

ORIGINAL ARTICLES

Impact of Intercropping Ewaise Mangoes, Balady Mandarins and Solo Papayas with Zaghoul Date Palms on Growth, Rhizosphere Bacteria, Nutrients and Productivity of the Palms

Ibtesam F. M. Badawy

Hort. Dept. Fac of Agric, Assiut University, Egypt

ABSTRACT

This study was carried out during 2010 and 2011 seasons to evaluate the influence of intercropping Ewaise mangoes, Balady mandarins and Solo papayas with Zaghoul date palms on the leaf area, nutrients in the pinnae, total counts of bacteria in the rhizosphere, yield and fruit quality of Zaghoul date palms. Palms (pure stand) had a higher leaf area, nutrients, bunch weight, yield/ palm compared to palms intercropped with mangoes, mandarins and papayas. Rhizosphere of intercropped palms had greater total counts of bacteria rather than pure stand of palms. Growing Ewaise mangoes, Balady mandarins and Solo papayas with Zaghoul date palms had no negative effects on both physical and chemical characteristics of date fruits comparing with pure stand of palm. Yield of Zaghoul date palms was slightly declined with intercropping rather than cultivation of date palm alone. Intercropping date palms with Solo papayas gave the best results with regard to yield quantitatively and qualitatively comparing with the other intercrops. Intercropping Ewaise mangoes gave the highest net profit followed by Balady mandarins. Growing Ewaise mangoes or Balady mandarins with Zaghoul date palms could be recommended for obtaining the highest net return per unit area.

Key words:

Introduction

Egypt is considered to be one of the major date producing countries in the world. The number of females and the yield reached 12 million palms and 1.5 million ton fruits, respectively (2011 statistics). Date palms supply enough space for intercropping even if they are fully grown as they do not cover much area being a very tall tree (Akyurt *et al.*, 2002). Previous studies showed that it is possible to grow a mixed fruit orchard such as date palm intercropped with citrus (Morteon, 1987 and Ali *et al.*, 1988).

Polyculture is claimed to be one of the most considerable cropping techniques in sustainable agriculture to its utilization a number of environmental benefits from promoting land biodiversity to diversifying agricultural outcome. This model integrates low, medium and tall plants as well as plants of short, medium and long life cycles, including trees. Therefore, the tendency for exploitation the land under date palms whether for annual or perennial crops is increasing day by day to better utilization the microclimate and soils under date palm.

Previous studies showed that intercropping those trees that cultivated at wider spaces with various intercrops resulted in promoting net profit and at the same time had no considerable adverse effects on the yield and fruit quality of the main crop (Samson, 1970; Simon, 1978; Purseglove, 1978; Maharana and Das, 1981; Reuveni, 1986; Morteon, 1987; Bhuvu *et al.*, 1988; Ashour *et al.*, 1992a and 1992b; Ebrahiem and Haggag, 1993; El- Halawany and Shaltout, 1993; El- Hebshi, 1993; Ashour *et al.*, 1993; Abou- Rayya and Kassem, 1993; Ashour *et al.*, 1994; Warigley, 1995; Ali *et al.*, 1998; Ong *et al.*, 2000; Abou- Elail, 2001; Akyurt *et al.*, 2002; Ahmed and Mansour, 2003 and Abouziena *et al.*, 2010).

The merit of this study was testing the effect of intercropping of Ewaise mangoes, Balady mandarins and Solo papayas with Zaghoul date palms on the yield quantitatively and qualitatively of date fruits.

Materials And Methods

This study was conducted during two consecutive seasons of 2010 and 2011 on forty- eight 25 -years old offshoots derived Zaghoul date palms intercropped or not with grafted Ewaise mangoes trees, Balady mandarins trees (15 years old) as well as Solo papaya (one year old) in a private orchard located at Malawy district, Minia Governorate. The texture of soil is clay. Zaghoul date palms are planted at 10 × 10 meters apart, Balady mandarin and Solo papaya trees are planted at the center of distance among palms in separate plots. Surface irrigation system was followed. All horticultural practices that usually applied in the orchard concerning

the four fruit crops species were followed as usual. Number of bunches per each palm was adjusted to 8 at the following stage.

The present experiment included the flowering four treatments:-

- 1- Pure stand of Zaghoul date palms.
- 2- Intercropping Zaghoul date palms with Ewaise mango trees.
- 3- Intercropping Zaghoul date palms with Balady mandarin trees.
- 4- Intercropping Zaghoul date palms with Solo papaya trees.

Each treatment was replicated three times, four trees per each (plot). Complete randomized block design was followed.

Leaf area was calculated on one six- months old leaf per palm from which the medium four pinnae were taken for calculating the leaf area according to the equation reported by Ahmed and Morsy (1999). In this pinnae, percentages of N, P, K and Mg were determined according to the procedures that outlined by Wilde *et al.*, (1985).

Rhizosphere samples were collected from the depth of 15 – 30 cm adhering very closely to Zaghoul date palm roots. Rhizosphere from soil of pure stand and intercropped date palms (four treatments) were used to estimate the total counts of bacteria on the basis serial 10- fold dilutions (Johnson and Curl, 1972). Colony forming unites (CFW) were recorded after one week using extract agar medium modified by Mahmoud *et al.*, (1964).

At the peak of colour development (1st week of August), bunches per palm were harvested for determining, yield (kg.), bunch weight (kg.), fruit weight (g.), total soluble solids %, total and reducing sugars % and total acidity % (as g malic acid/ 100 pulp) (A.O.A.C., 1995). Soluble tannins % was determined using the method that outlined in Balbaa (1981).

The obtained data from each season were exposed to the proper statistical analysis of variance according to Mead *et al.*, (1993) using new L.S.D at 5 % for made all comparisons between means.

Results And Discussion

Leaf area and its content of N, P, K and Mg:

Data in Table (1) clearly show that leaf area and different nutrients in the palm pinnae were significantly varied according to various intercropping treatments. Intercropping Zaghoul date palms with Ewaise mangoes, Balady mandarins and Solo papayas significantly reduced the leaf area and the four macronutrients comparing with pure stand of Zaghoul date palms. A gradual and significant reduction on these characters were recorded with growing Solo papayas, Balady mandarins and Ewaise mangoes with Zaghoul date palms. The maximum values were recorded with using Solo papayas intercrop rather than the other intercrops. Intercropping Ewaise mango trees with Zaghoul date palms achieved the lowest values. Pure stand of Zaghoul date palm had the highest values. These results were true during both seasons.

The reduction on the leaf area and its content of macro nutrients might be attributed to the competition occurred on organic foods, mineral elements and water among the three intercrops of the major fruit crops.

These results are in agreement with those obtained by Ashour *et al.*, (1992a) and (1993) and Ahmed and Mansour (2003).

Total count of bacteria in the rhizosphere:

Data in Table (1) clearly show that total number of bacteria in the rhizosphere samples (d.w) ranged from 71 cfu x 10⁵ g to 270 cfu x 10⁵ g in the first season and from 79 cfu x 10⁵ g to 271 cfu x 10⁵ g in the second one. Intercropping significantly was responsible for increasing total number of bacteria rather than non-intercropping palms. Total number of bacteria increased from 71 in pure stand of date palms to 270 cfu x 10⁵ g in intercropped palms in the first season and from 79 to 271 cfu x 10⁵ g in the second season. Using Solo papaya intercrop with Zaghoul date palms significantly produced the maximum values (270 and 271 cfu x 10⁵ g during both season, respectively). Unintercropping (Sole palms) had the minimum values (71 and 79 cfu x 10⁵ g during 2010 and 2011 seasons, respectively). Similar results were announced during both seasons.

The beneficial of intercropping in enhancing microflora in the rhizosphere was attributed to the decomposable root debris and root exudates that amending the bacteria with the available source of nutrients to grow and proliferate (Allen, 1961).

These results are in approval with those obtained by Mohamed *et al.*, (1964).

Bunch weight and yield/ palm:

It is evident from the data in Table (2) that bunch weight and yield/ palm were slightly varied among the four intercropping treatments. Monoculture of Zaghoul date palm produced higher fruit yield/ palm rather than intercropping. No significant differences between Sole Zaghoul date palm and that intercropped with any intercrops (Ewaise mangoes, Balady mandarins and Solo papaya) on bunch weight and yield/ palm. Growing mandarins or papayas under date palm resulted in the highest fruit yield/ palm compared to intercropping with mangoes. The lightest bunch and the lowest yield were recorded on the palms that intercropping with mango. The highest yield (184 and 188 kg/ palm) was recorded on Sole Zaghoul date palms.

The slight reduction on both bunch weight and yield in response to intercropping might be attributed to the competition on organic and mineral foods among different date palms. The reducing effect of intercropping on growth and nutritional status of the trees surely reflected on lowering yield and its components.

Similar results were revealed by Abou- Elail (2001) and Ahmed and Mansour (2003).

Quality of the fruits:

Data in Table (2) clearly show that different intercropping patterns had no significant adverse effects on fruit quality comparing with pure stand of date palms. Growing Zaghoul date palms alone slightly improved quality of the fruits in terms of increasing fruit weight, total soluble solids %, total and reducing sugars % and reducing both total acidity and soluble tannins comparing with pure stand of date palms. The best intercrops in this connection was Solo papayas followed by mandarins and finally with mango trees. Similar results were announced during each season.

The reducing effect of intercropping on the yield might be attributed to the competition for different nutrients and water between the various crops.

The results of Abou- El- Lail (2001) and Ahmed and Mansour (2003) emphasized the present result.

Net profit:

Data in Table (3) obviously reveal that intercropping gave the highest net profit comparing with pure stand of date palms. The promotion was associated with intercropping date palms with Solo papaya, Balady mandarins and Ewaise mango trees, in ascending order. It could be concluded that intercropping Ewaise mango trees with Zaghoul date palms can be more profitable than growing pure stand of Zaghoul date palms. These results were true during both seasons.

The beneficial of intercropping on promoting net profit might be attributed to the summation of both yields of main crop and intercrops.

The results of El- Halawany and Shaltout (1993) who found that date palm plantation which is intercropped characterized by higher net profit rather than non- intercropping.

As a conclusion, it is suggested to intercropping Ewaise mango trees with Zaghoul date palms for utilization a number of environmental benefits from promoting and biodiversity to diversifying agricultural outcomes.

Table 1: Effect of intercropping Zaghoul date palms with Ewaise mangoes, Balady mandarins and Solo papaya on the leaf area, percentages of N, P, K and Mg in the pinnae, total bacteria counts and bunch weight of date palms during 2010 and 2011 seasons.

Character Intercropping treatment	Leaf area (m ²)		Leaf N %		Leaf P %		Leaf K %		Leaf Mg %		Total bacteria counts (cfu)		Bunch weight (kg.)	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Pure stand of palm *	2.3	2.3	1.62	1.66	0.36	0.32	0.99	0.96	0.39	0.43	71.0	79.0	23.0	23.5
Palm intercropped with mango **	1.9	1.9	1.21	1.25	0.22	0.23	0.83	0.83	0.30	0.32	211.0	216.0	22.0	22.5
Palm intercropped with mandarin ***	1.9	2.0	1.31	1.35	0.27	0.26	0.90	0.90	0.33	0.35	250.0	255.0	22.5	23.0
Palm intercropped with papaya ****	2.0	2.1	1.40	1.47	0.31	0.29	0.96	0.94	0.36	0.40	270.0	271.0	22.8	23.3
New L.S.D at 5 %			0.06	0.07	0.03	0.02	0.05	0.04	0.02	0.02	9.1	9.5	NS	NS

Zaghoul date palms

** Ewaise mango trees

*** Balady mandarin trees

**** Solo papaya trees

Table 2: Effect of intercropping Zaghoul date palms with Ewaise mangoes, Balady mandarins and Solo papaya on the yield per palm (kg.) as well as some physical and chemical characteristics of the fruits of date palms during 2010 and 2011 seasons.

Character Intercropping treatment	Yield/ palm (kg.)		Fruit weight (g.)		T.S.S %		Total sugars %		Reducing Sugars %		Total acidity %		Soluble Tannins %	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Pure stand of palm *	184.0	188.0	26.0	26.3	28.0	29.0	21.6	22.3	14.0	15.0	0.222	0.230	0.49	0.48
Palm intercropped with mango **	176.0	180.0	24.0	24.5	26.8	26.9	20.0	21.6	13.0	13.3	0.313	0.321	0.55	0.53
Palm intercropped with mandarin ***	180.0	184.0	24.5	25.0	27.0	27.2	20.5	22.0	13.5	13.9	0.291	0.299	0.53	0.51
Palm intercropped with papaya ****	182.4	186.4	25.0	25.5	27.5	27.7	20.6	22.8	14.0	14.5	0.271	0.280	0.52	0.50
New L.S.D at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

* Zaghoul date palms

** Ewaise mango trees

*** Balady mandarin trees

**** Solo papaya trees

Table 3: Effect of intercropping Ewaise mango trees, Balady mandarin trees and Solo papaya trees with Zaghoul date palms on net return (L.E/ Fed./ year) during 2010 and 2011 seasons.

Character Intercropping treatment	2010							2011						
	Yield Zaghoul date palm ton/ fed./ year	Price of selling	Yield of intercrops ton/ fed./ year	Price of selling intercrops	Total selling	Total costs	Net Profit	Yield Zaghoul date palm ton/ fed./ year	Price of selling	Yield of intercro ps ton/ fed./ year	Price of selling intercro ps	Total selling	Total costs	Net Profit
Pure stand of palm *	7.4	29600	---	---	29600	4000	25600	7.5	30000	--	--	30000	4000	26000
Palm intercropped with mango **	7.0	28000	4.0	20000	48000	9000	39000	7.2	28800	4.0	20000	48800	9000	39800
Palm intercropped with mandarin ***	7.2	28800	4.0	6000	34800	6000	28800	7.4	29600	4.0	6000	35600	6000	29600
Palm intercropped with papaya ****	7.3	29200	1.0	2000	31200	5000	26200	7.5	30000	1.0	2000	32000	5000	27000

* Zaghoul date palms

** Ewaise mango trees

*** Balady mandarin trees

**** Solo papaya trees

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