EFFECT OF PLANTING DISTANCE AND TRAINING SYSTEM ON FRUIT SET AND YIELD OF MANFALOUTY POMEGRANATES

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Abstract: This investigation was carried out at the experimental orchard of Assiut University during 1992 and 1993 seasons. The main objective was to study the effect of certain planting distances and number of main stems (trunks) per trees on flowering and fruiting responses of pomegranate. The results of this experiment could be summarized in the following points;

1- Neither spacing treatments nor single - or multiple - trunk systems had any considerable effects on percentage of perfect flowers relative to total number of perfect flowers/tree.

2- The widest spacing together with training Manfalouty pomegranate tree in 3 or 4 main stems induced the highest values of initially fruit setting.

3- The percentage of ultimate fruit retention relative to total number of perfect flowers/tree was not statistically influenced with spacing treatments, number of main stems/tree or their combination. Nevertheless, the widest spacings (3.5 - 5.0 m apart) and multiple-trunked systems (3 or 4 main stems) slightly promoted the ultimate fruit retention at harvesting date.

4- Fruit yield (kg) per tree increased as the distance between trees or as the number of main stems/tree were increased.

From this study, it could be recommended that the widest spacing (5 m) together with training tree into 3 or 4 main stems/tree were responsible to improving the perfect flower percentages and yield.

Introduction

In Egypt, pomegranate fruits are an important cash crop because they have several nutritive, industrial and medicinal values. Manfalouty (*Punica granatum*, L.) is considered the most principal cultivar grown in Assiut governorate where pomegranate culture is grown commercially. Recently, there has been an increasing demand for this to meet the needs of local as well as the foreign markets.

The actual planting distances and number of main stems of pomegranate plant in the orchard are of great importance factors which control the successful growth and the

productivity of the orchard, Hayes (1970). Kulenkamp *et al.* (1981) recorded that most of pomegranate roots were in the top 60 cm deep and spread 1 m from the trunk.

Faiziev (1973) studied the response of some pomegranate cvs. to spacing on (5x3, 4x2.5 or 4x1.5 m) and found that the highest yields were obtained from the closest spacing.

Popenoe (1974) reported that when pomegranate plants are planted in orchard form, the bushes should be set 12 to 18 feet apart. The standard planting distance is 20x20 feet, whereas planting closer than 18x18 feet is not normally recommended for commercial pomegranate production (The Division of Agricultural Sciences in California, 1977).

Kutuzova (1984) tested 5 spacings densities for some pomegranate cvs. He found that spacings of 3x2.5 or 4x2 m produced high and economic yields of good quality fruits.

Regarding related fruits, individual high tree yields of apples could be achieved under higher planting distance, Khaak (1985), Blizzard *et al.* (1988) and Palmer *et al.* (1992). Similarly, finding were found by Pepelyankov and Grnevski (1986) and Alekseeva (1996) on pear and peach trees, respectively.

As Training systems, some young and mature trees of pomegranate are subjected to considerable injury of infestation of certain stem borers. Hence, trees have to train to several main stems to avoid such infestation as well as to promote more fruit yield.

Takhamzov and Aliev (1975) studied the effect of training method of some pomegranate cvs on their economic production. Plants were trained with 1, 2, 4 (control), 6, 8, or 10 main branches/tree. They found that the most economic method were the 6-branch trees owing to high yield and ease of picking.

Pomegranates trees may be trained to a bush, single-or multiple trunked tree (Anonymous, 1977).

The merits of this study were finding out the effect of certain planting distance and training to single and multiple-trunk systems on the flowering, fruit set and yield of pomegranate.

Materials and Methods

This investigation was carried out during 1992 and 1993 seasons on 6 years - old on Manfalouty pomegranate trees(*Punica granatum*, L.) grown on clay soil in the experimental orchard of Assiut University.

Planted 108 trees at spacing of (5x5, 3.5x3.5 or 2.5x2.5 m) were chosen according to their vegetative

growth. Each planting distance was divided into four training system according to number of main trunks (1, 2, 3 or 4 trunks/tree). Thus, this experiment was set up in a split plot design including 3 main planting distances (as main plots), and 4 training systems (as sub-plot). Both the main plots and sub plots were replicated three times giving a total actual number of 108 trees (3x3x4x3 = 108 trees). The effect of these treatments of planting density and multiple-trunk system on flowering and fruiting responses were determined.

During the flowering season all perfect and male flowers were counted and labeled. At the end of flowering season, the percentage of perfect flowers were estimated relative to total produced number of them. Whereas, initial fruit set and ultimate fruit retention percentages were estimated relative to total perfect flowers. Fruit yield was evaluated as (kg/tree). All fruits were harvested in bulk at once as the recommended maturity standard outlined by El-Kassas (1984) and El-Kassas *et al.* (1989).

Statistical analysis was carried out according to Snedecor and Cochran (1980). Treatment means were compared according to Duncan's multiple range test at 0.05 level of probability.

Results and Discussion

The discussion of data obtained deals with the specific effect of each of planting distances and multiple-trunk systems on flowering and initial fruit set as well as ultimated fruit retention percentages and yield of Manfalouty pomegranate under Assiut environmental conditions:

1. Flowering:

The percentage of perfect flowers relative to total number of flowers/tree:

Table (1) show the combined effects of planting distance and number of main stems per bush on perfect flowers relative to two types of flowers. It could mentioned that the widest spacing (5 m) together with single trunk tree could produce the highest density of perfect flowers. This was obvious during 1992 season. However, all training systems were equally effective under the widest spacing in producing the highest density during 1993 season. This result emphasized that the widest spacing has the pronounced effect rather than number of main stems per bush especially during 1993 season. The two factors appeared to affect the percentage of light interception and consequently affect on the rate of photosynthesis which indirectly promote flower bud formation.

From the aforementioned results and discussion, it could be concluded that the proportion (as percent) of perfect flowers relative to total types of perfect and male flowers was affected mainly with planting distance rather than number of stems per bush of Manfalouty pomegranate. The widest spacing (5 m) produced the highest density as compared with moderately (3.5 m) or closest (2.5 m apart) spacings. The effect of number of stems per bush on the density of perfect approved the single trunk tree.

2. Fruit set:

2.a. The initial fruit set relative to total perfect flowers/tree:

Table (2) show the combined effects of spacing treatments and number of main stems/tree on the percentage of initial fruit set during 1992 and 1993 seasons. The widest spacings (5 m apart) together with training the Manfalouty pomegranate with 3 or 4 main stems could produce the highest values of initially fruit setting.

Generally, it could be concluded that the initial fruit setting relative to number of perfect flowers was affected with planting distance, number of stems/tree and combination of both. The highest values could be produced under the widest spacing (5 m) and when plants were trained to 3-4 main stems. The initial fruit set follows the specific effect of each of spacing treatments and number of main stems/tree when the combined effects of both factors were compared.

2.b. Ultimate fruit retention relative to total number of perfect flowers per tree:

The combined effects between spacing treatments and number of main stems/tree on ultimate fruit retention were found in Table (3). It could be concluded that the widest spacing and leaving 3 or 4 main stems/tree could produce the highest values of ultimate fruit retention. Such finding was obvious especially during 1992 season.

Additionally, the highest values of ultimate fruit retention were found when pomegranate tree was trained to 4 main stems together with 5 m planting distance, Table 3.

From the aforementioned results and discussion, it could be concluded that pomegranate is characterized by little drop of fruits at all stages of development throughout the growing season. Slight insignificant higher percentage was observed under widest spacings, 4 main stems/tree.

3. Yield in kg per tree:

Data presented in Table 4 show the specific effect of planting distance, number of main stems/tree and combination of both on the yield (in kg/tree) of Manfalouty pomegranate tree.

The specific effect of planting distance on the yield in kg per tree showed gradual increase with increasing planting distance.

During 1993 season, the yield per tree appeared to be more twice the yield of 1992 season. However, the difference in such yield was only noticed under the closest spacing.

For instance, the yield in kg/tree (av. of 2 yrs) increased from 15.5 to 23.5 or 23.9 with increasing spacing from 2.5 to 3.5 or 5.0 m apart, respectively. Such findings were previously confirmed by numerous investigators; Khaak (1985), Alekseeva (1986), Pepelyankov and Grnevski (1986), Blizzard *et al.* (1988) and Palmer *et al.* (1992). They all found that individual tree of respective fruit could be high under wider spacing but result lower yield per area unit.

The specific effect of multiple-trunk systems on fruit yield in kg per tree showed an increase in fruit yield in kg/tree as the number of main stems was increased during 1992 and 1993 seasons.

The combined of planting distance and number of main stems per tree on fruit yield in kg/tree is shown in Table 4. Approximately similar trend was acquired during 1992 and 1993 seasons with only higher yield was noticed during 1993. Thus, the highest fruit yield in kg/tree was obtained under the widest spacing together with 3 or 4 main trunks per tree.

Table (1): Effect of planting distance and number of main stems per bush on percentage perfect flowers of Manfalouty pomegranate during 1992 and 1993 seasons.

Main stems per bush	Spacing treatments			
	5.0 m	3.5 m	2.5 m	Mean
	1992 season			
1	51.76 a	46.28 ab	37.42 bc	45.16 A
2	43.69 abc	45.88 ab	34.72 bc	41.43 AB
3	40.95 abc	42.83 abc	34.94 bc	39.57 AB
4	40.83 abc	32.10 c	36.75 bc	36.56 B
Mean	44.31 A	41.77 AB	35.96 B	
	1993 season			
1	46.01 ab	40.56 abc	33.24 cd	39.94 A
2	44.02 abc	40.95 abc	39.95 abc	41.64 A
3	49.67 a	43.60 abc	27.80 d	40.36 A
4	49.00 ab	40.13 abc	36.67 bcd	41.93 A
Mean	47.18 A	41.31 B	34.41 C	

Table (2): Initial fruit set of Manfalouty pomegranate as affected by planting distance and number of main stems per bush during 1992 and 1993 seasons.

Main stems per bush	Spacing treatments			
	5.0 m	3.5 m	2.5 m	Mean
	1992 season			
1	82.37 abc	74.44 bc	67.02 c	74.61 B
2	85.28 abc	76.21 abc	72.85 c	78.11 B
3	86.64 abc	77.61 abc	75.10 abc	79.79 AB
4	94.33 a	80.52 abc	92.86 ab	89.25 A
Mean	87.16 A	77.20 B	76.96 B	
	1993 season			
1	78.08 a	75.84 a	74.36 a	76.09 A
2	85.38 a	79.44 a	75.70 a	80.17 A
3	87.15 a	83.80 a	73.79 a	81.58 A
4	85.65 a	80.70 a	84.63 a	83.66 A
Mean	84.06 A	79.94 A	77.12 A	

Table (3): Effect of planting distance and number of main stems per bush on ultimate fruit retention of Manfalouty pomegranate during 1992 and 1993 seasons.

Main stems per bush	Spacing treatments			
	5.0 m	3.5 m	2.5 m	Mean
	1992 season			
1	71.69 ab	63.73 ab	55.40 b	63.71 A
2	76.20 a	72.54 ab	63.11 ab	70.62 A
3	76.74 a	71.11 ab	69.39 ab	72.41 A
4	82.95 a	71.44 ab	67.93 ab	74.11 A
Mean	76.90 A	69.70 AB	63.96 B	
	1993 season			
1	55.95 c	62.57 abc	58.29 bc	58.94 B
2	76.39 a	70.93 ab	75.35 a	74.22 A
3	63.17 abc	75.89 a	67.53 abc	68.87 A
4	72.43 ab	67.47 abc	65.67 abc	68.52 A
Mean	66.99 A	69.22 A	66.71 A	

Table (4): Effect of planting distance and number of main stems per bush on yield (in kg/tree) of Manfalouty pomegranate during 1992 and 1993 seasons.

Main stems per bush	Spacing treatments			
	5.0 m	3.5 m	2.5 m	Mean
	1992 season			
1	12.01 bc	8.76 cd	4.25 d	8.34 B
2	12.53 bc	13.24 bc	10.20 bcd	11.99 A
3	16.50 ab	15.03 abc	9.34 bcd	13.62 A
4	20.65 a	12.24 bc	9.61 bcd	14.17 A
Mean	15.43 A	12.32 B	8.35 C	
	1993 season			
1	23.25 cde	27.32 bcde	17.18 e	22.58 B
2	30.23 abcd	38.08 ab	20.24 de	29.52 A
3	35.09 abc	37.72 ab	25.26 cde	32.69 A
4	40.50 a	35.33 abc	28.17 bcde	34.67 A
Mean	32.27 A	34.61 A	22.71 B	

From the aforementioned results and discussion, it could be concluded that the fruit yield (kg/tree) consistently increased with increasing the planting distance. Regarding the effects of multiple-trunk systems on fruit yield, it could be concluded that, the more the number of main stems per tree, the more yield kg/tree was obtained. The fruit yield kg/tree was highest under the widest spacing together with 3 or 4 multiple trunk system.

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تأثير أبعاد الغرس وطريقة التربية على عقد الثمار وكمية المحصول للرمان المنفلوطى

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قسم البساتين – كلية الزراعة – جامعة أسيوط

أجريت هذه الدراسة على أشجار الرمان المنفلوطى المنزرعة فى مزرعة كلية الزراعة – جامعة أسيوط عام ١٩٩٢ – ١٩٩٣ وتم تصميم التجربة بنظام الأحواض المنشقة حيث كانت أبعاد الزراعة هى القطع الرئيسية متضمنة ثلاث معاملات رئيسية هى ٥ ، ٣,٥ ، ٢,٥ متر وداخل كل معاملة تم تربية أشجار بساق واحدة أو ٢ أو ٣ أو ٤ سيقان وأعتبرت القطع الشقية وكررت القطع الرئيسية والشقية ثلاث مرات وتم معرفة أثر ذلك على الصفات التالية :

١- نسبة الازهار الخنثى بالنسبة لمجموع الازهار الكلية / شجرة .

٢- نسبة العقد المبدئى بالنسبة للازهار الخنثى الكلية .

٣- نسبة العقد النهائى الكلى بالنسبة للازهار الخنثى الكلية .

٤- تقدير المحصول للشجرة الواحدة (كجم)

ويمكن تلخيص أهم النتائج التى أمكن الحصول عليها فيما يأتى :

١) لم تؤثر ابعاد الزراعة وطرق التربية على نسبة الازهار الخنثى مقارنة بمجموع الازهار الخنثى / شجرة .

٢) تزيد نسبة العقد المبدئى من الأزهار الخنثى كلما زاد مسافة الغرس وكذلك كلما زاد عدد السيقان / شجرة .

٣) لم يتأثر العقد النهائى بالنسبة لمجموع الازهار الخنثى / شجرة بأبعاد الزراعة أو طريقة التربية أو الأثر المتبادل بينهما . ومع ذلك فإن أوسع مسافات الزراعة وزيادة عدد السقان الى ٣-٤ / شجرة قد أعطى أعلى قيم العقد النهائى أثناء الحصاد .

٤) زاد محصول الأشجار (كجم / شجرة) نتيجة أبعاد الغرس أو عدد السيقان / شجرة فكان أحسن محصول عند الزراعة على أبعاد ٥ م والتربية على ٣-٤ فرع / شجرة .

ولذا توصى الدراسة بأفضلية الزراعة على ٥ م والتربية على ٣-٤ ساق / شجرة .