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EFFECT OF PRUNING SEVERITY ON GROWTH, YIELD AND FRUIT QUALITY OF SUCCARY ABIAD MANGO CULTIVAR

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ABSTARCT

Twenty years old trees of "Succary Abiad" mango cv grown in sandy soil at the orchard of the Faculty of Agriculture, Suez Canal University, were subjected to single tipping (removal of apical buds), frequent tipping (removal of apical buds after each flushing), light, mediate and severe pruning (removal of 5, 10 and 15 cm from the apex, respectively) during 2002 / 2003 and 2003 / 2004. The pruning treatments were significantly stimulated emergence of vegetative flushing, while significantly delayed emergence of prolific flushing compared to unpruned trees. Sex ratio (male: perfect flowers) was observed to be lower in flowers of panicles that appeared in mediate pruning than unpruned trees. Mediately pruned trees produced higher leaf area, number of panicles and number of fruits. A significant increment in tree yield was showed from mediate pruning treatment, while severe pruning reduced tree yield. However, the yield was not respond to single or frequent tipping compared to the controls. SSC was significantly increased as pruning severity increased but titratable acid was decreased. So, mediate pruning should be practiced immediately after fruit harvest for early cultivars like Succary Abiad to increase yield and improve fruit quality.

INTRODUCTION

Mango is one of the most important fruit crops in Egypt. Succary Abiad is considered the most dominant mango cv in Ismailia Governorate because it's fruit ripened earlier than the other cultivars by about one month.

Pruning is commonly used as a mean to control size and synchronize the vegetative and reproductive cycle of trees. Traditionally, Egyptian mango growers do not prune the newly planted mango saplings, in the belief that mango trees must grow to a large size before they can begin producing fruits, while pruning of dead wood, sickly branches and opening the tree canopy were done on old mature mango trees when it was necessary.

The lack of information about pruning of Succary Abiad cv was noticed. In addition, habit of tree growth, tree canopy density and pruning severity are varied among cultivars. (Oosthuyse, 1993 a,b).

Many studies indicate that if pruning of mango trees performed directly after fruit harvest, it would be useful in light penetration (Lal *et al*., 2000), stimulative vegetative growth (Oosthuyse, 1994, 1995 and 1997), enhance fruit bud development (Walt *et al*., 1996 and Sharma and Singh, 2006 a, b), increase fruit set, yield, fruit weight and SSC (Firas and Stassen, 1996, Davie and Stassen, 1997, Firaz *et al*., 1997 a, b and Mohan *et al*., 2001).

The objective of this research is to detect the effect of different pruning severity on vegetative growth, flowering, tree yield and fruit quality of Succary Abiad mango cv.

MATERIALS AND METHODS

This investigation was conducted during 2002 / 2003 as well as 2003 / 2004 seasons on Succary Abiad mango cultivar (*Mangifera indica* L.) grafted to seedling mango rootstock at the farm of the Faculty of Agriculture, Suez Canal University, Ismailia, Egypt. The trees were 20 – year – old grown in sandy soil and planted at 5 x 5m and subjected to the standard orchard management practiced as recommended by El-Khoreiby (1997).

The following six selective pruning treatments were applied after fruit harvest (Late week of August), 1) control; unpruned trees, 2) single tipping; removal of apical buds of mature terminal shoots, 3) frequent tipping; removal of apical buds by pruning after each flushing cycle and after the new leaves have turned dark green, 4) light pruning, removal of 5 cm shoot apex from top, 5) mediate pruning; removal of 10 cm shoot apex from top, 6) severe pruning; removal of 15 cm shoot apex from top. The experiment involved six treatments with 3 replicates each as one tree in a randomized complete block design. So, 18 trees were used in this study.

Four branches in each tree (one from each of the four wind directions) were tagged for studying vegetative and flowering parameters. The days required for emergence each new vegetative and prolific flushing were recorded. The total number of new shoots developed on such branches was counted. Length of twenty new shoots as well as length and width of ten newly developed leaves were measured. The leaf area was calculated using the following formula (Nii *et al*., 1995): $Y = -0.146 + 0.706\ X$, where Y = leaf area (cm^2) and X = leaf length (cm) × width (cm). The total leaf area per shoot was determined by multiplying the total number of new leaves by leaf area.

Sex ratio (male: perfect flowers), which has direct relationship with fruit set and yield, was determined during full bloom by counting male and perfect flowers in randomly selected 10 panicles per tree.

The number of fruits per tree and average fruit weight were recorded during harvesting. Tree yield was determined by multiplying number of fruits per tree by average fruit weight. Five fruits were taken per tree for analyzing quality parameters. The soluble solids content (SSC %) in the sample fruit pulp was measured using hand refractometer. Titratable acidity (%) was determined in the same pulp of the sampled fruit according to A.O.A.C. (1996).

The collected data were analyzed using the statistical program M.STAT (1990) and treatment means were compared using LSD at 5 % level of significance (Steel and Torrie, 1980).

RESULTS

The different pruning severities were significantly stimulated emergence of vegetative flushes compared to unpruned trees as shown in table (1). The trees that received severe pruning appeared the shortest period required for emergence postharvest vegetative flush. It is clear that different pruning types advanced emergence of new flush by about (2.5 – 2.4), (5.5 – 6.3), (3.6 – 2.9), (4.0 – 7.2) and (7.7 – 9.1) days for single,

frequent tipping, light, mediate and severe pruning in the first and second seasons, respectively. The same trend was observed for the postflower vegetative flush.

Days required for emergence new panicle were significantly longer in pruned trees than unpruned ones, which had the shortest period. So, emergence of new panicles were delayed proportional to the control by about (5.2 – 9.8), (9.9 – 15.2), (19.8 – 18.9), (29.7 – 38.5) and (35.3 – 42.9) days in trees that received single, frequent tipping, light, mediate and severe pruning in the first and second seasons, respectively.

Sex ratio (male: perfect flower) which developed in Succary Abiad mango trees, following pruning treatments was significantly influenced by pruning severity (Table 2). Sex ratio was observed to be highest in flowers that appeared in panicles of unpruned trees, while the lowest value was observed in flowers of panicles that appeared in mediate pruning. However, sex ratio in flowers that appeared in panicles of other treatments came in between.

Number of panicles per tagged branch was significantly influenced by pruning treatments. The highest number of panicles appeared in mediately pruned trees and the lowest observed in unpruned trees. Number of panicles seemed to be almost equal either in single and frequent tipping or in severe pruning and control, so each of the two treatments above – mentioned appeared no significant differences in both seasons.

The length of new flush developed on trees that received severe pruning was significantly recorded the longest flush than unpruned trees which gave the shortest one (Table 2). Single or frequent tipping had no significant effect on length of new flush. However, the number of leaves developed per new flush appeared to be higher on tree that received severe pruning than other treatments. The trees that received mediate pruning produced a significant higher leaf area of the newly developed leaves, while total leaf area per new shoot was higher on trees pruned severely than the control trees which showed poor vegetative growth.

The total number of fruit harvested per tree showed significant difference among the pruning treatments as shown in (Table 3). The trees that received mediate pruning produced the highest fruit number, while the lowest number of fruit per tree was recorded on trees that received severe pruning. The trees that received single or frequent tipping showed no significant difference than control trees.

The highest fruit mass recorded on trees that received severe pruning, which was not significantly differed from control trees only during (2002 – 2003) season. Mediate pruning treatment was significantly produced the lowest fruit weight than the control trees and other treatments in both seasons.

Tree yield was significantly influenced by pruning severity, where trees that received mediate pruning produced the highest yield and the lowest yield gained on severely pruned trees. Tree yield appeared in almost equal in both types of tipping and control with no significant difference in the two seasons.

Soluble solids content (SSC %) was significantly increased as pruning severity increased, where trees pruned severely had the highest SSC than the other treatments. Titratable acid was not significantly affected by pruning treatments despite of slight reductions in acids were observed with increasing pruning severity. SSC: acid ratio behaved in a similar manner as that of SSC, where it was significantly increased as pruning severity increased.

DISCUSSION

Pruning trees immediately after fruit harvest when temperature is high (late week of August), encouraged the trees to produce new vegetative growth owing to removal the apical dominance as also been stated by Oosthuyse (1995). In similar related work, Oosthuyse (1994, 1997) found that new vegetative flushing in pruned trees occurred within 13 days after pruning. However, the new flushing was delayed on unpruned trees(control) because the old flower stalks that remained on the shoots inhibited the vegetative growth (Oosthuyse and Jacobe, 1995).

The stimulative effect of pruning brought the tree to delay blooming when the weather is always warm and the air humidity is low. Oosthuyse (1994 and 1997) also indicated that postharvest pruning resulted in slightly delayed flowering. He explained that vegetative regrowth caused by pruning after harvest elevated the level of endogenous gibberellins, and thereby affects a delay in bud development and a delay in flowering. On the other hand, a delay in flowering is generally considered as advantage, since inflorescence development when temperature is higher, results in decrease the proportion of male as opposed to perfect flowers formed (Singh *et al.*, 1974 and Mullins, 1986) and gives more effective pollination (Issarakraisila *et al*., 1991).

Sex ratio was significantly influenced by pruning severity, which was higher in unpruned trees (Table 2). This significant influence on sex ratio may be due to improve canopy microclimate after pruning as reported by Sharma and Singh (2006b). Majumder *et al*. (2001) found that relative humidity and temperature inside the tree canopies may influence sex ratio in mango. In addition, high temperature was suitable for development of male flowers which increased sex ratio (Singh *et al.*, 1974 and Mullins, 1986). Moreover, Sharma and Singh (2006b) found that canopy temperature was lowest in unpruned trees and higher in pruned severely. From this standpoint, higher sex ratio in unpruned trees may be attributed to low temperature in denser canopies and lower sex ratio in pruned trees to higher temperature inside the tree canopies. These results are in accordance with those found by Sharma and Singh (2006b), who reported that sex ratio was highest in flowers of unpruned trees and lowest in flowers of severely pruned trees.

The highest number of panicles in trees mediately pruned and lower in pruned trees may be due to availability of adequate light inside the tree canopies of mediately pruned trees, which is absolutely necessary for the development of panicles in mango (Schaffer and Gaye, 1989). The

equalization number of panicles on both single and frequent tipping treatments as well as unpruned trees, may be because in tipped trees only new growth of the shoots tips were removed, which did not cause any difference in light penetration as compared to unpruned trees. However, the lowest number of panicles in trees pruned severely could be attributed more vegetative growth, which occurred by heavy pruning caused shading effect due to overcrowding. Similar responses have been observed by Pratap *et al*. (2003), Sharma and Singh (2006b) and Sharma *et al*. (2006).

Either tipping or pruning treatments led to increase length of new shoots, number of leaves and leaf area. Similar results have been reported by Oosthuyse and Jacobe (1995), Walt *et al*. (1996), Kaewnate *et al*. (2003), Kumar *et al*. (2003) and Surachot *et al*. (2003).

The higher fruit numbers in trees that received mediate pruning may be attributed to reduce sex ratio (Table 2), which have direct relationship with fruit set and yield (Majumder *et al.,* 2001). However, the fruit number decreased in severely pruned trees because of delay accumulation of carbohydrate reserves by strong regrowth after heavy pruning, resulting in a decrease in flowering shoot rate (Chen and Zhang, 1996) and increase in fruitlet abscission (Yeshitela *et al*., 2003 and 2005 and Sharma *et al*., 2006).

Severe pruning increased fruit weight which may be due to enhance the development of new vegetative shoots (Table 2), which can replenish the tree's carbohydrate reserve and the trees store a good amount reflected in a larger fruit weight (Walt *et al.*, 1996). However, Oosthuyse (1993b) and Stassen *et al.* (1999) explained the increment in fruit weight due to severe pruning, through a decrease in number of fruits per tree, which in turn led to increase fruit weight. On the basis of these findings, the lower fruit weight obtained in this experiment due to tipping, light and mediate pruning could be attributed to increase fruit numbers per tree as shown in table 3.

With respect to the actual yield, a significant higher yield was observed for mediate pruning treatment due to reduce sex ratio, which could lead to increase fruit set, number of fruits and consequently yield (Table 3). In similar related work on some mango cultivars, Firaz and Stassen (1996); Firaz *et al*. (1997b); Gross *et al*. (1997); Avilan *et al*. (2001) and Bhanu *et al*. (2003) found that trees yield was highest under moderate pruning, followed by severe and light pruning. However, both types of tipping and severe pruning decreased significantly tree yield owing to reduce fruit number per tree as also stated by Oosthuyse (1993 and 1997) and Firaz and Stassen (1996). Further, no reduction in tree yield due to pruning was observed if trees were pruned immediately after harvest (Firaz *et al*., 1997a).

Higher fruit SSC of Succary Abiad by pruning treatment was expected because in postharvest pruning, trees will get enough time to produce a new flush and those flushes mature early in the season especially for early cultivar like Succary Abiad. Beside, the rate of photosynthesis is greater in leaves that developed in pruned tree than in those developed in unpruned tree (Sharma *et al*., 2006) and consequently starch content in the leaves is higher in pruned than unpruned trees (Oosthuyse, 1994). Presumably, fruit number is not exceeding the tree's capacity. Therefore, all

fruits could receive an adequate supply of carbohydrates and SSC increase. It could be seen that pruning treatments significantly decreased titratable acids. In this respect, Wolstenholme and Whiley (1995) observed that higher fruit SSC has lower titratable acids, which ultimate affects the SSC: acid ratio.

It could be seen that not all pruning treatments had negative effects as that was believed by mango growers. Where, the application of mediate pruning on Succary Abiad trees considered to be the most effective treatment for higher yield and improve fruit quality, especially when it done immediately after fruit harvest.

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تأثير شدة التقليم على النمو و المحصول و جودة ثمار المانجو صنف سكرى ابيض

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أجرى هذا البحث على أشجار مانجو عمرها عشرون عاماً صنف سكرى أبيض نامية فى تربة رملية بمزرعة كلية الزراعة – جامعة قناة السويس، خلال عامى (2002 – 2003)و (2003- 2004) لدراسة تأثير ست مستويات تقليم [1- (كنترول) بدون تقليم، 2- إزالة البرعم الطرفى للأفرخ مرة واحدة، 3- إزالة البرعم الطرفى للأفرخ بعد كل دورة نمو، 4- تقليم خفيف (إزالة 5 سم من القمة الخضرية للأفرخ)، 5- تقليم متوسط (إزالة 10 سم من القمة الخضرية للأفرخ، 6- تقليم شديد (إزالة 15 سم من القمة الخضرية للأفرخ)]على النمو الخضرى و المحصول و أيضاً صفات الثمار.

أدت معاملات التقليم إلى الإسراع في ظهور دورة النمو الخضرى و تأخير التزهير مقارنة بالأشجار التي لم يتم تقليمها. و لقد لوحظ انخفاض النسبة الجنسية (الأزهار المذكرة (مختزلة المتاع) إلى الخنثى) فى أزهار النورات التى تكونت على أشجار معاملات التقليم و التى أعطت أعلى مساحة و رقية و عدد نورات و أيضاً أعلى عدد ثمار على الشجرة.

أعطت أشجار معاملة التقليم المتوسط زيادة معنوية فى المحصول بينما قل محصول أشجار معاملة التقليم الشديد و لم يتأثر المحصول بإزالة البرعم الطرفى للأفرخ سواء مرة و احدة أو بعد كل دورة نمو مقارنة بأشجار الكنترول. زاد محتوى الثمار من المواد الصلبة الذائبة زيادة معنوية مع زيادة شدة التقليم، فى حين قل محتوى الثمار من الحموضة.

وعلى ذلك يجب إجراء التقليم المتوسط مباشرة بعد جمع الثمار فى أصناف المانجو مبكرة النضج مثل السكرى الابيض لزيادة المحصول و تحسين جودة الثمار.

Table (1): Effect of pruning severity on days required for emergence vegetative and prolific flushing.

Pruning severity	2002 - 2003			2003 - 2004		
	Days required for emergence			Days required for emergence		
	Postharvest flush	Panicle	Postflower flush	Postharvest flush	Panicle	Postflower flush
No pruning (control)	20.82	160.44	186.42	21.61	155.31	182.00
Single tipping	18.33	165.67	198.11	19.17	165.14	195.48
Frequent tipping	15.56	170.35	199.58	15.34	170.54	189.80
Light pruning	17.25	180.27	207.93	18.73	174.24	202.59
Mediate pruning	16.78	190.10	215.30	14.40	193.77	220.35
Severe pruning	13.14	195.72	223.17	12.51	198.25	229.76
LSD at 5% level	1.28	4.41	5.25	1.30	4.77	6.61

Table (2): Effect of pruning severity on sex ratio and some vegetative parameters during (2002 – 2003) and (2003 – 2004) seasons.

Pruning severity	Sex ratio	No. of panicle per tagged branch	Length of new shoot (cm)	No. of leaves per new shoot	Leaf area (cm^2)	Total leaf area per new shoots (cm^2)
2002 - 2003						
No pruning (control)	4.18	7.18	10.00	9.89	94.30	932.63
Single tipping	3.12	6.31	13.56	9.44	96.00	906.24
Frequent tipping	3.00	6.79	14.11	10.80	97.80	1056.24
Light pruning	2.80	8.17	15.78	11.13	99.77	1110.44
Mediate pruning	2.25	10.13	13.00	10.67	105.32	1123.76
Severe pruning	4.00	7.10	17.67	12.56	102.11	1282.50
LSD at 5% level	0.20	0.76	0.61	0.27	1.12	10.30
2003 – 2004						
No pruning (control)	5.30	8.50	12.11	9.35	98.13	917.52
Single tipping	4.11	9.87	15.61	10.56	97.98	1034.67
Frequent tipping	3.51	9.12	15.72	11.00	102.00	1122.00
Light pruning	2.90	11.63	16.00	14.12	98.90	1396.47
Mediate pruning	2.43	14.25	14.32	11.83	110.17	1303.31
Severe pruning	3.89	8.11	18.11	16.44	103.38	1699.57
LSD at 5% level	0.49	0.81	0.86	1.10	1.60	55.85

Table (3): Effect of pruning severity on tree yield and fruit quality during (2002 – 2003) and (2003 – 2004) seasons.

Pruning severity	No. of fruits per tree	Fruit weight (g)	Tree yield (Kg)	Soluble solids content (%)	Titratable acids(%)	SSC/acid ratio
2002 - 2003						
No pruning	322.30	293.91	94.73	13.95	0.38	36.71
Single tipping	338.15	275.32	93.09	14.00	0.37	38.84
Frequent tipping	342.06	281.18	96.18	14.19	0.36	39.42
Light pruning	446.23	264.00	117.80	14.60	0.36	40.55
Mediate pruning	483.13	258.56	124.92	14.75	0.34	43.38
Severe pruning	308.00	290.13	89.36	15.24	0.33	46.19
LSD at 5% level	26.13	6.34	3.60	0.22	N.S.	1.91
2003 - 2004						
No pruning	451.00	293.19	133.58	14.15	0.41	34.51
Single tipping	460.54	291.81	134.39	14.35	0.39	37.82
Frequent tipping	458.46	287.24	131.69	14.89	0.38	39.18
Light pruning	438.33	280.15	122.80	15.10	0.37	40.81
Mediate pruning	517.79	270.11	139.78	15.17	0.37	41.00b
Severe pruning	328.60	303.22	99.64	16.28	0.36	45.22
LSD at 5% level	23.02	3.13	3.12	0.31	N.S.	1.11