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INFLUENCE OF SUMMER PRUNING ON GROWTH, FRUIT SET AND FRUIT QUALITY OF ANNA APPLE TREES

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Abstract

The effect of summer pruning and shoot topping in April, May or June on Anna apple (*Malus domestica* Borkh.) trees/M.M. 106 were studied through 1995/96 seasons to investigate the response on growth rate, leaf mineral content, productivity, fruit characters, and fruit mineral content. The growth rate of shoot length, number of shoots, leaf area, and dry matter increased after summer pruning and shoot topping. Also, the leaves of pruned trees accumulated much more nutrient elements (N, P, K). Productivity parameters (percentage of fruit set, number of spurs in one meter of a main scafold, and spurs' number per pruned tree apparently increased with pruning treatments. Pre-harvest fruit abscission significantly decreased, may be as a result of raising the level of potassium in both leaf and fruit. Although the number of mature fruits per tree decreased, fruit quality characters (fruit weight, volume, fimness, total soluble solids (TSS), acidity and TSS/ratio), and fruit nutrient elements content (N,P,K, Ca) increased. The influence of summer pruning was found to be linearly related to its severity (the length of removed shoot). However, pruning in May was better than in April or June.

INTRODUCTION

Interest in summer pruing of fruit trees increased in recent years due to the need for additional means of growth control when dwarfing rootstocks do not control tree size adequately in intensive orchards. Excessive tree crowding caused by vigorous intensive vegetative growth reduces fruit quality and increases pruning and pesticide requirements (Marini, 1985). There are three objectives for which summer pruning can be used as a cultural practice in Pome fruits. 1) to improve fruit colour and quality; 2) to regulate growth and control vigor, and 3) to reduce pest and disease problems (Forshey, *et al.*, 1992).

Plant responses to summer pruning may be dependent upon several factors

i.e. the time of pruning, the type of pruning cut, geographical location, and upon tree vigor (Marini and Barden, 1982). Topping and summer pruning were found to increase shoot length, leaf surface area (Kilany, 1982; Lord and Doman, 1983) and shoot number of different apple and pear cultivars (Myer and Ferree, 1983; Forshey and Marmo, 1984).

Summer pruning of apple trees changed the pattern of dry matter distribution (Mika *et al.*, 1983), and increased leaf dry weight (Stephen and Ferree, 1986); leaf mineral content (Taylor and Ferree, 1986); number of spurs of main scafold; and spurs number per treated pear tree (Nasr, 1996). Moreover, Verga and Borsboon (1970) noticed that topping the shoots of "Comice" pear trees to 6-8 leaves per shoot, improved fruit set, while fruit set of "Jersymac" apple trees increased as a result of summer pruning in June (25%) or in July+August (24%) compared with unpruned control (14%) (Ferree and Stang, 1980). On the same line, Guignebault *et al.* (1990) and Saleh (1991) stated that increasing the level of pruning decreased number of fruits but increased individual fruit weight, diameter and firmness. Contrary, Kilany (1982) and Saleh (1991) pointed out that shoot topping had no effect on acidity, total sugars or T.S.S. /acid ratio of pear fruit; while increased fruit mineral content (Taylor and Ferree, 1986 and Nasr, 1996). Furthermore, Forshey, *et al.* (1992) found that removal of shoots by summer pruning has improved fruit calcium content and reduced the incidence of calcium related disorders in both apple and pear trees, with the influence of timing, severity and type of summer pruning cuts.

The aim of this investigation was to study the effect of summer pruning on vegetative growth of Anna apple trees as well as fruit quality parameters through shoot topping or removing half of new shoot length at the first of April, May, or June of 1995 and 1996 seasons.

MATERIALS AND METHODS

This study was conducted through 1995 and 1996 seasons, on Anna apple trees at El-Kanater Experimental Station. The trees were 6 years-old, grafted on Malling Merton 106 (MM 106) rootstock and cultural practices were carried out as usual.

Two levels of summer pruning were practiced at 1st of April, May or June;1) Shoot topping or 2) Removing half of the shoot length. Each treatment was repre-

sented by three replicates with three trees each, while control trees were unpruned.

The growth rate parameters (shoot length, shoot number, and leaf area) were measured on March 1st and November 1st, while leaf dry matter and leaf mineral content (N,P,K) were assessed at the mid of August. Number of spurs in one meter of main scafold, spurs number/tree, and percentage of fruit set were calculated. Fruit quality parameters (fruit weight, volume, and firmness, total soluble solids (T.S.S), acidity, and T.S.S./acid ratio) were estimated at harvest time. Also, fruit mineral contents (N,P,K and Ca) were determined. Data were statistically analysed according to Snedecor and Cochran (1990), and L.S.D. test was used for comparison between treatments. Also, the relationship between leaf dry weight, fruit abscission and firmness with leaf nitrogen, fruit potassium and calcium content, respectively were illustrated by regression and correlation coefficients.

RESULTS AND DISCUSSION

1- Growth rate and leaf mineral content :

The growth rate as a shoot length, shoot number, leaf area, and dry matter of Anna apple trees/MM 106 increased as a response to summer pruning and shoot topping treatments especially in May followed by April then June. In this respect, removing half of the shoot length was significantly more effective than topping (Table 1). Moreover, leaf mineral content (N,P,K) support and amplify this phenomenon where leaves succeded to accumulate more nitrogen, phosphorus, and potassium as a result of summer pruning treatments (Table 2). There was also a linear relationship between leaf dry weight and nitrogen content with high correlation coefficient r2=0.894 (Fig. 1). Other workers confirmed these findings by revealing that different severeties of summer pruning increased shoot length of apple and pear cultivars (Kilany, 1982), shoot number of "Mcintosh" apple (Myer and Ferree, 1983; Forshey and Marmo, 1984; Nasr, 1996); and leaf size of "Leconte" pear (Kilany, 1982); while Mika, *et al.* (1983) disclosed that summer pruning of apple trees changed the pattern of dry matter distribution but did not decrease the total content or slightly increased it (Nasr, 1996). In addition, the main nutrient elements (N,P,K) were found to be linearly related to the growth parameters (Taylor and Ferree, 1986; Nasr, 1996). Furthermore, some other investigators stated that early summer pruning of "Delicious" (Lord and Doman, 1983) and "Mcintosh" apple cultivars (Forshey and Mermo, 1984) had resulted into 20% more total growth extension than

Table 1. Shoot length and number, leaf area and dry matter of Anna apple as affected by summer pruning.

Months (A)	Pruning severity (B)	Shoot Length (cm) Seasons (C)			Shoot Number			Leaf Area (cm2)			Dry Matter (%)		
		95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)
	0	17.3	19.5	18.4	1.67	1.78	1.73	34.2	47.1	45.2	56.2	59.4	57.8
April	Topping	22.8	23.7	23.3	2.45	2.31	2.38	47.8	49.2	48.5	58.1	59.8	59.0
	Half	30.1	30.4	30.3	1.21	1.19	1.20	59.2	56.2	57.7	66.2	69.5	67.9
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		23.4	24.5	24.0	1.78	1.76	1.77	50.1	50.8	50.5	60.2	62.9	61.6
	0	17.3	1.95	18.4	1.67	1.78	1.78	43.2	47.1	45.2	56.2	59.4	57.8
May	Topping	25.4	27.6	26.5	2.52	2.39	2.46	53.2	50.9	51.1	61.3	60.2	60.8
	Half	33.9	31.6	32.8	1.62	1.49	1.56	61.3	59.1	60.2	69.4	68.8	69.1
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		25.5	26.2	25.9	1.94	1.89	1.92	51.9	52.4	52.2	62.3	62.8	62.2
	0	17.3	19.5	18.4	1.67	1.78	1.73	34.2	47.1	45.2	56.2	59.4	57.8
June	Topping	19.6	20.1	19.9	2.07	2.11	2.09	50.1	51.7	50.9	60.9	61.6	61.3
	Half	26.9	26.3	26.6	1.56	1.42	1.49	6.2	60.9	61.6	68.2	69.4	68.8
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		21.3	22.0	21.6	1.77	1.77	1.77	5.18	53.2	52.6	61.8	63.5	62.2
June	Topping	17.3	19.5	Ave.b	1.67	1.78	Ave.b	43.2	47.1	Ave.b	56.2	59.4	Ave.b
	Half	22.6	23.8	18.4	2.35	2.27	1.78	49.7	50.8	45.4	60.1	60.5	57.8
		30.3	29.4	23.2	1.46	1.37	2.31	60.9	58.7	50.2	57.9	59.2	60.3
Ave. (A*C)		23.4	24.2	29.9	1.83	1.81	1.42	51.3	52.1	59.8	61.4	63.0	58.6
				-			-			-			-

L.S.D. at 5%				
Months (A)	7.4	0.43	4.3	4.89
Pruning severity (B)	7.5	0.56	6.2	6.2
Inter. (A*B)	7.8	0.71	6.8	7.1

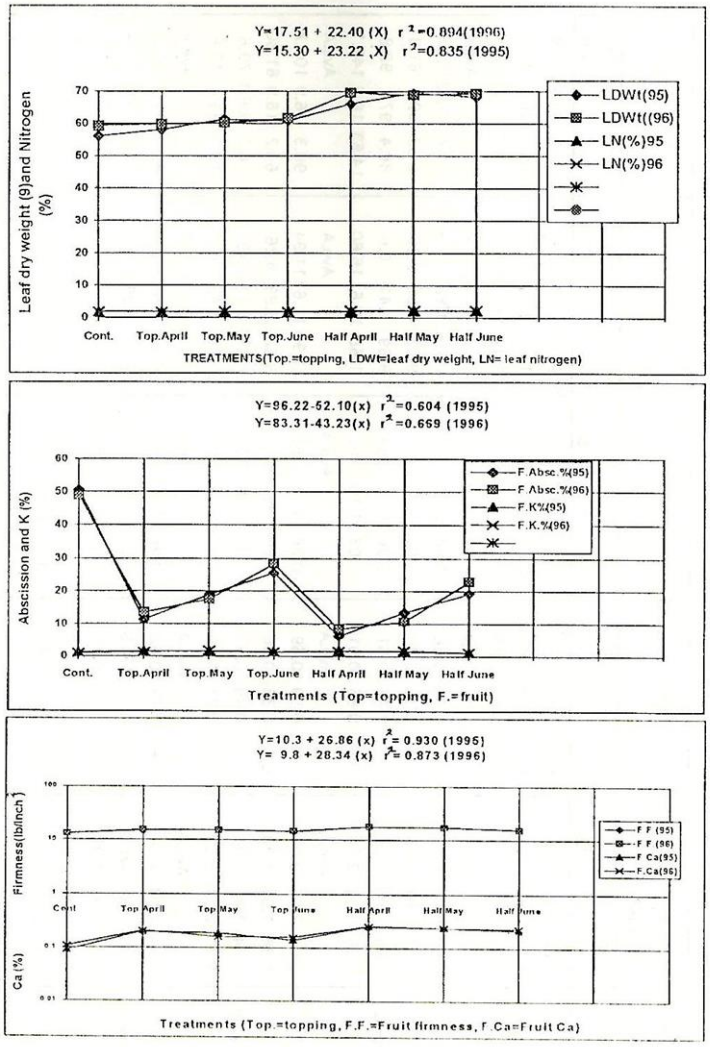

Fig. 1. Regression and correlation coefficients of leaf dry weight, fruit abscission and fruit firmness on leaf nitrogen, fruit potassium and calcium content, respectively.

Table 2. Leaf nitrogen, phosphorus, and potassium as well as number of spures per shoot or tree of Anna apple as affected by summer pruning.

Months (A)	Pruning severity (B)	N (%) Season (c)			P (%)			K (%)			Spurs/shoot			Spurs/Tree		
		95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)
April	0	1.88	1.91	1.90	0.31	0.38	0.36	0.89	0.92	0.91	9.62	8.89	9.26	6.42	69.4	61.8
	Topping	1.92	1.93	1.93	0.41	0.39	0.40	0.93	0.91	0.92	1.22	9.64	9.93	9.2	86.1	90.2
	Half	2.06	2.21	2.14	0.96	0.85	0.93	1.01	1.02	1.12	1.42	13.92	14.07	164.7	17.2	168.4
				Ave.A			Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		1.96	2.02	1.99	0.66	0.66	0.66	0.94	0.96	0.96	11.36	1.82	11.09	10.4	109.2	106.7
May	0	1.88	1.91	1.90	0.31	0.38	0.36	0.85	0.92	0.91	9.62	8.89	9.26	64.2	69.4	61.8
	Topping	1.89	1.96	1.93	0.66	0.46	0.61	0.96	0.96	0.96	9.69	1.41	10.6	88.4	97.1	92.8
	Half	2.36	2.32	2.34	0.88	0.93	0.91	1.03	1.16	1.02	1.68	16.61	16.60	14.63	16.6	149.1
				Ave.A			Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		2.04	2.06	2.06	0.68	0.59	0.69	0.96	0.96	0.96	11.90	11.67	11.94	96.3	16.9	101.2
June	0	1.88	1.91	1.90	0.31	0.38	0.36	0.89	0.92	0.91	9.62	8.89	9.26	64.2	16.9	61.80
	Topping	1.84	1.87	1.91	0.62	0.49	0.61	0.98	0.89	0.94	1.62	1.17	10.36	76.2	106.1	79.8
	Half	2.31	2.34	2.33	0.64	0.71	0.69	1.02	1.03	1.03	1.29	1.45	14.84	13.3	89.4	13.6
				Ave.A			Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		2.04	2.04	2.04	0.60	0.63	0.62	0.96	0.96	0.96	11.81	11.16	11.48	87.1	83.2	90.6
June	Topping	1.88	1.91	Ave.B	0.31	0.38	Ave.B	0.89	0.92	Ave.B	9.62	8.89	Ave.B	64.2	126.1	Ave.A
	Half	1.82	1.92	1.90	0.60	0.46	0.35	0.96	0.92	0.91	10.14	10.07	9.26	86.9	22.9	61.8
		2.48	2.29	1.92	0.84	0.84	0.47	1.02	1.02	0.94	16.29	14.97	10.11	147.6	69.4	87.4
Ave. (A*C)		2.01	2.04	2.27	0.66	0.66	0.84	0.96	0.46	1.02	11.68	11.31	16.4	96.9	88.8	14.93
				-			-			-			-			-

L.S.D. at 5%					
Months (A)	0.15	0.12	0.11	1.02	3.5
Pruning severity (B)	0.23	0.14	0.09	1.52	4.6
Inter. (A*B)	0.26	0.21	N.S.	2.14	7.8

unpruned trees while pruning in July or August caused less total growth extension .

2- Productivity, fruit quality and mineral content :

The present results through the two seasons of study show an apparent trend in the response of Anna apple trees to different severities and time of pruning. The percentage of fruit set, number of spurs in one meter of a main scafold, and number of spurs per tree increased on pruned than on unpruned trees. However, pruning in May gave the best results followed by April in some cases and by June in others (Table 3). Moreover, these parameters have been improved by removal of half the shoot length than shoot topping, this could be due to the influence of water and nitrogen supply to the remaining wood but not from increased photosynthate resources (Saleh, 1991). Furthermore, there are significant decrease in pre-harvest fruit abscission especially with severe summer pruning, probably due to the effect of raising the level of potassium in leaf and fruit (Tables 2 & 5 and Fig.1), while early pruning gave better results. Although there is significant reduction in number of fruits per pruned trees, all fruit quality characters were improved (Table 4). Also, fruits on pruned trees accumulated nutrients (N,P,K and Ca) much more than in the control (Table 5). This was reflected in better fruit weight, volume, firmness, T.S.S., acidity, T.S.S./ acid ratio, and linear relationship between fruit fimness and its calcium content with high correlation coefficient r2 = 0.930 (Fig. 1).

Several investigators considered topping and summer pruning an effective factor in improving flower bud formation and fruit quality (Utarmark, 1977; Mika *et al.*, 1983; Marini, 1986; Nasr, 1996) especially fruit set of "Jersymac" apple (Ferree and Stany, 1980), fruit weight and diameter of apple and pear (Kilany, 1982; Taylor and and ferree, 1984; Guignebault *et al.*, 1990; Saleh, 1991) and firmness (Marini, 1985; Nasr, 1996). This could possibly be due to the improvement of fruit calcium content (Preston and Perring, 1974; Forshey, *et al.*, 1992; Nasr, 1996). Also, summer pruning reduced the incidence of bitter pit and storage disorders, especially flesh breakdown (Preston and Perring, 1974; Utermark, 1977; Marini and Borden, 1982) while raised the level of potassium (Taylor and Ferree, 1986) sugar and titratable acidity (Nasr, 1996).

Table 3. Fruit set, abscission, total soluble solids/acidity and fruits number/tree of Anna apple as affected by summer pruning.

Months (A)	Pruning severity (B)	Fruit Set (%) Season (C)			Fruit Abscission (%)			Fruits/Tree			T.S.S. / Acidity		
		95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)
April	0	7.46	8.34	7.90	60.6	48.9	98.7	1427	1332	1380	37.4	30.9	43.2
	Topping	8.11	8.66	8.33	11.3	13.6	12.6	1003	996	1000	49.7	63.7	61.4
	Half	12.86	11.91	12.39	6.2	8.6	7.3	784	896	740	65.6	47.9	63.7
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		9.84	9.06	9.64	22.7	29.9	23.2	1071	1008	1040	48.8	44.0	48.4
May	0	7.48	8.34	7.70	60.6	48.9	48.7	1427	1332	1380	37.4	30.9	34.2
	Topping	8.08	7.98	8.01	18.9	17.6	18.2	1124	1106	1118	48.2	43.9	44.8
	Half	13.91	12.81	18.38	13.8	10.8	12.2	914	932	828	47.8	60.8	45.2
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		9.80	9.71	9.76	27.7	26.7	28.7	1166	1123	1139	72.7	41.7	42.7
June	0	7.48	8.34	7.70	60.8	28.9	49.7	1427	1332	1380	37.4	30.9	34.2
	Topping	8.13	8.47	8.26	26.6	28.4	27.0	1302	1221	1292	44.8	40.0	42.4
	Half	12.64	12.70	12.82	19.2	28.9	21.1	1284	1217	1241	44.9	44.7	44.8
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		9.38	9.80	9.63	31.8	39.4	32.6	1331	1267	1294	42.4	38.6	40.6
June	0	74.6	8.34	Ave.B	60.6	48.9	Ave.B	1427	1332	Ave.B	37.4	30.9	Ave.B
	Topping	8.09	8.30	7.90	18.8	19.8	48.7	1143	1108	1380	48.9	46.6	34.2
	Half	13.10	12.47	8.20	13.0	14.0	19.8	987	948	1120	46.8	47.8	42.2
		9.98	9.70	12.79	27.4	27.0	18.8	1186	1129	988	46.0	41.4	43.2
Ave. (A*C)				-			-			-			-

L.S.D. at 5%				
Months (A)	0.76	1.4	46	4.6
Pruning severity (B)	1.21	2.5	67	6.2
Seasons (C)	--	--	--	--
Inter. (A*B)	3.01	4.6	74	6.2
" (BxC)	--	5.2	21	--
" (A x C)	--	6.2	89	--

Table 4. Fruit weight, volume, firmness, total soluble solids (TSS), and acidity of Anna apple trees as affected by summer pruning.

Months (A)	Pruning severity (B)	Fruit Weight (g.) season (c)			Fruit volume (cm3)			Fruit fommess (bs/sc.inch)			Fruit T.S.S. (%)			Fruit Acidity (%)		
		95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)
April	0	86.1	86.3	86.7	71.2	78.3	74.8	13.2	12.9	13.1	7.86	7.42	7.64	0.21	0.24	0.23
	Topping	86.4	94.7	90.6	71.6	86.1	78.4	14.6	10.4	16.0	11.42	11.16	11.29	0.23	0.21	0.22
	Half	119.6	126.1	122.9	106.6	118.3	112.0	17.6	17.8	17.7	13.06	12.52	12.98	0.22	0.27	0.26
				Ave.A			Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		97.0	102.4	99.7	82.8	93.9	88.4	16.1	18.4	15.3	10.78	10.60	10.84	0.22	0.24	0.23
May	0	86.1	86.3	86.7	71.2	78.3	74.8	13.2	12.8	13.1	7.88	7.42	7.64	0.21	0.24	0.23
	Topping	89.4	91.4	90.4	76.7	83.2	76.6	18.4	16.1	16.3	10.62	10.41	10.52	0.23	0.24	0.24
	Half	112.1	116.2	114.2	98.2	107.9	103.1	17.1	17.3	17.2	12.84	12.71	12.78	0.27	0.26	0.26
				Ave.A			Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		96.6	98.0	96.8	81.7	89.8	85.8	16.2	16.1	16.2	10.44	10.18	10.31	0.24	0.24	0.29
June	0	86.1	88.3	86.7	71.2	78.3	74.8	13.2	12.9	13.1	7.86	7.42	7.64	0.21	0.24	0.23
	Topping	91.2	96.7	94.0	77.8	88.1	83.0	14.2	14.7	14.6	9.88	9.15	9.83	0.22	0.28	0.23
	Half	85.4	82.6	89.0	76.4	79.3	77.4	16.8	16.4	16.6	11.23	11.62	11.43	0.26	0.26	0.20
				Ave.A			Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		88.6	90.6	89.6	74.8	81.3	78.4	14.4	14.3	14.4	9.55	9.41	9.53	0.23	0.24	0.24
June	Topping	86.1	88.3	Ave.B	71.2	78.3	Ave.B	13.2	14.9	Ave.B	7.88	7.42	Ave.B	0.21	0.24	Ave.B
	Half	89.0	94.3	86.7	76.0	86.6	74.8	14.7	16.1	13.1	10.63	10.26	7.64	0.23	0.28	0.23
		107.0	110.3	91.7	93.1	101.8	80.3	16.8	16.8	14.9	12.38	12.42	10.46	0.26	0.26	0.23
Ave. (A*C)		93.7	57.0	108.7	79.8	88.6	97.6	14.5	14.9	18.3	10.26	10.03	12.40	0.23	0.24	0.26
				-			-			-			-			-

L.S.D. at 5%					
Months (A)	0.15	4.3	2.6	2.4	N.S.
Pruning severity (B)	9.6	7.2	3.6	2.6	0.08
Seasons (C)	--	--	--	--	--
Inter. (A*B)	9.8	8.4		2.9	0.09
" (B x C)	11.4	9.1		--	

Table 5. Fruit nitrogen, phosphorus, potassium and calcium content of Anna apple as affected by summer pruning.

Months (A)	Pruning severity (B)	N (%) Seasons (C)			P (%)			K (%)			Ca (%)		
		95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)	95	96	Ave. (A*B)
April	0	1.16	1.28	1.22	0.23	0.19	0.21	1.17	1.04	1.11	0.09	0.11	0.10
	Topping	1.84	1.72	1.78	0.38	0.35	0.37	1.52	1.43	1.48	0.20	0.21	0.21
	Half	2.06	2.17	2.12	0.45	0.47	0.46	1.73	1.65	1.69	0.25	0.26	0.26
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		1.69	1.72	1.71	0.35	0.34	0.35	1.47	1.37	1.43	0.18	0.19	0.19
May	0	1.16	1.28	1.22	0.23	0.19	0.21	1.17	1.04	1.11	0.09	0.11	0.10
	Topping	1.67	1.71	1.69	0.32	0.37	0.35	1.62	1.69	1.66	0.19	0.16	0.18
	Half	1.96	1.88	1.92	0.41	0.39	0.40	1.59	1.68	1.61	0.24	0.21	0.24
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		1.60	1.62	1.61	0.32	0.32	0.32	1.46	1.47	1.47	0.17	0.17	0.17
June	0	1.16	1.28	1.22	0.23	0.19	0.21	1.17	1.04	1.11	0.09	0.11	0.10
	Topping	1.43	1.32	1.38	0.26	0.24	0.26	1.31	1.38	1.35	0.14	0.16	0.15
	Half	1.65	1.74	1.70	0.37	0.38	0.38	1.22	1.14	1.18	0.21	0.23	0.22
				Ave.A			Ave.A			Ave.A			Ave.A
Ave. (A*C)		1.41	1.45	1.43	0.29	0.27	0.20	1.23	1.19	1.21	0.15	0.17	0.16
June	Topping	1.16	1.28	Ave.B	0.23	0.19	Ave.B	1.17	1.04	Ave.B	0.09	0.11	Ave.B
	Half	1.55	1.58	1.22	0.33	0.32	0.21	1.48	1.50	1.11	0.18	0.18	0.10
		1.89	1.93	1.62	0.41	0.41	0.33	1.51	1.49	1.49	0.23	0.24	0.18
Ave. (A*C)		1.57	1.60	1.91	0.32	0.31	0.41	1.38	1.34	1.50	0.17	0.16	0.24
				-			-			-			-

L.S.D. at 5%				
Months (A)	0.16	0.09	0.12	0.05
Pruning severity (B)	0.21	0.13	0.17	0.06
Inter. (A*B)	0.25	0.16	0.19	0.06

REFERENCES

1. Ferree, D.C. and E.J. Stany. 1980. Influence of summer pruning and Alar on growth, flowering, and fruit set of "Jerseymac" apple trees. Ohi Agric. Res. Deu. Ctr. Res. Circ, 259: 4-6 .

2. Forshey, C.G., D.C. Elfving, and L.S. Robert. 1992. Training and pruning apple and pear trees, Amer. Soc. Hort. Sci. ISBN No. 0-9615027.

3. Forshey, C.G., and C.A. Mermo. 1984. Pruning and debiossoming effect on shoot growth and leaf area of "Mcintosh" apple trees. J. Amer. Soc. Hort. Sci., 110 (2): 128-132.

4. Guignebauit, P., M. Trilot, and L. Hermann 1990. Pear trees routine pruning of two year-old shoots of conference, Infos (Paris) 57: 19-23 (Hort Abst., 60 (7) : 4990) .

5. Kilany, A.E. 1982. Effect of some growth regulators and hoticultural practices on the growth, productivity, and keeping quality of "Leconte" pear. Ph. D. Thesis, Hort. Dept. Fac. Agric. Cairo Univ.

6. Lord, W.J. and R.A. Doman. 1983. Growth and fruitng responses of "Red Spur Delicious" apple trees to pruning treatments. J. Amer. Soc. Hort. Sci., 108: 867-871.

7. Marini, R.P. 1985. Vegetative growth, yield, and fruit quality of peach as influenced by domant, summer pruning, and summer topping. J. Amer. Soc. Hort. Sci., 110: 133-139.

8. Marini, R.P. 1986. Defoliation, flower bud cold hardiness and bloom date of peach as influenced by three pruning treatments. J. Amer. Soc. Hort. Sci., 111: 391-394 .

9. Marini, R.P., and J.A. Barden. 1982. Yield, fruit size and quality of three apple cultivars as influenced by summer or dormant pruning. J. Amer. Soc. Hort. Sci., 107: 474-479.

10. Mika, A., M.J. Grochowska, A. Karaszewska, and M.W. Williams 1983. Effects of dormant and summer pruning, disbudding, and growth retardants on growth flower bud formation, and fruiting of young apple trees. J. Amer. Soc. Hort., Sci., 108: 655-660 .

11. Myers, S.C., and D.C. Ferre. 1983. Influence of time of summer pruning on growth and flowering of "Delicious" apple trees. J. Amer. Soc. Hort. Sci., 108 (4) 634 - 638.

12. Nasr, M.M. 1996. Studies on summer pruning of "Leconte" pear trees. M. Sc. Thesis. Fac. Agric. Cairo Univ.

13. Preston, A.P. and M.A. Perring. 1974. The effect of summer pruning and nitrogen on growth, cropping and storage of "Coxs Orange Pippin" apple. J. Hort. Sci., 49: 77-83.

14. Saleh, M.A. 1991. Physiological studies on flowering and fruit set of "Leconte" pear. M. Sc. Thesis, Fac. Agric. Zagazig Univ.

15. Snedecor, G.W. and G.W. Cochran. 1990. Statistical Methods. 7th Ed. The Iowa State Univ., Iowa, USA P. 593.

16. Stephen, C.M. and D.C. Ferree. 1986. Influence of summer pruning on the growth pattern of vigorous "Delicious" apple limbs. Hortsclence 21 (2): 252-253.

17. Taylor, B.H. and D.C. Ferree. 1984. The influence of summer pruning and cropping on growth and fruiting of apple. J. Amer. Soc. Hort. Sci., 109-24.

18. Taylor, B.H. and D.C. Ferree. 1986. The influence of summer pruning and cropping on the carbohydrate, nitrogen, and nutrient composition of apple trees. J. Amer. Soc. Hort. Sci., 111 (3) : 342-346.

19. Utermark, H. 1977. Summer pruning to control growth and maintain fruiting in mature apple trees. compact Fruit Tree, 10 : 86-90.

20. Verga, A. and O. Borsboom. 1970 . The influences of growth suppression on the cropping of pear. Fruittelt, 60: 436-438. (Hort. Abst., 40 : 7988) .

تأثير التقليم الصيفى على النمو الخضرى وصفات ثمار أشجار التفاح أنا

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درس تأثير التقليم الصيفى (إزالة نصف الفرع أو القمة فقط) فى أول أبريل أو مايو أو يونيو فى عامى ٩٥ – ١٩٩٦ على النمو الخضرى ومحتوى الأوراق من العناصر الغذائية وكذلك على عدد الدوابر الثمرية و نسبة العقد و أيضا على صفات الجودة فى الثمار ومحتواها من العناصر الغذائية فى صنف التفاح أنا المطعوم على أصل م.م. ١٠٦، وقد سبب التقليم الصيفى زيادة معدل النمو (طول الفرع – عدد الأفرع – مساحة الورقة – نسبة المادة الجافة) وزيادة محتوى الأوراق من العناصر الغذائية (نتروجين – فوسفور – بوتاسيوم) و أيضا زيادة عدد الدوابر على الفرع وعلى الشجرة مع زيادة نسبة عقد الثمار فى الوقت الذى قلت فيه نسبة تساقط الثمار ربما بسبب إرتفاع نسبة عنصر البوتاسيوم فى كل من الورقة والثمرة. وبالرغم من نقص عدد الثمار على الأشجار نتيجة للتقليم الصيفى إلا أن صفات الجودة فى الثمار الناضجة (وزن الثمرة – حجم الثمرة – صلابة الثمرة – نسبة المواد الصلبة الذائبة – الحموضة) وكذلك محتوى الثمرة من العناصر الغذائية (النتروجين – الفوسفور – البوتاسيوم – الكالسيوم) قد زادت بصورة معنوية كما وجد أن تأثير التقليم الصيفى يكون أكثر فعالية فى حالة إزالة نصف الفرع عنها فى حالة إزالة قمة الفرع فقط بينما أعطى التقليم فى شهر مايو أفضل النتائج، مما يؤيد التوصية بإزالة نصف الفرع فى أول شهر مايو لتحسين جودة الثمار فى التفاح أنا .