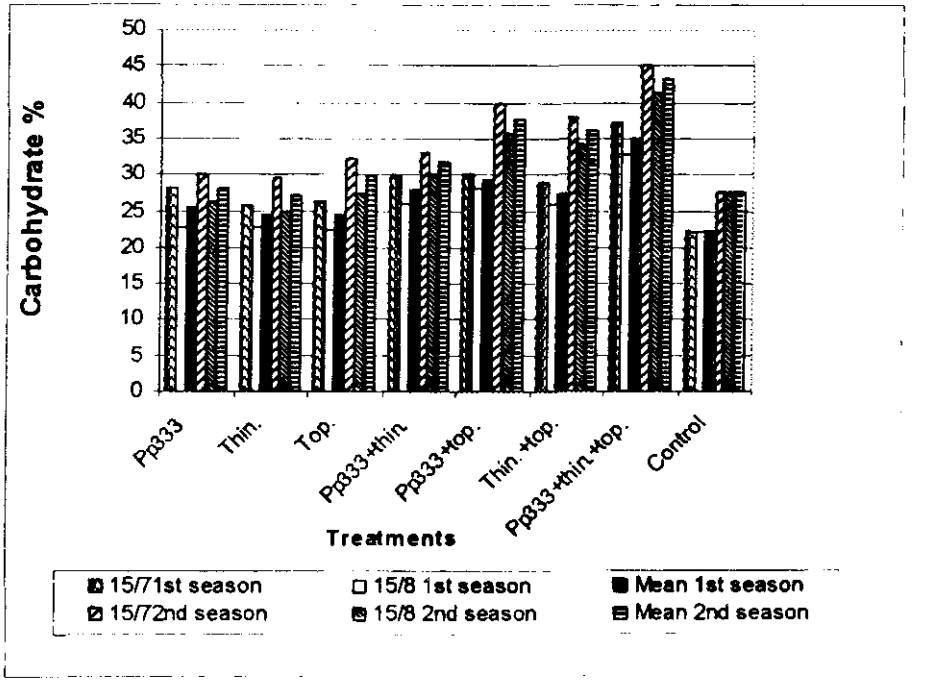

Fig. (1): Effect of summer pruning and paclobutrazol on carbohydrate accumulation in spurs during two successive experimental 2002-2003 and 2003-2004 seasons (as an average of 5 sampels).

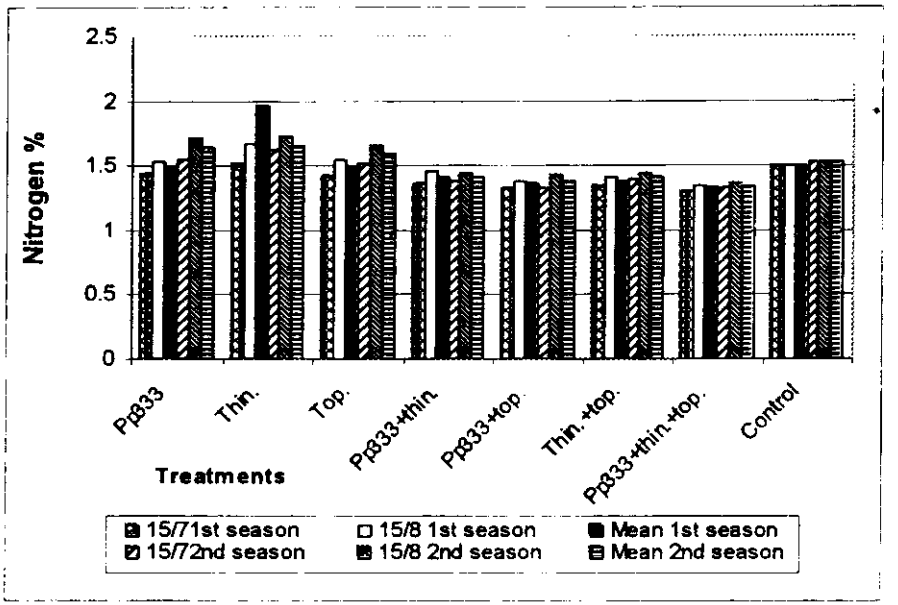

Fig. (2): Effect of summer pruning and paclobutrazol on nitrogen accumulation in spurs during two successive experimental 2002-2003 and 2003-2004 seasons (as an average of 5 sampels).

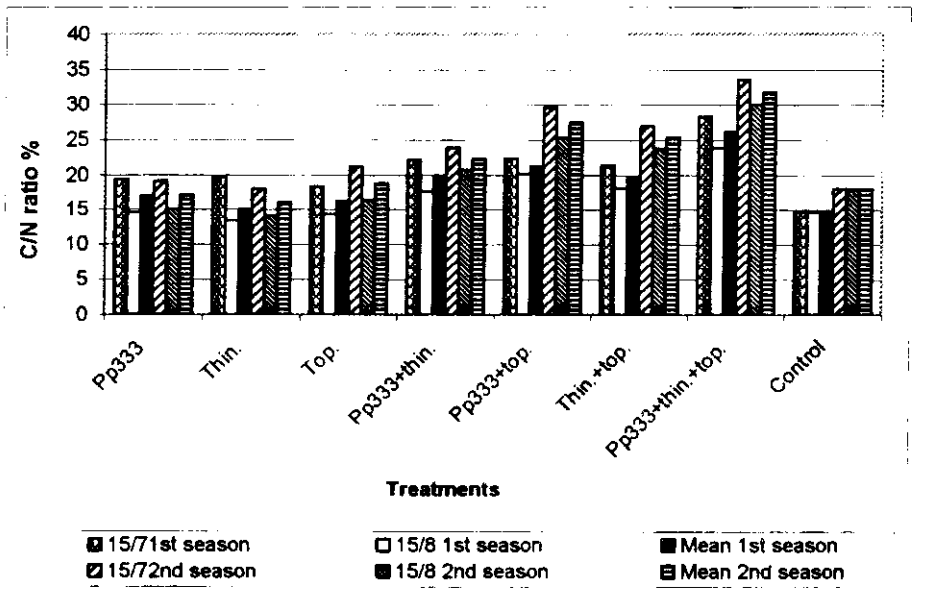

Fig. (3): Effect of summer pruning and paclobutrazol on C/N ratio accumulation in spurs during two successive experimental 2002-2003 and 2003-2004 seasons (as an average of 5 sampels).

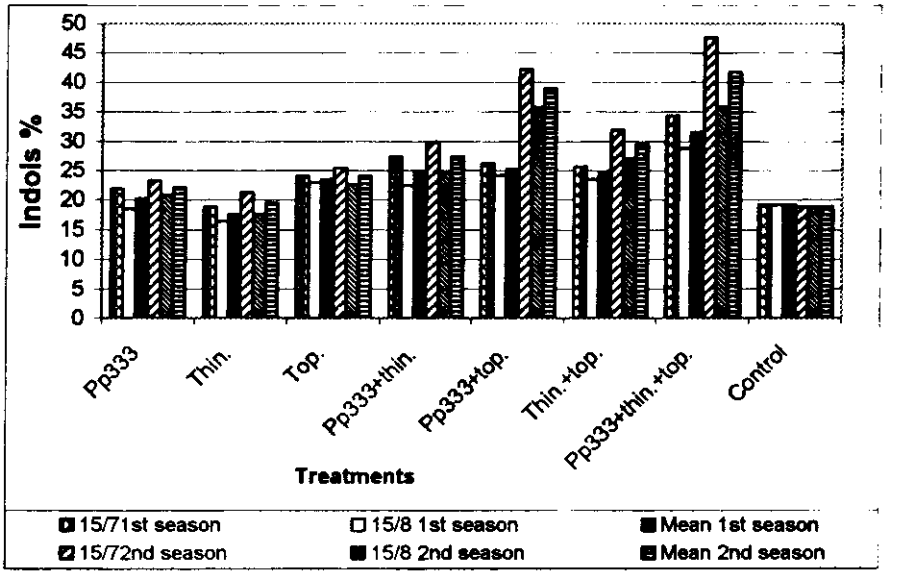

Fig. (4). Effect of summer pruning and paclobutrazol on indols accumulation(mg/100g) in spurs during two successive experimental 2002-2003 and 2003-2004 seasons (as an average of 5 sampels).

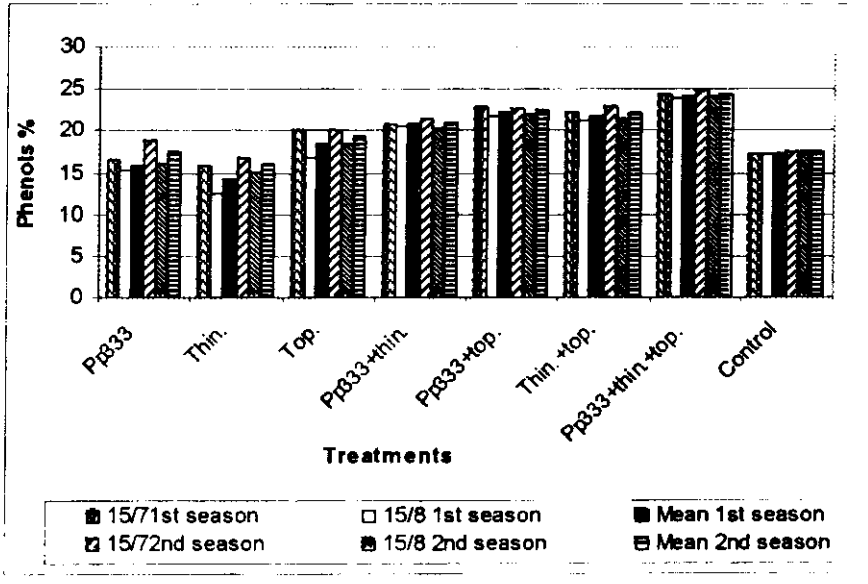

Fig. (5): Effect of summer pruning and paclobutrazol on phenols accumulation in spurs during two successive experimental 2002-2003, 2003-2004 seasons (as an average of 5 sampels) .

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تأثير بعض معاملات التقليم الصيفي و الرش بالباكلوبترازول على حالة الدوابرو الصفات الثمرية لاشجار مشمش العمار.

سميرة منصور محمد*، طارق عبد العليم فايد*، عاطف معتمد حسين، صفاء محمد ماجد****

* قسم الفاكهة - كلية الزراعة - جامعة القاهرة

** قسم بحوث الفاكهة متساقطة الاوراق - معهد بحوث البساتين - مركز البحوث الزراعية

تم اجراء هذا البحث خلال موسمين ٢٠٠٢/٢٠٠٣ - ٢٠٠٣ /٢٠٠٤ على اشجار مشمش العمار عمرها ٦ سنوات و مطعومة على اصل مشمش بذرى .

اجريت معاملات التقليم الصيفى و هى خف افرع (إزالة $^{1}/_{3}$ عدد الأفرع)، تقصير (ازالة $^{1}/_{3}$ طول الفرع) مع او بدون الرش بالباكلوبترازول (١٠٠٠ جزء فى المليون) سواء فى معاملات منفردة او فى معاملات مركبة على افرع عمر سنة و ذلك بغرض تحفيز تكوين دوابر ثمرية . وقد اظهرت النتائج ما يلى :

١ – ان المعاملة المركبة الثلاثية (الخف + التقصير + الرش بالباكلوبترازول) اعطت اعلى نتائج معنوية فى تكوين الدوابر الثمرية مقارنة بالمعاملات الفردية و المزدوجة .

٢ – اما بالنسبة لتوزيع الدوابر على الافرع فكانت اعلى نسبة للدوابر على الجزء الطرفى للفرع ثم الوسطى ثم القاعدى بالتوالى وذلك فى جميع المعاملات .

٣ – كان لميعاد المعاملات تأثير هام حيث لوحظ ان المعاملات التى اجريت فى ١٥ يوليو كانت افضل فى جميع النتائج من ١٥ اغسطس .

٤ – المعاملة الثلاثية اعطت اعلى محصول (٧,٣٧٥ و ٨,٦٣١) فى الموسمين مقارنة بالمعاملات الاخرى.

٥ – اوضح تحليل الثمار ان الصفات الفيزيائية (وزن الثمار و حجم الثمار و الصلابة) زادت بدرجة معنوية بالمعاملة الثلاثية، اما % TSS و الحموضة اثرت المعاملة الثلاثية فى% TSS و لكن لم تتأر الحموضة باى معاملة.

٦ – اتضح من التحليل الكيماوى زيادة كل من الكربوهيدرات و نسبة الكربون للنيتروجين و الاندولات و الفينولات بالإضافة إلى انخفاض كمية النيتروجين.

عامة : اتضح من الدراسة ان المعاملة الثلاثية (الخف + التقصير + الرش بالباكلوبترازول) فى ١٥ يوليو الافضل فى تحفيز تكوين الدوابر الثمرية بالاضافة الى تأثيرها على زيادة جودة الثمار من حيث الوزن، الحجم و محتوى الثمار من المواد الذائبة الكلية.