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Effect of Three Training Systems on "Aggezi" Olive Trees

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THIS WORK was conducted at an "Aggezi" olive orchard at the 6th of October city, 6th of October governorate. Trees were in the fifth and sixth years of the age, during 2006 and 2007growing seasons. The objective of this work to study the effect of three training systems (globe, monocone and vase) with 2,3&4 branches each, on the shoot growth, flowering, fruiting, yield and fruit quality. The obtained results showed that, the vase training system gave the highest values of the leaf and assimilation area compared to other systems on the olive tree in both growing seasons. Meantime, the 4 branches of the same training system gave the same analogous effect. Moreover, The 3 branches surpassed other treatments in shoot length, No. of leaves and internodes/shoot in the second one. The vase system also increased significantly the length of inflorescence in both seasons as well as number of inflorescences and flowers/shoot in the first season only compared to other systems. The 4 branches of the vase system increased significantly the No. of inflorescences and flowers/shoot in 2006 and 2007 respectively. The 4 branches of the monocone system surpassed other treatments in No. of female flowers/shoot and sex ratio in the second season. Although, there were nonsignificant differences between the three training systems in fruit set, fruit set percentage, flesh weight percentage and fruit weight, the vase system gave the highest significant values of the yield of fruits (Kg/tree) compared to other training systems in both seasons. In addition, the 2 branches of the vase system gave the highest value of fruit set and the 4 branches of the mono cone system gave the highest yield in the first one. Eventually, we can recommend the monocone system with 4 main branches as the best method of training systems in The 6th of October governorate, followed by the vase system with 2 branches.

Keywords: *Training systems, Aggezi olive, Globe, Monocone, Vase, Shoot growth, Flowering, Fruit characteristics and Yield.*

Aggezi olive cultivar is an autochthonous Egyptian table cultivar (Navero *et al.*, 2000). Moreover, it is one of the authentic cultivar for breeding new clones of olive through the project of genetic improvement in Egypt (1994-2000). The concept of pruning olive tree *(Olea europaea* L.*)* is necessary to maintain the balance between the tree vegetative growth and reproductive functions. The most important objective of pruning is the maximization of the productivity with improving fruit quality, besides delaying the onset of decline trees old age (Gucci & Cantini, 2000 and Munoz, 1989). The first real formation of pruning should be done when the tree produces the first large crop (real bearing), and not before because pruning in juvenile stage provokes heavy production losses

(Hartman *et al.*, 1960). Orchards where the trees have more than one trunk produce lower yield in the short and long-term than do plantations growing on single-trunk trees, although having the same number of trunks per feddan. Many types of training were practiced and were depend on several factors, soil type, climatology, variety, harvesting methods and local customs, the most widely spread types were the vase and globe like forms (Morettini, 1972). The scaffold branches forming the framework of the crown and the crown may have various aspects in the vase, globe and monocone shapes which are natural shapes, similar to the form of olive spontaneously adopts and it is typical in different areas of low rainfall and intense sunlight, coasts and others, meantime to ensure maximum crops in minimum time, bear as long as possible and produce fruits of satisfactory quality (Temsamani, 1983).

The objective of this work is the choosing of the best training system (Globe, monocone or vase) and number of scaffold branches for each one (2,3 or 4) which may achieve the best growth, maximum crop and fruit quality under The 6th of October governorate .

Material and Methods

Twenty seven, five years old "Aggezi" olive trees growing in the farm at the 6th of October city, 6th of October governorate. The soil farm is sandy loam and surface irrigation system is used. The olive trees were planted 6 X 6 meters apart. The training systems (globe, monocone and vase) with 2,3 and 4 branches each was carried out in November, (2005) . Treatments were arranged as split plot design, the main is training system and the sub is number of branches. Every treatment is represented by three trees. Winter fertilization was executed in a drench under the end of the tree shade with 1kg/tree Calcium super phosphate (15.5%P_2O_5), 500g. potassium sulphate (48%K_2O) and 500 g. ammonium sulphate (20.6%), the rest of nitrogenous fertilizers divided as follow: 1kg/tree ($(NH_4)_2$-SO_4) during January, 1kg in April and 1kg/tree in May. Data started to be collected in the two seasons (2006 and. 2007) as follows:

Vegetative growth

Shoot length (cm), No. of leaves/shoot, No. of internodes/shoot, leaf area (cm^2) using area meter CI-203 and assimilation area (cm^2).

Flowering characteristics

Number of inflorescence, length of inflorescence, Number of flowers/branch, Number of female flowers/branch, sex ratio (%) Number of fruit set/branch, fruit set (%).

Fruit characteristics and yield

Fruit and seed weight (g), flesh weight (g.), flesh weight percentage, and yield as (Kg)/tree.

Statistical analysis

The experiment included in this study followed a complete randomized design in factorial experiment. The obtained data was subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Differences between treatments were compared by Duncan's multiple rang test described in the SAS (SAS, 1986).

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Results and discussion

Shoot growth

As for the response of shoot length, number of leaves and internodes/shoot, leaf area and assimilation area to different pruning systems (global, monocone and vase) with two, three and four scaffold branches of "Aggezi" olive tree during 2006 and 2007 growing seasons, data in Table 1 revealed that the three pruning systems (global, monocone and vase) showed nonsignificant difference in shoot length, No. of leaves and No. of internodes /shoot in both growing seasons. Also, the leaf area and assimilation area of the three systems didn't take definite trend in the first season. However, the vase system surpassed the other two systems in both leaf area and assimilation area followed by the mono cone shape then the global one in the second season.

Concerning the response of the shoot growth, leaf area and assimilation area to the number of branches, It is obvious that, although there were nonsignificant differences between the number of branches (2,3&4) in the three systems of pruning as regard to the shoot length, No. of leaves/shoot, No. of internodes/shoot and the assimilation area in the first season, the three branches of the vase system were increased significantly the shoot length, No. of leaves/shoot and the No. of internodes/shoot more than the other treatments in the second one. On the contrary, the two branches of the global system gave the least values in the same characteristics during the same growing season. Whereas, leaf area of the trees with four branches in vase system gave the highest values compared to other treatments in both seasons and assimilation area gave the same analogous effect with two and four branches in the second season only. These results go in harmony with those of Fontanazza *et al.* (1987) Gucci & Cantini (2000) and Morettini (1972)

Flowering

As regards the response of flowering to different pruning systems *i.e* global, monocone and vase (Table 2), data showed that the No. of inflorescences were increased significantly by vase system followed by the monocone one compared to the global system in the first season, whileas there was nonsignificant difference between the three pruning systems in the second one. The vase system gave the highest significant values of inflorescence length and No. of flowers/shoot compared to the other systems in both 2006 & 2007 growing seasons. As for the No. of female flowers and sex ratio, the monocone system surpassed the vase and global ones in the second season, whereas there was nonsignificant difference in the first one.

TABLE 1. The effect of three training systems (global, monocone & vase) with 2,3and 4 scaffold branches on the shoot growth of "Aggezi" olive tree during 2006 and 2007 growing seasons.

Tree shape	No. of branches	Shoot length (cm)		No. of leaves/shoot		No. of internodes/shoot		Leaf area (cm^2)		Assimilation area (cm^2)/shoot	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Global	2	22.66 a	16.27 b	29.55 a	27.88 b	14.77 a	13.66 b	3.18 cd	3.06 d-f	94.29 a	86.04 b
	3	21.66 a	21.05 ab	29.33 a	30.31 ab	14.66 a	17.11 b	3.38 c	3.57 bc	98.83 a	108.16 ab
	4	25.77 a	22.22 ab	35.99 a	36.77 ab	18.33 a	17.72 b	3.04 cd	2.92 ef	109.10 a	107..48 ab
Average		23.37 A	19.85 A	31.63 A	31.66A	15.92 A	16.16 A	3.20 A	3.18 B	100.74 A	100.56 B
Monocone	2	20.89 a	21.49 ab	28.66 a	33.89 ab	14.33 a	17.94 b	3.15 cd	3.22 c-e	90.81 a	109.44a b
	3	23.22 a	20.98 ab	35.52 a	33.08 ab	16.11 a	16.75 b	3.25 c	3.13 d-f	115.73 a	103.45 ab
	4	29.88 a	21.16 ab	39.33 a	35.55 ab	19.66 a	17.78 b	3.34 c	3.39 b-d	131.72 a	120.50 ab
Average		24.66A	21.21 A	34.52 A	34.17 A	16.70 A	17.49 A	3.25 A	3.25 B	112.76 A	111.13 AB
Vase	2	23.77 a	20.77 ab	28.44 a	34.66 ab	17.55 a	19.05 ab	3.76 b	3.67 b	10.6.04 a	127.80 a
	3	20.33 a	22.55 a	33.11a	37.42 a	16.55 a	23.68 a	2.19 d	2.82 f	114.42 a	103.27 ab
	4	27.77 a	20.88 ab	37.11a	31.44 ab	19.66 a	15.64 b	4..57a	4.78 a	142.49 a	140.25 a
Average		23.96 A	21.40 A	32.59 A	34.51 A	17.92 A	19.46 A	3.75A	3.76 A	124.10A	127.88 A

*Means followed by the same (lower or higher case) letter within the same column are not significantly different , p = 0.05.

TABLE 2. The effect of three training systems (global, monocone & vase) with 2,3and 4 scaffold branches on the flowering of "Aggezi" olive tree during 2006 and 2007 growing seasons.

Tree shape	No. of branches	No. of inflorescences/shoot		Length of inflorescence		No. of flowers/shoot		No. of female flowers/shoot		Sex ratio	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Global	2	17.44 b	15.05 a	2.59 ba	2.57 b	16.07 ab	11.93 ab	6.20 ab	1.87 bc	38.45 a	15.65 d
	3	15.99 b	33.39 a	2.26 a	2.25 b	13.10 c	10.57 b	3.50 b	1.83 bc	27.46 a	18.16 cd
	4	22.00a b	18.61 a	2.57 a	2.54 b	16.55 a	11.33 ab	6.07 ab	3.87 ab	36.59 a	34.02 a-c
Average		18.48B	22.35 A	2.47 B	2.45 B	15.24 B	11.28 A	5.26 A	2.52 B	34.17 A	22.61 B
Monocone	2	20.33 ab	16.33 a	2.31 a	2.68 b	12.85 c	11.63 ab	4.55 b	3.80 ab	34.61 a	32.92 a-c
	3	20.00 ab	18.35 a	2.40 a	2.38 b	13.66 bc	11.30 bc	6.55 ab	4.03 ab	46.90 a	38.60 ab
	4	29.16 ab	15.00 a	2.45 a	2.41 b	17.70 a	12.20 ab	6.45 ab	5.30 a	36.84 a	42.92 a
Average		23.16 AB	16.56 A	2.39 B	2.49 B	14.72 B	11.38 A	5.85 A	4.38 A	39.45 A	38.15 A
Vase	2	21.99 ab	12.33 a	2.63 a	3.61 a	18.54 a	10.87 b	9.74 a	3.63 ab	52.77 a	33.46 a-c
	3	28.50 ab	17.76 a	3.02 a	3.03 ab	16.75 a	12.67 ab	5.70 ab	1.20 c	34.26 a	9.86 d
	4	33.25 a	8.92 a	2.85 a	2.80 b	16.05 ab	13.70 b	6.00 ab	3.05 a-c	38.24 a	22.33 b-d
Average		27.00 A	13.90 A	3.13 A	3.10 A	17.52 A	12.34 A	7.21 A	2.68 B	41.23 A	22.37 B

*Means followed by the same (lower or higher case) letter within the same column are not significantly different , p = 0.05.

In regard to the interaction effect of the number of branches under the three systems, the four branches of the vase system and two branches of the vase system gave the highest significant values in number of inflorescences/shoot and length of inflorescence compared to the other number of branches in the first and second seasons respectively. In contrast, the three branches of the global system gave the least value of the number and length of inflorescences/ shoot in the same season. Meanwhile, there was nonsignificant difference between treatments in the second and first ones, respectively.

As for the No. of flowers and No. of female flowers /shoot, the two branches of the vase system have the highest significant values compared to other treatments in the first season. On the other hand, two branches of the monocone system and three branches of the global system gave the least values of both number of flowers and number of female flowers respectively. Meantime, four branches of the vase system and monocone system surpassed other treatments in No. of flowers and No. of female flowers/shoot respectively in the second season. In contrast, the three branches of global and vase systems reduced significantly the No. of flowers and No. of female flowers/shoot respectively, in the same growing season (2007).

Four branches of the monocone system increased significantly the sex ratio in comparison with other No. of branches of the three pruning systems in the second season. On the contrary, the three branches of the vase system significantly minimized the sex ratio values. The response of the olive tree flowering characteristics to the training and pruning was reported by (Munoz, 1989 and Abou El-Kashab & El-Iraqy, 2005).

Fruit characteristics and yield

In regard to fruit set, fruit set percentage, flesh weight percentage and fruit weight as affected by pruning systems (Table, 3), there were non significant differences between the different systems of pruning in both 2006 & 2007 seasons. However in the interaction, the two branches of the vase system and the three branches of the monocone one gave the highest significant differences in the No. of fruit set and the fruit set percentage, respectively. On the contrary, the three branches of the global system gave the least significant values of both characteristics in the first season. For the rest of the treatments of the same characteristics, flesh weight percentage and fruit weight exhibited nonsignificant differences between the No. of branches of different pruning systems.

As regards, the effect of the three pruning systems (global, monocone& vase) on Aggezi olive tree yield, data revealed that the vase system gave the highest significant values (kg/tree) compared to other pruning systems in both growing seasons. In contrast to the global system and the monocone one gave the least yield values in the first and second seasons, respectively. These results are consistent with Munoz (1989) Fontanazza, (1984) and Temsamini, (1983) concluded that the limbs and scaffold branches of the permanent trunks should be lopped to increase the assimilation area which can be reflected on flowering and fruiting.

Concerning the interaction. the four branches of the monocone system increased significantly the yield compared to other number of branches of the three pruning systems in the first season. In reverse, the three branches of the global system exhibited the least value of the yield. However, there was nonsignificant difference in the yield in the second one.

The training and pruning of olive trees techniques requires an understanding of the biology and the plants interaction with its environment variability which reflected on the production from year to year (Gucci & Cantini, 2000; Temsamini, 1983 and Munoz, 1989).

Interestingly, the vas system with different branches consistent with the lopped shape (Temsamini, 1983), and this may be reflected on the growth and production (Munoz, 1989). Therefore, we can recommend the monocone training system with 4 branches and the vase system with 2 branches for Aggezi olive tree (shown in Fig 1&2) as the best methods of training on "Aggezi" olive tree under the conditions of 6 of October governorate, in Egypt.

TABLE 3. The effect of three training systems (global, monocone & vase) with 2,3and 4 scaffold branches on the fruits and yield of "Aggezi" olive tree during 2006 and 2007 growing seasons.

Tree shape	No. of branches	No of fruit set/shoot		Fruit set percentage		Flesh weight percentage		Fruit weight (g.)		Yield (Kg/tree)	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Global	2	3.50 a-c	3.38 a	21.72 ab	28.40 a	5.89 a	5.93 a	6.83 a	6.87 a	10.33 c	5.67 a
	3	2.40 c	2.46 a	18.45 b	23.65 a	6.96 a	6.93 a	7.84 a	7.83 a	7.67 c	5.00 a
	4	5.30 ab	3.31 a	31.99 a	29.19 a	6.53 a	6.49 a	7.44 a	7.41 a	13.50 bc	11.67 a
Average		3.73 A	3.05 A	24.06 A	27.08 A	6.46 A	6.45 A	7.37 A	7.37 A	10.50 B	7.44 AB
Monocone	2	3.13 bc	2.86 a	24.25 ab	24.49 a	6.89 a	6.93 a	7.78 a	7.82 a	9.00 c	5.67 a
	3	4.53 a-c	4.33 a	32.98 a	42.63 a	5.79 a	5.82 a	6.84 a	6.85 a	23.33 a-c	5.00 a
	4	4.67 ab	3.39 a	26.38 a	28.18 a	6.56 a	6.55 a	7.45 a	7.43 a	38.33 a	7.67 a
Average		4.11 A	3.53 A	27.87 A	31.77 A	6.41 A	6.43 A	7.35 A	7.36 A	23.56 A	6.11 B
Vase	2	5.60 a	4.33 a	30.24 ab	40.25 a	6.17 a	613 a	7.14 a	7.16 a	35.33 ab	15.00 a
	3	4.40 a-c	3.43 a	26.43 ab	27.56 a	6.16 a	620 a	7.08 a	7.07 a	29.00 a-c	12.33 a
	4	3.40 bc	3.58 a	20.89 ab	27.73 a	6.21 a	6.22 a	7.16 a	7.16 a	23.50 a-c	11.33 a
Average		4.31 A	3.68 A	24.66 A	31.02 A	6.17 A	6.18 A	7.13 A	7.13 A	29.44 A	12.89 A

Means followed by the same (lower or higher case) letter within the same column are not significantly different , p = 0.05.

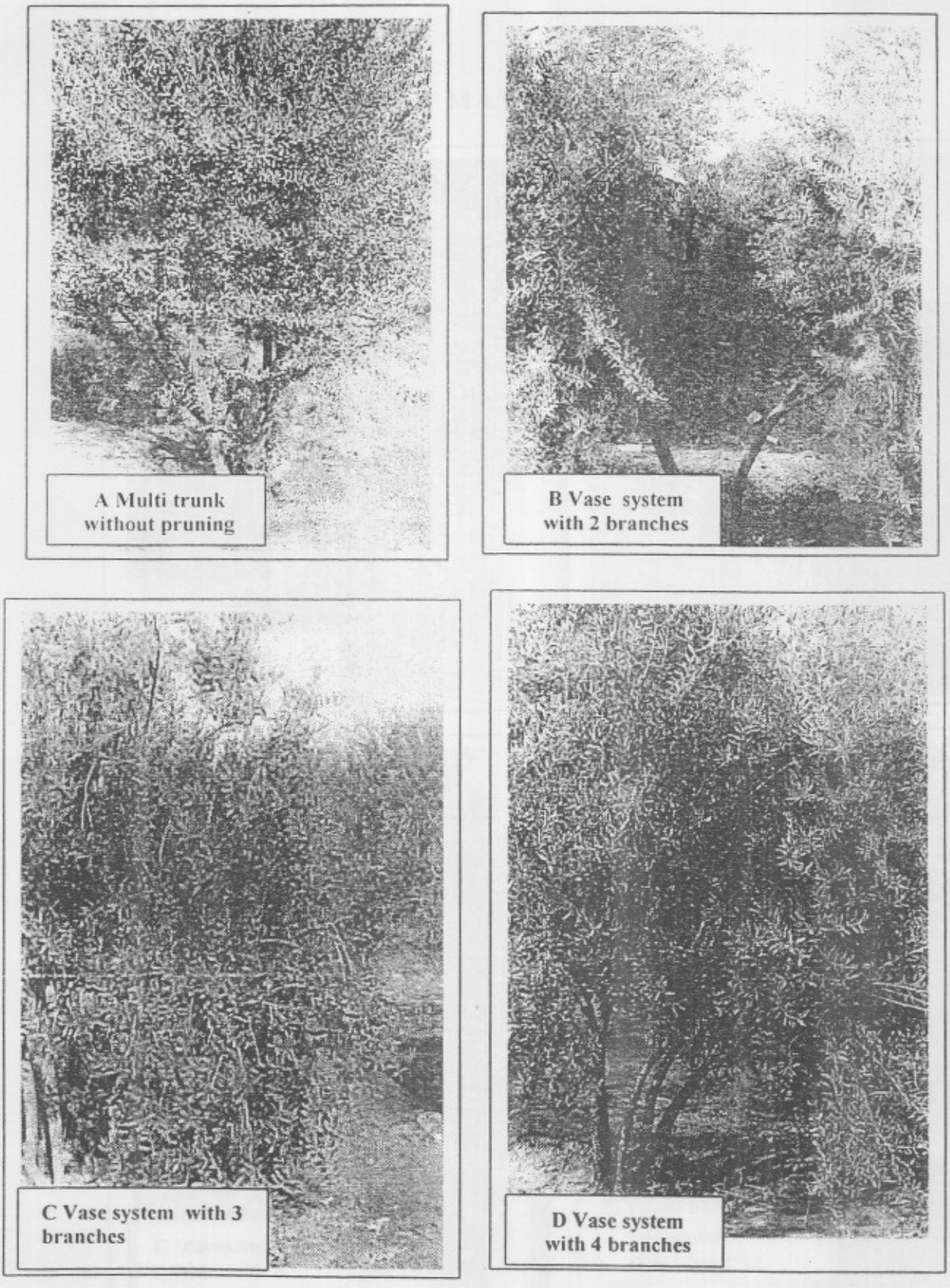

Fig. 1. A comparison between the multi trunk tree and the vase training system with different branches number.

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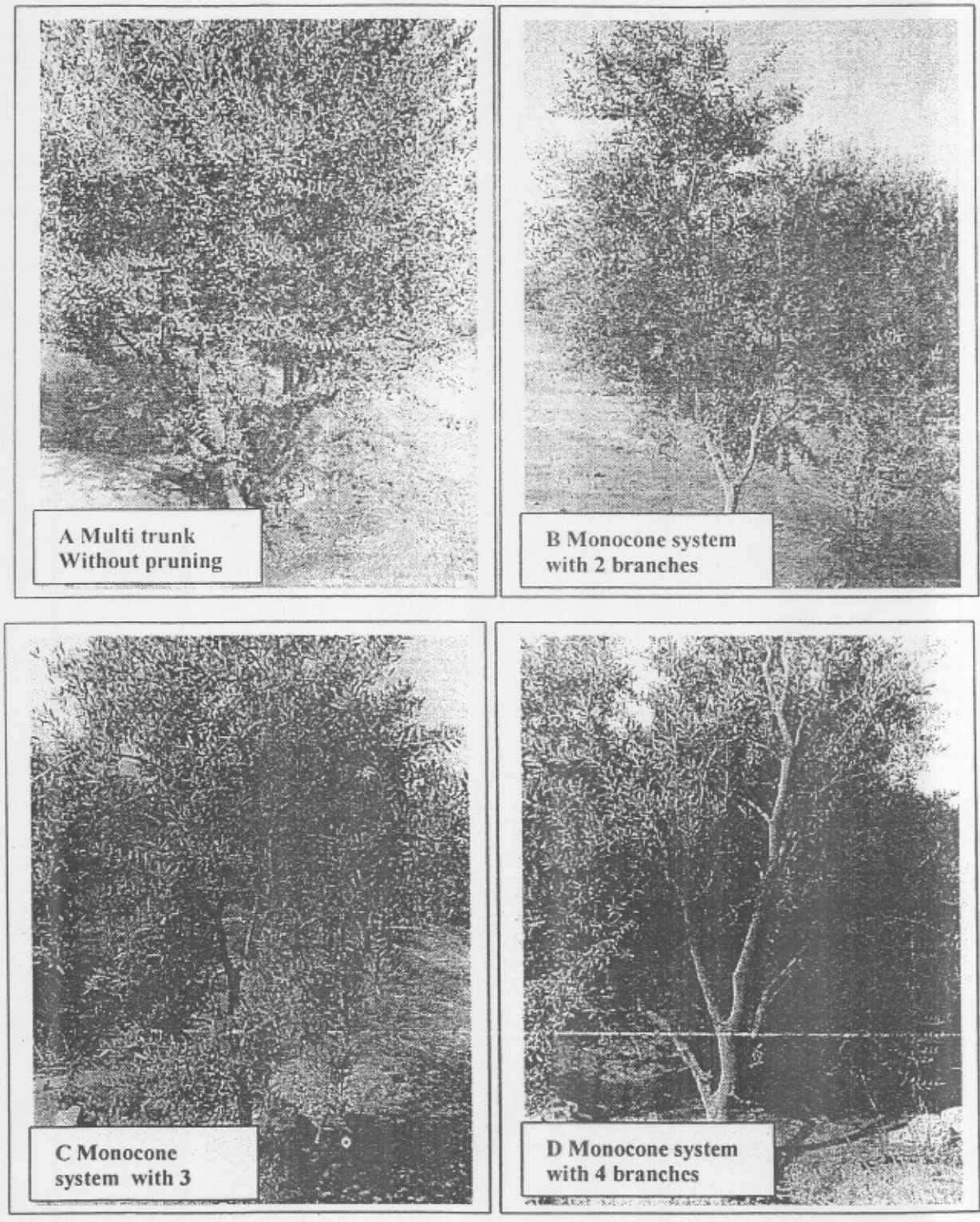

Fig. 2 . A comparison between the multi trunk tree and the monocone training system with different branches number.

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تأثير ثلاث نظم تربية على أشجارالزيتون صنف العجيزى

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تم تنفيذ هذا البحث فى مزرعة بمدينة ٦ أكتوبر محافظة السادس من أكتوبر. وكانت الأشجار عمر ٥ سنوات. والهدف من هذا البحث هو دراسة تأثير ٣ نظم من التربية (كروى و مخروطى و كأسى) مع عدد ٢و ٣ و٤ أفرع لكل نظام على النمو الخضرى والزهرى والثمرى والمحصول لأشجار الزيتون صنف "العجيزى" أثناء موسمى النمو ٢٠٠٦ و ٢٠٠٧. وكانت النتائج كالآتى:

أعطى نظام التربية الكأسية مع ٤ أفرع هيكلية أعلى مساحة ورقية ومساحة تمثيلية للأوراق فى كلا موسمى النمو وطول النورة وعدد النورات والأزهار على الفرع فى موسم النمو الأول. فى حين أعطى نظام التربية على ٤ أفرع لنفس النظام زيادة فى عدد النورات والأزهار فى كلا موسمى النمو.

على الرغم من أنه لم يكن هناك أى فروق معنوية بين النظم الثلاثة للتربية فى عقد الثمار والمواصفات الثمرية ووزن الثمرة إلا أن النظام الكأسى أعطى أعلى قيمة معنوية للمحصول. علاوة على أن النظام الكأسى مع ٢ أفرع هيكلية والنظام المخروطى الأحادى مع ٤ أفرع أعطى اعلى إنتاج (كجم/شجرة) خلال موسمى النمو. ومن هنا نستطيع أن نوصى من خلال الدراسة ، أن نظام التربية المخروطية مع عدد ٤ أفرع رئيسية هو أفضل طرق التربية للزيتون "العجيزى" فى محافظة ٦ أكتوبر يليه التربية الكأسية مع عدد ٢ أفرع رئيسية.