Impact of Different Types of Summer Pruning on Solitaire Apricot Trees

Alaa. S. Abdel-Rahman, O. S. Mokhtar and S. K. Okba
Deciduous Fruits Research Department, Horticulture Research Institute, Agricultural Research Center

ANSTRACT

This research was conducted on Apricot trees "Solitaire" cultivar four years old, grafted on Nemguard rootstock 4*5 m apart (210 trees/feddan) in sandy soil at the private farm of Assiut governorate, Egypt during two successful seasons (2021/2022 and 2022/2023). Solitaire apricot trees were treated with different summer pruning treatments as follows: 1- head back pruning (HB) (0, 15, 30 and 45%), 2- thinning pruning (TP) (0, 25 and 50%). The main purpose of this trail is to study the effect of summer pruning on the Solitaire vegetative and fruit growth behavior to preserve the physical and chemical characteristics of tree growth, increase yield, and raise economic value. The results showed that a combination of 30% head-back pruning with 25% thinning pruning improved the tree the highest physical and chemical characteristics which reflect on the vegetative, flowering and fruiting quantity and quality compared to the other pruning treatments under the study.

Keywords: Apricot- Heading Back- Solitaire- Thinning Pruning.

INTRODUCTION

Apricot, (*Prunus armeniaca* L.) belongs to the group of deciduous fruits commonly known as stone fruit (Gregory, 1993). One of the best-known temperate fruit trees the diverse areas from the cold winters to the subtropical climate (Stobdan et al., 2021). The cultivated area reached 13076 feddan with productivity of 74067 tons (Food and Agriculture Organization of the United Nations, 2023).

Pruning is one of the important mechanical applied to fruit trees. It helps limbs to be strong to support fruit and the branches are angled to allow sunlight for flower buds to develop and for fruit to ripen (Demirtas et al., 2010). Pruning treatments can be done according to time or the development stage of treesand also be done at the end of summer to remove cut back upright shoots on shoots or to Summer pruning to apricot .side branches trees showed a positive effect on flower increases fruit quality ,bud formationand controls tree development(Eiada et al., 2012).

MATERIALS AND METHODS

The experiment conducted during two seasons (2021/ 2022 and 2022/ 2023) on Solitaire apricot trees four years old were grafted on Nemguard rootstock at 4*5 m apart (210 trees/feddan) in sandy soil at a private farm, in Assiut governorate, Egypt.

Apricot trees were treated with different summer pruning treatments as follows:

1- Head back pruning (HB) (0, 15, 30, and 45%), 2- thinning pruning (TP) (0, 25 and 50%). Each treatment in this study contained three replicates and each replicate contained three trees also, the experiment design was arranged in a Factorial analysis.

Experimental measurements:

(I) Vegetative measurements:

(A) Physical characteristics of vegetative growth parameters:

1- Shoot length (cm): Was measured by using ruler.

2- Leaf area (cm^2): Six mature leaves fifth leaf from the base of new branches were taken during June for estimating leaf area meter (model 1203, CID, Inc.,

USA). Leaves number per shoot were counted at the end of each season of study.

(B) Chemical characteristics of vegetative growth parameters:

1- Leaf chlorophyll content: Leaf area chlorophyll content was estimated in the field, by using SPAD 502 meter (Minolta Co., Osaka, Japan). Thirty leaves were randomly taken starting from the seventh leaf from the base of bearing shoots located around the crown. Measurements were carried out at the beginning of May during both study seasons.

2- Leaf nitrogen content (%): sample of 5 grams dry weight from each replicate was used to estimate the leaf nitrogen content. Then, it was estimated by Micro–Kjeldahl according to (A.O.A.C, 2005).

3- Leaf phosphorus content (%): was estimated as described by (Chapman and Parker, 1961).

4- Leaf potassium content (%): was estimated according to (Lilleland and Brown, 1946).

5- Total carbohydrates (mg/100g): It was determined in dry leaf samples collected at the 2nd week of July of each season as mg/100 g D.W. (A.O.A.C., 2005).

6- C/N ratio: was estimated according to the following equation:

C/N ratio = Total carbohydrates/Total Nitrogen

(II) Fruiting measurements:

(A) Physical characteristics of fruits:

1- Fruit weight (g): Average fruit weight was determined by weight a sample of fruits from each replicate and the mean fruit weight was calculated.

Fruit size (cm^3): Using water displaces meter method.

2- Fruit length (cm): Was determined by a sample of ten random fruits from each replicate and the **mean** calculated.

3- Fruit diameter (cm): Average fruit diameter measured by using a vernier caliper.

4- Fruit firmness: is an important physical property of fruits, the mechanical properties elastic modulus of fruit was measured by using compression test apparatus**.**

5- Number of fruits: was determined by count number of fruits from each replicate and the mean fruit number per tree was calculated.

6- Fruit set (%):

Fruit set percent = Number of fruit set/ Total number of flowering x 100.

7- Fruit retention: counted at the time of harvest and the percentage of fruit retention was calculated as:

Fruit retention (%) = M1 Total No. of fruit retained on fruiting arm/M1 Total number of fruit set on fruiting arm x 100

8- Yield (Kg /tree): At harvest time was calculated: Number of fruits per tree x Average fruit weight in the mature stage.

(B) Chemical characteristics of fruits:

1-Total soluble solids (TSS° Brix): determined using a digital refractometer (Model PR-32, Atago, Japan) by squeezing the juice.

2- Total sugars (%): In ethanol extract, total sugars were determined by using the phenol-sulphuric acids methods (Dubois et al., 1956) as follows: One ml of ethanol sugars extracted was mixed with phenol (0.5ml 5%) in a test tube and immediately followed by the addition of 5 ml of concentrated sulfuric acid then the mixture was shaken gently and left to cool. The blank contained all the reagents without fruit extract which was replaced with 1 ml 80% ethanol.

The absorbance of the developed yellow-orange color was measured at 490 nm using a spectrophotometer. A standard curve was carried out using pure glucose with a suitable Figs concentration. The number of total sugars was calculated and expressed as a percentage.

3- Total acidity (T.A. %): was determined by titration with a standard

solution of sodium hydroxide (0.1N), using phenolphthalein as an indicator (A.O.A.C., 2005). The results were expressed as percentages of anhydrous tartaric acid according to the following equation:

Total acidity = M1 M1 of NaOH x 0.0075/ M1 M1 juice used x 100

4- Vitamin C (L Ascorbic Acid): mg/100 ml juice): Vitamin C content was measured by the colorimetric method described in A.O.A.C (2005) based on the reduction of 2, 6- di chlorophenol indophenol-sodium (DCIP), standardized with ascorbic acid. The fruit ascorbic acid extracts were titrated with DCIP solution until a light rose pink hue persisted for 30 seconds. The amount of DCIP solution used in the titration stage was determined and used to calculate vitamin C (100 mg/ mL juice) content.

- **Statistical analysis:** was carried out according to Snedecor and Cochran (1989) using analysis of variance. The significance is determined using LSD values at 0.05 levels (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

(I) Vegetative growth parameters:

(A) Physical characteristics of vegetative growth:

1- Shoot length (cm): Data on shoot length in **Table (1)** confirmed that the shoot length of Solitaire apricot trees in the summer (HB or TP) pruning and their interactions were significant in both seasons. The treatments of pruning HB 30% only affected the increase in shoot length compared to the other pruning (HB 0, 15, or 45%) in the same season. Also, the treatment of TP 25 % only was significantly increased in the shoot length of Solitaire apricot trees followed by TP 50 or 0 % in the same season. In addition, the interaction of treatments of the summer pruning HB 30% with TP 25% showed the highest shoot length (48.60 cm) of Solitaire apricot trees in both seasons.

2- Leaf area (cm^2): The main effect of experimental treatments **Table (1)** showed the leaf area was significantly affected by summer pruning (head back pruning (HB), or thinning pruning (TP), and the interactions between them in two seasons. Leaf area was significantly highest in head back pruning in 30% of Solitaire trees compared to the other treatments of head back pruning in both seasons. Also, the treatment of TP 25 % only was increased in the leaf area of Solitaire apricot trees followed by TP 50 or 0 % in both seasons. The double treatment of summer pruning (HB30% **+** TP25%) showed the best results for leaf area than other treatments during both seasons.

The obtained results of shoot length and leaf area are in line with Demirtas et al.(2010) who found that pruning treatment significantly affected both shoot length and leaf area. Also, the highest shoot length and leaf area were obtained from the interaction of summer + winter pruning treatment as 77.84 cm and 39.43 cm^2, respectively. Neri and Massetani (2011) cleared that pruning in late summer results in more successfully obtaining a better light distribution in the canopy and efficient carbon allocation to fruiting shoots .Eiada et al. (2012) reported that treatment at 40 or 50% of the thinning pruning and the same treatments of heading back pruning at the same time were superior in vegetative characteristics. Moale (2015) studied the effect of different applications of summer pruning on three cultivars of apricot. He found that the cultivars respond well to summer pruning by shortening the annual growth by 20 cm and after 5-6 days the fruit buds form differentiation on these shoots in the vegetative stag

Table (1). Effect of different summer pruning treatments on shoot length (cm) and leaf area (cm^2) of Solitaire apricot trees (2021/ 2022 and 2022/ 2023).

Treat.	Shoot length				Leaf area			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
Season 2022								
Hb0%	29.15 G	40.90 DE	38.76 EF	**36.27 C**	20.33 F	22.19 DE	21.67 EF	**2.40 B**
Hb15%	36.90 F	41.25 DE	44.56 BC	**40.90 B**	21.17 EF	24.15 BC	22.10 DE	**22.47 B**
Hb30%	43.25 CD	48.60 A	46.30 AB	**46.05 A**	21.40 EF	26.50 A	25.27 AB	**24.39 A**
Hb45%	42.28 CD	43.15 CD	42.19 CD	**42.54 B**	22.31 DE	23.20 CD	23.45 CD	**23.00 B**
Mean	**37.89 B**	**43.48 A**	**42.95 A**	**----**	**21.30 B**	**24.01 A**	**23.12 AB**	**---**
Season 2023								
Hb0%	30.48 G	42.50 E	42.52 E	**38.50 D**	20.84 E	24.00 D	24.04 CD	**22.96 C**
Hb15%	38.20 F	45.62 BCD	42.33 E	**42.05 C**	26.02 A-D	25.13 A-D	25.99 A-D	**25.71 B**
Hb30%	43.67 DE	48.97 A	46.48 BC	**46.37 A**	25.85 A-D	27.38 A	26.98 AB	**26.74 A**
Hb45%	47.58 AB	43.00 E	44.36 CDE	**44.98 B**	26.71 A-D	24.50 B-D	26.86 A-C	**26.02 B**
Mean	**39.98 B**	**45.02 A**	**43.92 A**	**----------**	**24.85 A**	**25.25 A**	**25.97 A**	**----**

(B) Chemical characteristics of vegetative growth:

1- Leaf nitrogen content (%): It is pretty evident as shown from data in **Table (2)** Solitaire apricot trees are significantly affected by different summer pruning treatments under study in both seasons. However, the increasing rate of N% in HB 30% summer pruning only was higher than other treatments in the first season but, in the second season the treatments of HB (15, 30 and 45%) recorded the same results. Also, the leaf nitrogen content was not significant by using all treatments of TP in summer pruning in the first season but, in the second season, the treatment of 25% TP only recorded the highest N% followed by 50, or zero % of TP treatments. The effect of the interaction of head back pruning with thinning pruning, the results showed that 30% HB + 25% TP gave the highest N% compared to other interactions in this respect during both seasons.

2- Total carbohydrates (mg/100g): Data concerning total carbohydrates in **Table (2)** indicated that the different summer pruning treatments of Solitaire apricot trees are significant in both seasons. Also, the treatments of head back pruning 30%, or thinning pruning 25% only had the highest significance for total carbohydrates compared to the other treatments of the two types of summer pruning under study. The double interaction treatments of head back and thinning summer pruning had recorded that the treatments of 30% HB plus 25 %TP gave the higher carbohydrates (%) in the first season. However, in the second season, the interaction of all treatments of HB plus 25% TP only gave the highest carbohydrates (%).

3- C/N ratio: Data in **Table (2)** showed that the C/N ratio was significant for the two types of summer pruning of Solitaire trees and the interaction between them under study. The treatment of 30, or 45% of head back pruning was significant to the C/N ratio in the first season but, in the second season, the treatment of 30 % only gave the increased C/N ratio compared to the other treatments under study. Also, the treatment of thinning pruning 25% had a higher significant C/N ratio in both seasons. The affected double interaction between the HB 30% plus zero % TP or 45% HB plus 25% TP gave the highest C/N ratio in the first season. However, in the second season, the interaction between the 45% HB plus 25% TP recorded the highest C/N ratio compared to the other interaction under study.

The effect of summer pruning and the time of pruning on the total carbohydrate content of two peach tree cultivars. The results showed that the earlier time of summer pruning had lower carbohydrate content compared to the late time of pruning. Concerning that, Ikinci et al. (2014)

repeated that summer pruning treatments had different effects on the carbohydrate contents of peach trees. Moatamed (2012) reported that summer pruning treatments and the dates of pruning on 'Le-Conte' trees had high significant affected on nitrogen% of leaves and total carbohydrate content. Farag et al., (2019) found that a combination of summer pruning and foliar spraying with 1% $MgSO_4$ on the canopy of Flame seedless grapes recorded the best chemical properties of leaf content of nitrogen, total carbohydrate and C/N ratio.

4- **Leaf chlorophyll content:** Data on the leaf chlorophyll content in **Table (3)** showed that chlorophyll % was significant for the two types of summer pruning of Solitaire trees and the interaction between them under study. Data in summer pruning of HB treatments showed that the pruning of 30% followed by 15, 45, and zero in both seasons increased the leaf chlorophyll content. Also, the type two (TP) pruning treatment, which was 25 %, showed a higher significant leaf chlorophyll content in both seasons. Data of interactions with the two types of summer pruning presented in the combination of head back pruning 30% plus thinning pruning 25% showed the highest chlorophyll% in both studied seasons.

5- **Leaf phosphorus content (%):** Data concerning phosphorus % in **Table (3)** indicated that Solitaire apricot trees are significantly affected by different summer pruning treatments and the interactions between them under study. Data of the first type of summer pruning (head back pruning) showed that the treatment 30% recorded the highest phosphorus % compared to the other treatments in one season. However, in the second season, all treatments of HB pruning were not significant and, recorded the same results of phosphorus %. In addition, data of type two of summer pruning under study (thinning pruning) recorded that all treatments of TP.

6- **Leaf potassium content (%):** Leaf potassium content in **Table (3)** showed that potassium % in summer pruning types of Solitaire apricot trees was significant in the two seasons under study. The head-back summer pruning only showed that the affected 30 % head-back pruning of Solitaire trees had increased the potassium content in the first and second seasons, respectively. Also, the treatment of 25% thinning pruning only had the same results of potassium content under study. Data of interactions between the two types of summer pruning under study recorded that 30% of head back pruning plus 25% of thinning pruning was the higher significance of potassium % compared to other interaction treatments in both seasons.

These results are in harmony with Neri and Massetani (2011) which they evaluated different types of summer pruning on two cultivars of stone fruits. They found that the late summer pruning obtained a better light distribution in the canopy and feedback of leaf mineral content on two cultivars under study. Ikinci et al. (2014) found that summer pruning and the time of pruning positively affected the leaf mineral content of the peach trees. On the other hand, Thokchom et al. (2021) found that pruning intensities and nitrogen levels exert considerable influence on the leaf mineral content of trees. Chlorophyll (%) and leaf mineral content showed declining trends with increasing pruning severity and nitrogen levels.

(II) Fruiting measurements:

(A) Physical characteristics of fruits:

1- **Fruit set%, fruit weight (g), and number of fruits:** Data in **Table (4)** showed that the fruit set percentage, fruit weight and numbers of fruits per tree were significant with the two types of summer pruning and the interactions between them under study in both seasons. Also, data of the summer pruning in the first type of pruning (head back pruning) and the second type (thinning pruning) in Table 4 illustrated that the HB 30% only, or TP 25% only had increased the fruit set %, fruit weight and the number of fruits per tree in both seasons. In addition, the interactions treatment with 30% HB + 25% TP of summer pruning showed the

highest physical characteristics of fruits in both seasons.

In these concerns (Demirtas et al., 2010, Neri and Massetani, 2011, İkinci et al., 2014 and Moale et al., 2015) the different effects of the summer pruning and the pruning time on fruit characteristics of apricot trees they found that the summer pruned trees had a higher average of fruit set % fruit weight and the number of fruits on apricot trees cultivars.

2- **Fruit length (cm), fruit diameter (cm) and fruit retention:** It was noticed from **Table (5)** that the fruit length, fruit diameter and fruit retention of apricot trees Solitaire cultivar were significantly affected by summer pruning types and all interactions between them under study. Also, data on fruit length in Table 5 cleared that head back pruning in one season was not significant of all the treatments but, in the second season, the treatment of 30 % of head back pruning recorded the highest average of fruit length as followed by the treatments of head back pruning at (45, 15 and 0%). Conceding data of the thinning pruning treatments in the same table showed that the treatment at 25% of pruning had a higher significant effect than other treatments of pruning in both seasons. In addition, the interaction of 30% of head back pruning plus 25 % thinning pruning increased the fruit length (4.367 and 4.533 cm) in the two seasons, respectively.

Data of the summer pruning of fruit diameter and fruit retention on apricot trees Solitaire cultivar showed that the HB pruning treatment at 30% only or 25% TP pruning only had increased the fruit length and the fruit retention per tree in both seasons. Also, the interaction treatment with 30% HB ＋ 25% TP of pruning showed the highest physical characteristics of fruits in both seasons.

In parallel to these results, Demirtas et al. (2010) found that the different treatments of pruning significantly affected both shoot diameter and length. The highest shoot diameter and length were obtained from pre-harvest summer pruning treatments as 8.52 mm and 77.84 cm, respectively. Also, Hota et al. (2017) study the summer pruning of apricot trees in combination with different concentrations of N-acetyl thiazolidine 4-carboxylic acid (NATCA), and Forchlorfenuron (CPPU). They found that the summer pruning with CPPU 10 ppm only recorded the highest fruit retention (38.12%) among all the treatments under study.

3- **Fruit size (cm^3), fruit firmness and yield (kg /tree):** Data in **Table (6)** showed that the fruit size, fruit firmness and fruit yield per tree were significant with the different summer pruning and the interactions between them under study in both seasons. Also, data of the summer pruning in the HB pruning, and TP pruning in **Table (6)** illustrated that the HB 30 % or TP 25% only had increased the fruit size, fruit firmness and fruit yield in both seasons. In addition, the interaction treatment with 30% HB ＋25 % TP of summer pruning showed the highest fruit size, fruit firmness and fruit yield in both seasons under study. (Demirtas et al., 2010, Neri and Massetani, 2011, İkinci et al., 2014 and Moale et al., 2015) the different effects of the summer pruning and the pruning time on fruit characteristics of apricot trees they found that the summer pruned trees had a higher average of physical characteristics of fruits on apricot trees.

Table (2). Effect of different summer pruning treatments on leaf nitrogen content, total carbohydrates (mg/100g) and C/N ratio of Solitaire apricot trees (2021/2022 and 2022/2023).

Treat.	Leaf nitrogen content				Total carbohydrates				C/N ratio			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
						Season 2022						
Hb0%	0.700 EF	0.715 DF	0.732 C-F	**0.716B**	6.400 CD	6.100 CD	6.333 CD	**6.280 B**	9.14 C	8.53 DE	8.65 DE	**8.77 C**
Hb15%	0.780 A-C	0.751 B-E	0.710 D-F	**0.747AB**	6.530 CD	7.950 AB	6.290 CD	**6.923AB**	8.37 E	10.59 AB	8.86 CD	**9.27 B**
Hb30%	0.686F	0.827 A	0.797 AB	**0.770 A**	7.480 B	8.360 A	6.100 CD	**7.313 A**	11.00 A	10.11 B	7.65 F	**9.59 A**
Hb45%	0.756 B-D	0.728 C-F	0.714 D-F	**0.733 B**	6.767 C	8.150 AB	6.000 D	**6.970AB**	8.95 CD	11.20 A	8.40 E	**9.52 A**
Mean	**0.731 A**	**0.755 A**	**0.738 A**	-----	**6.794 B**	**7.640 A**	**6.181 C**	----	**9.37 B**	**10.11 A**	**8.39 C**	----
						Season 2023						
Hb0%	0.694 D	0.767 B-D	0.725 CD	**0.729 B**	6.000 F	7.660 B	6.680 DE	**6.780B**	8.38D	10.00 B	9.21 CD	**9.20BC**
Hb15%	0.785 BC	0.795 A-C	0.739 B-D	**0.773 A**	6.300 EF	8.270 A	7.117 CD	**7.229 AB**	8.03 DE	10.40 AB	9.63 C	**9.35 B**
Hb30%	0.729 B-D	0.868 A	0.762 B-D	**0.786 A**	7.347 BC	8.750 A	7.413 BC	**7.837 A**	10.1 B	10.08 B	9.73 C	**9.97 A**
Hb45%	0.7817 BC	0.732 B-D	0.806 AB	**0.773 A**	6.627 DE	8.350 A	6.453 EF	**7.143 AB**	8.50 D	11.40 A	8.01 DE	**9.30 B**
Mean	**0.7474 B**	**0.791 A**	**0.758 AB**	-----	**6.568 C**	**8.257 A**	**6.916 B**	----	**8.75 C**	**10.47 A**	**9.15 B**	----

Table (3). Effect of different summer pruning treatments on leaf phosphorus content (%), leaf potassium content (%) and leaf chlorophyll content, of Solitaire apricot trees (2021/ 2022 and 2022/ 2023).

Treat.	Leaf chlorophyll content				Leaf phosphorus content				Leaf potassium content			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
						Season 2022						
Hb0%	25.34 E	26.90 D	26.13 DE	**26.12 C**	0.272 C	0.326 A-C	0.289 BC	**0.296 B**	0.600 F	0.697 B-E	0.678 C-E	**0.658 C**
Hb15%	30.42 B	30.84 B	30.74 B	**30.67 A**	0.319 A-C	0.340 AB	0.320 A-C	**0.322 AB**	0.648 EF	0.732 BC	0.702 B-E	**0.694 BC**
Hb30%	29.99 B	33.67 A	28.58 C	**30.75 A**	0.338 AB	0.346 A	0.333 AB	**0.339 A**	0.665 DE	0.822 A	0.742 B	**0.743 A**
Hb45%	28.76 C	28.30 C	28.84 C	**28.63 B**	0.324 A-C	0.335 AB	0.324 A-C	**0.328 AB**	0.657 DE	0.735 B	0.711 B-D	**0.701 B**
Mean	**28.63 B**	**29.93 A**	**28.57 B**	-----	**0.313 A**	**0.337 A**	**0.317 A**	----	**0.6424 C**	**0.747 A**	**0.708 B**	---
						Season 2023						
Hb0%	26.11 G	29.79 D-F	28.39 F	**27.10 C**	0.290 C	0.344 A-C	0.307 BC	**0.314 A**	0.625 F	0.712 C-E	0.705 DE	**0.681 C**
Hb15%	29.36 EF	32.75 BC	30.65 C-E	**30.92 B**	0.342 A-C	0.355 AB	0.348 AB	**0.348 A**	0.664 EF	0.7620 BC	0.710 C-E	**0.712 BC**
Hb30%	29.95 D-F	35.42 A	34.50 AB	**33.29 A**	0.328 A-C	0.374 A	0.348 AB	**0.350 A**	0.677 EF	0.847 A	0.769 B	**0.764 A**
Hb45%	31.63 CD	31.27 C-E	28.41 F	**30.44BC**	0.343 A-C	0.344 A-C	0.354 AB	**0.347 A**	0.715 B-E	0.748 B-D	0.718 B-E	**0.727 B**
Mean	**29.26 C**	**32.31 A**	**30.49 B**	-----	**0.326 B**	**0.3541 A**	**0.339 AB**	---	**0.670 C**	**0.767 A**	**0.725 B**	----

Table (4). Effect of different summer pruning treatments on fruit set%, fruit weight (g), and number of fruits of Solitaire apricot trees (2021/2022 and 2022/2023).

Treat.	Fruit set (%)				Fruit weight (g)				Number of fruits/tree			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
Season 2022												
Hb0%	14.05D-F	16.52 B	15.34 B-D	**15.30BC**	34.60 D	36.37 CD	35.66 CD	**35.54 C**	484.0 C	449.0 F	428.0 G	**453.7 B**
Hb15%	12.72 F	15.91 B	14.22 C-E	**14.28 B**	34.95 D	36.32 CD	37.90 BC	**36.39 B**	397.0 H	505.0 B	462.0 E	**454.7 B**
Hb30%	15.50 B-D	18.77 A	15.64 BC	**16.64 A**	36.53 CD	45.26 A	39.95 B	**40.58 A**	472.0 D	567.0 A	390.0 H	**476.3 A**
Hb45%	10.36 F	13.46 EF	13.30 EF	**12.37 D**	29.68 E	34.32 D	31.76 E	**31.92 D**	422.3 G	426.0 G	429.0 G	**425.8 C**
Mean	**13.16 C**	**16.17 A**	**14.63 B**	**----**	**33.94 C**	**38.07 A**	**36.32 B**	**------**	**443.8 B**	**486.8 A**	**427.3 C**	**------**
Season 2023												
Hb0%	13.15 DE	17.80 B	14.11 CD	**15.02 B**	34.72 F	38.70 C	36.33 DEF	**36.58 C**	594.7 D	621.7 BCD	523.7 E	**580.0 B**
Hb15%	12.50 EF	16.64 B	15.33 C	**14.82 B**	35.16 EF	38.20 CD	37.95 CD	**37.10 B**	586.0 D	659.3 B	650.3 BC	**631.87 AB**
Hb30%	14.27 CD	22.15 A	17.20 B	**17.87 A**	37.40 CDE	46.52 A	42.15 B	**42.02 A**	576.7 DE	759.3 A	607.3 BCD	**647.8 A**
Hb45%	11.56 F	11.42 F	11.61 F	**11.48 C**	29.50 G	34.53 F	30.64 G	**31.56 D**	464.7 F	599.0 CD	418.3 F	**494.0 C**
Mean	**12.87 C**	**17.00 A**	**14.56 B**	**----**	**34.19 C**	**39.49 A**	**36.77 B**	**-----**	**555.5 C**	**659.83 A**	**549.9 B**	**------**

Table (5). Effect of different summer pruning treatments on fruit length (cm), fruit diameter (cm) and fruit retention of Solitaire apricot trees (2021/ 2022 and 2022/ 2023).

Treat.	Fruit length (cm)				Fruit diameter (cm)				Fruit retention (%)			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
Season 2022												
Hb0%	3.657 BC	4.000 AB	3.863 AB	**3.919 A**	3.933 C	4.067 BC	4.067 BC	**4.022 B**	60.11 F	66.38 D	65.33 DE	**63.49 C**
Hb15%	3.403 C	4.333 A	4.033 AB	**3.923 A**	4.167 BC	4.200 A-C	4.200 A-C	**4.189 A**	72.00 C	75.00 B	63.47 E	**70.16 B**
Hb30%	4.067 AB	4.367 A	4.200 A	**4.211 A**	4.200 ABC	4.533 A	4.233 A-C	**4.322 A**	64.36 DE	80.47 A	74.30 BC	**73.04 A**
Hb45%	4.067 AB	4.033 AB	4.067 AB	**4.056 A**	4.067 BC	4.333 AB	4.333 AB	**4.244 A**	55.20 H	58.40 FG	56.32 GH	**56.64 D**
Mean	**3.798 B**	**4.183 A**	**4.058 A**	**-------**	**4.092 B**	**4.283 A**	**4.208 AB**	**-----**	**62.92 C**	**70.06 A**	**64.86 B**	**------**
Season 2023												
Hb0%	4.300 AB	4.067 B	4.067 B	**4.145 A**	4.000 D	4.167 B-D	4.100 CD	**4.089 C**	65.43 DE	68.15 CD	65.71 DE	**66.43 B**
Hb15%	3.067 C	4.033 B	4.400 AB	**3.833 B**	4.200 B-D	4.400 A-C	4.100 CD	**4.233 BC**	70.36 C	74.51 B	64.20 E	**69.69 A**
Hb30%	4.133 AB	4.533 A	4.367 AB	**4.344 A**	4.133 B-D	4.600 A	4.433 AB	**4.389 A**	68.42 CD	78.50 A	63.14 E	**70.02 A**
Hb45%	4.000 B	4.367 AB	4.200 AB	**4.189 A**	4.100 CD	4.300 A-D	4.367 A-C	**4.256 AB**	52.00 F	53.12 F	50.00 F	**51.71 C**
Mean	**3.875 B**	**4.250 A**	**4.258 A**	**----------**	**4.108 B**	**4.367 A**	**4.250 AB**	**------**	**64.05 B**	**68.57 A**	**60.76 C**	**-----**

Table (6). Effect of different summer pruning treatments on fruit size (cm^3), fruit firmness, and yield (kg /tree) of Solitaire apricot trees (2021/ 2022 and 2022/ 2023).

Treat.	Fruit size (cm^3)				Fruit firmness				Yield (kg /tree)			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
						Season 2022						
Hb0%	33.33 E	36.67 C	40.00 B	**36.66 B**	1.700 DE	1.827 C-E	2.217 BC	**1.915 AB**	15.59 EF	16.33 DE	15.27 FG	**15.73 C**
Hb15%	36.67 C	36.67 C	36.67 C	**36.67 B**	1.470 E	2.190 BC	2.300 BC	**1.987 B**	16.49 D	20.59 B	14.79 F-H	**17.29 B**
Hb30%	35.67 D	46.67 A	40.13 B	**40.82 A**	2.197 BC	2.900 A	2.560 AB	**2.552 A**	14.51 GH	22.86 A	18.47 C	**18.61 A**
Hb45%	31.63 F	33.33 E	33.33 E	**32.76 C**	1.400 E	2.041 CD	1.843 CDE	**1.761 CD**	14.36 H	15.44 F	14.48 GH	**14.76 CD**
Mean	**34.33 C**	**38.33 A**	**37.53 B**	------	**1.692 B**	**2.240 A**	**2.230 AB**	-----	**15.24 C**	**18.80 A**	**15.75 B**	-----
						Season 2023						
Hb0%	33.15 E	36.54 D	41.12 C	**36.94 C**	1.420 G	2.350 BC	2.220 CDE	**1.996 B**	20.95 A-C	23.73 A-C	21.56 A-C	**22.08B**
Hb15%	36.78 D	37.41 D	37.50 D	**37.23 B**	1.730 F	2.497 B	2.110 DE	**2.112 AB**	21.82 A-C	26.31 AB	19.42 BC	**22.52 B**
Hb30%	36.95 D	48.20 A	43.60 B	**42.92 A**	2.290 CD	2.947 A	2.500 B	**2.579 A**	24.81 AB	27.61 A	24.59 AB	**25.67 A**
Hb45%	30.00 F	33.00 E	33.42 E	**32.14 D**	1.355G	2.250 C-E	2.060 E	**1.888 BC**	16.97 C	23.49 A-C	19.86 BC	**20.11 C**
Mean	**34.22 B**	**38.79 A**	**38.91 A**	----	**1.699 C**	**2.511 A**	**2.223 B**	-------	**21.14 B**	**25.29 A**	**21.36 AB**	-----

(B) Chemical characteristics of fruits:

1- Total soluble solids (TSS %), total acidity (%), and TSS/acidity: It was noticed from **Table (7)** that the TSS, total acidity and TSS/acidity of apricot trees Solitaire cultivar were significantly affected by summer pruning types and all interactions between them under study. The results of TSS, and total acidity in **Table (7)** showed that the different treatments of pruning had a higher TSS content and total acidity% when using 30% of head back, or 25% of thinning pruning only in both seasons than other treatments in the study. Also, the double interaction treatments of pruning the highest result of TSS content and the total acidity in the two seasons of study when using 30% HB with 25 %TP.

In addition, the effect of types of summer pruning in **Table (7)** showed that the treatment at 45 % head back pruning had a higher TSS/acidity in one season. However, treatments 30 or zero in the same type of pruning recorded the highest TSS/acidity in the second season. Also, data of treatment at 25%of thinning pruning recorded the highest results in both seasons followed by zero, and 50%. The double 45% head back pruning + zero% thinning pruning in the first season increased the results of TSS/acidity but, the interaction at 15% HB+ 25% TP, and 45% HB + zero% TP or zero HB+25% TP recorded the highest results of TSS/acidity than other of interactions in the study.

2- Total sugars (%) and vitamin C (mg/100 ml): Data on total sugar content and vitamin C in **Table (8)** confirmed that the total sugar content and vitamin C of Solitaire apricot trees in the summer (HB or TP) pruning and their interactions were significant in both seasons. The treatments of pruning HB 30% only affected the increase in total sugar content and vitamin C compared to the other pruning treatments in the same season. Also, the treatment of TP 25 % only significantly increased the total sugar content and vitamin C of Solitaire apricot trees followed by TP 50 or 0 % in the same season. In addition, the interaction of treatments of the summer pruning HB 30% with TP 25% showed the highest total sugar content and vitamin C of Solitaire apricot trees in both seasons.

The obtained results of the chemical characteristics of fruits are in line with Eiada et al. (2012) found that the head back pruning treatment 40, or 50% had the greatest chemical fruit characteristics however, the time treatments were unaffected by dry matter percentage in leaves, TSS, and acidity. Yehia et al. (2019) reported that 60% of the thinning pruning treatment obtained high chemical characteristics of Priana apricot trees, control (without thinning) was given the low chemical fruit characteristics.

Table (7). Effect of different summer pruning treatments on TSS%, total acidity%, and TSS/acidity% of Solitaire apricot trees (2021/ 2022 and 2022/ 2023).

Treat.	TSS (%)				Total acidity(%)				TSS/acidity			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
Season 2022												
Hb0%	15.33 FG	16.36 D	18.30 B	**16.66 B**	1.220 BC	1.270 AB	1.170 C-E	**1.220 A**	12.57 FG	12.88 F	15.64 B	**13.69 C**
Hb15%	15.17 G	17.62 C	16.11 DE	**16.30 BC**	1.150 DE	1.130 EF	1.200 CD	**1.160 B**	13.19 DE	15.59 B	13.43 CD	**14.07B**
Hb30%	15.72 EF	19.25 A	16.10 DE	**17.02 A**	1.190 CD	1.283 A	1.217 BC	**1.230 A**	13.21 DE	15.00BC	13.23 E	**13.81 C**
Hb45%	15.00 G	15.94 DE	15.17 G	**15.37 C**	0.8500 G	1.080 F	1.150 DE	**1.027 C**	17.65 A	14.76 C	13.19 DE	**15.20 A**
Mean	**15.31 C**	**17.29 A**	**16.42 B**	-----	**1.102 B**	**1.191 A**	**1.184 A**	-----	**14.16 A**	**14.56 A**	**13.87 B**	------
Season 2023												
Hb0%	18.28 D	18.85 B-D	18.77 B-D	**18.63 B**	1.170 BC	1.160 C	1.240 A-C	**1.190 AB**	15.62 BC	16.25 A	15.14 C	**15.67 A**
Hb15%	16.25 EF	19.51 AB	18.86 B-D	**18.21 BC**	1.180 BC	1.160 C	1.260 AB	**1.200 AB**	13.77 D	16.82 A	14.92 CD	**15.17 AB**
Hb30%	19.29 A-C	20.19 A	18.91 B-D	**19.46 A**	1.210 BC	1.320 A	1.190 BC	**1.240 A**	15.94 B	15.29 C	15.89 B	**15.71 A**
Hb45%	15.60 F	17.05 E	18.47 D	**17.04 C**	0.960 D	1.180 BC	1.180 BC	**1.107 B**	16.25 A	14.45 CD	15.65 B	**15.45 AB**
Mean	**17.35 B**	**18.90 A**	**18.75 A**	-----	**1.130 B**	**1.205 A**	**1.217 A**	-----	**15.40 AB**		**15.40 AB**	-----

Table (8). Effect of different summer pruning treatments on total Sugars% and vitamin C (mg/100 mL) of Solitaire apricot trees (2021/ 2022 and 2022/ 2023).

Treat.	Total sugars (%)				Vitamin C (mg/100 ml)			
	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean	TP0 shoots/tree	TP25 shoots/tree	TP50 shoots/tree	Mean
Season 2022								
Hb0%	12.36 GH	21.95 C	15.00 EF	**16.44 C**	6.260 F	8.060 DE	7.420 EF	**7.250 C**
Hb15%	19.12 D	19.06 D	18.71 D	**18.96 B**	6.990 EF	9.460 ABC	8.810 BCD	**8.420 B**
Hb30%	14.10 FG	28.95 A	24.58 B	**22.54 A**	7.020 EF	10.69 A	9.650 AB	**9.120 A**
Hb45%	11.73 H	16.52 E	14.54 F	**14.26 D**	7.843 DE	8.963 BCD	8.263 CDE	**8.360 B**
Mean	**14.33 C**	**21.62 A**	**18.21 B**	------	**7.028 C**	**9.293 A**	**8.536 B**	----
Season 2023								
Hb0%	15.91 C	15.47 C	15.35 C	**15.58 C**	6.190 H	7.807 F	8.033 EF	**7.343 C**
Hb15%	13.24 C	19.33 ABC	17.32 C	**16.63 B**	7.020 G	9.600 B	8.950 CD	**8.523 BC**
Hb30%	17.50 BC	26.04 A	24.91 AB	**22.81 A**	7.160 G	10.83 A	9.790 B	**9.260 A**
Hb45%	12.61 C	15.20 C	15.13 C	**14.31 D**	8.663 D	9.100 C	8.250 E	**8.671 BC**
Mean	**14.81 B**	**19.01 A**	**18.17 AB**	-----	**7.258 C**	**9.334 A**	**8.756 B**	----

CONCLUSION

From the aforementioned results and discussions, it could be concluded that the summer pruning more successfully obtained a better light distribution in the canopy and efficient carbon allocation to fruiting shoots. Also, the apricot trees appeared a good response to all growth parameters, leaf mineral content, and physical and chemical fruit characteristics.

RECOMMENDATION

We can recommend using the interaction treatments of 30% head back pruning plus 25 % thinning pruning to obtain the best physical and chemical characteristics which reflect on the vegetative, flowering and fruiting quantity and quality compared to the other pruning treatments for Solitaire apricot trees.

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الملخص العربى

تأثير مستويات مختلفة من التقليم الصيفى على أشجار المشمش السوليتير

ألاء سامى عبدالرحمن، اسامه سعد مختار ، سامح كامل ابراهيم
قسم بحوث الفاكهة متساقطة الأوراق، معهد بحوث البساتين، مركز البحوث الزراعية

تم إجراء هذة الدراسة على أشجار مشمش صنف سوليتير عمر أربع سنوات مطعومه على أصل نيماجارد بمسافة 4 × 5 متر (210 شجرة/فدان) مزوعة في تربة رملية بمزرعة خاصة بمحافظة أسيوط خلال موسمين متتالين (2022/2021 و2023/2022). حيث تم معاملة أشجار المشمش سوليتير بمعاملات تقليم صيفي مختلفة على النحو التالي: 1- تقليم تقصير للافرع (HB): (15، 30 و 45 %)، 2- تقليم خف للافرع (TP) (0.0، 25 و 50 %). حيث كان الغرض الرئيسي من هذه التجربة هو دراسة تأثير التقليم الصيفي على سلوك النمو الخضري والثمري لاشجار المشمش السوليتير لتحسين الخصائص الفيزيائية والكيميائية لنمو الأشجار وزيادة المحصول ورفع القيمة الاقتصادية له. حيث أظهرت النتائج أن المعاملة المزدوجة بين تقليم التقصير 30% وتقليم الخف 25% أدت إلى الحصول على أعلى الصفات الفيزيائية والكيميائية والتي تنعكس على كمية ونوعية النمو الخضري والزهرى والإثمار مقارنة بباقى معاملات التقليم الأخرى خلال هذة الدراسة.