

## Physiological Studies on Intercropping of Some Legumes on Sewy Date Palms

Nagwa , R.A. <sup>1</sup> ; Faissal, F. Ahmed <sup>2</sup> and Al- Hussein, S.A. Hamad<sup>3</sup>

<sup>1</sup>Field Crops Res. Instit., ARC, Giza, Egypt.

<sup>2</sup>Hort. Dept. Fac. of Agric. Minia Univ. Egypt.

<sup>3</sup>Hort. Res. Instit. ARC. Giza. Egypt.

[faissalfadel@yahoo.com](mailto:faissalfadel@yahoo.com)

**Abstract:** This study was initiated during 2011/ 2012 & 2012/ 2013 seasons to evaluate the impact of intercropping three under story legume crops namely Egyptian clover, Balady fenugreek or field bean with the over story crop namely Sewy date palm on growth, yield and quality of main crop and the three intercrops in comparison with pure stand of these crops. Growth, palm nutritional status, yield and fruit quality of the main crop namely Sewy date palm were positively affected by all intercropping systems relative to the date palm sole. The best intercrop was Egyptian clover followed by fenugreek and field bean occupied the last position in this respect. Growth, yield and its attributes of the three intercrops did not change negatively with intercropping with Sewy date palm. Evaluation of growing clover, fenugreek or field bean with Sewy date palm indicated that growing clover with date palm could be used for combating desertification in sandy soil in arid land regions and gave the highest net return per unite area.

[Nagwa , R.A.; Faissal, F. Ahmed and Al- Hussein, S.A. Hamad. **Response Of Sakkoti And Bartemuda Date Palms To Spraying Seaweed Extract.** *World Rural Observ* 2014;6(4):81-88]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online). <http://www.sciencepub.net/rural>. 13

**Keywords:** Intercropping, legumes, Sewy date palms yield.

### 1. Introduction

Intercropping is claimed to be one of the most considerable cropping techniques in sustainable agriculture due to its utilization a number of environmental benefits from promoting land biodiversity to diversifying agricultural outcome. In Egypt, date palm, ranks the third position after citrus and grapevine (**Agricultural Economic Bulletin, 2013**). Palms provide enough space for intercropping even if they are fully grown as they do not cover much being very tall trees (**Akyurt et al., 2002**). Legumes may also be grown together with date palms (**Mahmoudi et al., 2008 and Shiraz, et al., 2008**). In addition, intercropping hindered the occurrence of pests in date palm orchards by shifting predator prey abundance.

Previous studies showed that intercropping date palms and other fruit crops that cultivated wide 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 under and overstory crops (**El- Hebshi, 1993; Abou- Rayya and Kassem, 1993; Mcintre et al., 2001; Abou- El-Lail, 2001; Akyurt et al., 2002; Ahmed and Mansour , 2003; Rahman et al., 2006; Ouma, 2009; Abouzienna et al., 2010; Mansour et al., 2012 and Song et al., 2013**).

This study was carried out to investigate the impact of intercropping one of the three legumes namely fenugreek, clover and field bean as understory crops with Sewy date palms as an overstory crop.

On some vegetative growth characters, leaf chemical composition, yield and quality components of these intercrops and main crop. This work was a comparative study of the previous measurements of the three legumes and Sewy date palms as intercrops against their sole cropping.

### 2. Material and Methods

This investigation was carried out in a private Sewy date palm orchard located at El- Dakhla oasis district, New Valley governorate during 2011/ 2012 & 2012/ 2013 seasons. The texture of soil is sandy clay soil (**Wilde et al., 1998**).

**Table (1): Analysis of the tested soil.**

Characters	Value
Sand %	70.6
Silt %	4.4
Clay %	25.0
Texture	Sandy clay
pH( 1: 2.5 extract)	7.81
E.C. (1: 2.5 extract) ( mmhos 1 cm/ 25°C)	1.05
O.M. %	0.95
Total CaCO <sub>3</sub> %	3.11
Total N %	0.07
Available P (ppm)	3.5
Available K (ppm)	201.9

The three understory legumes were grown at the same population, density and distribution in the solid planting and intercropping as well. Three legumes namely Egyptian clover, fenugreek and field beans as intercrops were intercropped with Sewy date palms or left without intercropping (solid state). The eight intercropping patterns are summarized as follows:

- 1- Pure stand of Egyptian clover.
- 2- Pure stand of fenugreek.
- 3- Pure stand of field bean.
- 4- Pure stand of Sewy date palms.
- 5- Intercropping Egyptian clover with Sewy date palms.
- 6- Intercropping Fenugreek with Sewy date palms.
- 7- Intercropping field bean with Sewy date palms.
- 8- The overstory component namely Sewy date palms (solid state).

Each treatment was replicated three times, two palms, per each in the overstory crop or two plots per each for understory crops (the area of each plot = 10.5 m<sup>2</sup>).

#### a- Overstory Sewy date palm as main crop

Sewy date palms as a main crop were 20-years old at the start of experiment and planted at 10x 10 meters apart. All palms received the same horticulture practices that already applied in the orchard. The following characters were studied, during both seasons, leaf area (cm<sup>2</sup>) (Ahmed and Morsy, 1999), percentages of N, P, K, Mg and S (Wilde *et al.*, 1985), total chlorophylls & total carotenoids (mg/ 100 g F.W.) (Von -Wettstein, 1957), yield / fed (tons); fruit weight (g.), T.S.S. %, total and reducing and non acidity sugars % (A.O.A.C., 2000), total acidity % (as g malic acid/ 100 ml juice) (A.O.A.C., 2000), and total soluble tannins % (Balbaa, 1981).

#### b- The three understory crops namely Egyptian clover, fenugreek and field beans as intercrops.

##### b-1 The first intercrop namely Egyptian clover.

Seeds were sown broadcasting at a rate of 25 kg seeds / fed on the last week of October during both seasons. Three cuttings were taken for green forage at 60 days after sowing, 50 days after the first cuttings and 40 days after the second cutting. The following traits were measured in the three cuttings, during both seasons number of nodules/ plant, plant height (cm.); fresh and dry forage yields (tons/ fed) as well as percentages of N and P in the forage (A.O.A.C., 2000).

##### b-2- The second intercrop namely fenugreek

Seeds of Balady fenugreek were sewn broadcasting at the common method of sowing at a rate of 10 kg seeds / fed on the last week of October. After 165 days, the following characters during both seasons were measured, number of nodules/ plant; plant height (cm.), number of branches per plant, number of leaves

per plant, 1000 seed weight, seed total proteins % , seed yield (Ardab/ fed) and straw yield ( tons/ fed.)

##### b-3- The third intercrop namely field bean:

Seeds of field bean var. Giza 452 were sown in hills 15 cm apart on both sides of the ridge at the last week of Oct. Ridges were 70 cm apart. After 170 days during both seasons, these traits were measured, number of nodules/ plant, plant height (cm.), number of branches per plant, number of leaves/ plant, dry weight of leaves and stem/ plant, number of pods/ plant, number of mature pods/ plant at harvest , percentage of mature pods, pod length (cm.), number of seeds/ pod, 100 seed weight(g.) , seed yield per plant (g.) and per feddan (Ardab), straw yield/ fed. (Tons) and seeds total proteins %.

#### Competitive relationships and yield advantages:

##### 1- Land Equivalent Ratio (LER) according to Willey and Osiru (1979) using the following formula:

$$LER = \frac{yab}{yaa} + \frac{yba}{ybb}$$

Where: Yaa = pure stand yield of species a

Ybb= pure stand yield of species b

Yab = mixture yield of a (when combined with b)

Yba = mixture yield of b (when combined with a).

##### 2- Area Time Equivalent Ratio (ATER):

Area time equivalent ratio provides more realistic comparison of the yield of intercropping over monocropping in terms of time taken by component crops in the intercrop according to Hiebsch (1978) and Hiebsch and McCollum (1987 a & b) . Also we used the method utilized by Hiebsch (1980) ATER was calculated by formula area time equivalent ratio.

ATER= (LERa x LERb x DC) Dt where LER is land equivalent ratio of crop, DC is duration (days) taken by crop, Dt is days to intercropping system from planting o harvest.

##### 3- Aggressivity (Agg):

This was proposed by Mc-Gilchrist (1960) and was determined according to the following formula:

$$Aab = \frac{Yab}{yaa} - \frac{Yba}{ybb} \times \frac{zba}{zba}$$

An aggressivity value of zero indicates that the component crops are equally competitive. For any other situations both crop will have the same numerical value but, the high of the dominant crop is positive and the dominated is negative. The greater the numerical value of (Agg), the greater difference in competitive abilities and hence the larger the difference between actual and expected yield. Where Zab representing the sown proportion of intercrop a (Egyptian clover or fenugreek and fababean) in combination with (palm) and zba the sown proportion of intercrop b (palm) in combination with a (Egyptian clover or fenugreek and faba bean)

4- Competitive ratio (CR) was calculated by the following formula as given by Willey and Rao (1980).

$$CR = C Ra + C Rb$$

$$C Ra = LERa / LERb \quad X \quad Zba / Zab$$

Where: LER<sub>a</sub> and LER<sub>b</sub> represent relative yield of a and b intercrops, respectively. Since the CR values of the two crops will in fact be reciprocals of each other. CR<sub>a</sub>, CR<sub>b</sub> are the competitive ratio for (a) and (b) intercropping.

#### **5-Net = return and monetary advantage**

Net return was calculated according to the prices of all land preparations practices, main products and production and land rent according to the official prices issued by the Ministry of Agriculture and Reclamation.

### **3. Results**

#### **a) Results:**

#### **1-Effect of various cropping systems on growth characters, palm nutritional status, yield and quality of the fruits of the overstory crop namely Sewy date palm.**

It is clear from the data in Tables ( 2 &3) that polyculture of any one of the three understory crops namely clover, fenugreek or field bean with over story crop namely Sewy date palm significantly was accompanied with enhancing the leaf area, percentages of N, P, K , Mg and S, total chlorophylls and total carotenoids in the leaves , yield / palm, fruit weight, T.S.S. %, as well as reducing , non- reducing and total sugars % and decreasing both total acidity % and total soluble tannins % relative to monoculture of Sewy date palm. In ascending order, the best under story crops intercropped with palm as over story crop were field bean, fenugreek and clover. Significant differences on the previous parameters were observed among all pure stand and intercropped treatments. The best results were obtained due to intercropping Egyptian clover with Sewy date palm. The unfavourable effect on growth, yield and fruit quality were observed on Sewy date palm under monoculture system. Similar results were announced during 2011/ 2012 & 2012/ 2013 seasons.

#### **2-Effect of various cropping systems on growth and yield of the three under story crops namely Egyptian clover, fenugreek and field beans.**

Data listed in Tables (4 to 8) clearly show that intercropping Egyptian clover, fenugreek or field bean with palm had no significant effect on all characters of clover (no. of nodules / plant, plant height, fresh and dry forage yield and percentages of both N and P in the forage in the three cuts, fenugreek (no. of nodules per plant; plant height, no. of branches per plant, number of leaves plant, 1000 seed weight, seed total proteins and seed and straw yields /fed. and field bean ( no. of nodules/ plant, plant height, no. of branches and leaves/ plant; dry weights of leaves and stems / plant, no. of pods / plant, no. of mature pods %; pod length , no. of seeds / pod, 100 seed weight, seed yield per plant and per fed., straw yield per fed. and seeds total proteins% comparing with pure stand of each understory crops.

This means that intercropping effectively maximized net return per fed. without causing any inferior effects on growth and yield of both main crop and the intercrops. These results were true during both seasons.

#### **3- Effect of various cropping systems on the yield per feddan of Sewy date palms and the three intercrops.**

It is clear from the data in Tables (9 & 10) that yield of Sewy date palm was significantly increased with intercropping the three legumes with it comparing with pure stand of palm. However, the yield of Egyptian clover, Balady fenugreek and field bean was nearly the same in both sole and intercropped systems. Intercropping Egyptian clover with Sewy date palm significantly produced the maximum values comparing to the other cropping systems. The second best intercrop applied with Sewy date palm was fenugreek and field bean intercrop ranked the last position in this respect. These results were true during both seasons.

#### **4- Effect of various cropping systems on the land equivalent ratio (LER)**

It is clear from the data in Tables (9 & 10) that LER was significantly affected with varying intercropping systems. The values of land equivalent ratio for intercropping treatments were significantly greater than mono culture. It was the same (1.0) for all pure stand of main crop and intercrops, while it was ranged from 2.04 to 2.121 in the three intercropped systems. It was significantly highest on the main crop than on the three intercrops. The maximum values (2.121 & 2.123) were recorded on Egyptian clover intercropped with date palms.

#### **5- Effect of various cropping systems on the area time equivalent ratio (ATER)**

Data in Tables (9 & 10) clearly show that values area time equivalent ratio was slightly varied among the two intercrops namely fenugreek and field bean when anyone was intercropped with Sewy date palms. Values of area time equivalent ratio were 1.49 & 1.50 during both seasons, respectively for either fenugreek or field bean intercropped with Sewy date palms. Intercropping Egyptian clover with Sewy date palms resulted in the highest area time equivalent (1.55 & 1.56) during both seasons, respectively.

#### **6- Effect of various cropping systems on aggressivity**

Data in Tables (9 &10) show that aggressivity values of Sewy date palm were negative, whereas values of all intercrops were positive, meaning that Sewy date palm was dominated and the three intercrops were dominant.

#### **7- Effect of various cropping systems on competitive ratio (CR)**

Data presented in Tables (9 &10) revealed that Sewy date palms had competitive ratio higher than that in the three intercrops namely clover, fenugreek and

field bean when they were intercropped together. Values of competitive ratio for Sewy date palm intercropped with clover, fenugreek and bean were 1.155, 1.106 & 1.053 during the first season and were 1.10, 1.05 & 1.01 during both seasons, respectively. From these result it can be noticed that Sewy date palm was dominated crop when it was intercropped with clover, fenugreek or bean. These results were true during both seasons.

#### 8- Effect of various cropping systems on total profit (LE/ fed.)

It is evident from the obtained data in Tables (11 & 12) that all intercropping systems significantly improved total net profit (LE/ fed) over pure stand of over and under story crops. Pure stand of the main crop namely Sewy date palm produced 48080 and 49760 LE/ fed during both seasons, respectively. Total net profit produced from sole planting of clover reached 8090 during both seasons. Mono culture of fenugreek

produced total profit reached 2448 and 2579 LE while under pure stand of field bean total net profit was 1891 and 1169 LE/ fed during both seasons, respectively. Intercropping clover with palm produced 62690 & 70540 during both seasons, respectively. Values produced by fenugreek and field bean when intercropped with palms reached 54484 and 56442 & 51777 and 52719 LE during both seasons, respectively rather than pure stand of palm. The percentage of increase on total profit due to intercropping clover with palm reached 30.4 and 41.8% over pure stand of palm. Using fenugreek or field bean as intercrops increased net profit by 13.3 & 13.4% as well as by 7.7 & 5.9 % during both seasons, respectively rather than pure stand of palm. Therefore, from economical point of view, the best intercrop used with Sewy date palm was Egyptian clover followed by fenugreek and the understory crop namely field bean ranked the last position in this respect. These results were true during both seasons.

**Table (2): Effect of intercropping some legumes with Sewy date palms on the leaf area and its content of N, P, K, Mg, total chlorophylls, total carotenoids in the leaves of Sewy date palms during 2012/ 2013 seasons.**

Intercropping treatment	Leaf area (cm <sup>2</sup> ) %		leaf N		Leaf P %		Leaf K %	
	2012	2013	2012	2013	2012	2013	2012	2013
Pure stand of Sewy date palms	2.22	2.31	1.81	1.89	0.22	0.27	1.31	1.28
Intercropping Egyptian clover with palms	2.41	2.44	2.07	2.21	0.35	0.38	1.50	1.41
Intercropping field beans with palms	2.26	2.35	1.89	1.99	0.25	0.31	1.36	1.33
Intercropping fenugreek with palms	2.31	2.38	1.99	2.10	0.29	0.34	1.42	1.37
New L.S.D. at 5%	0.03	0.02	0.05	0.06	0.03	0.03	0.04	0.03
Character	Leaf Mg %		Leaf S %		Total chlorophylls (mg/ 100 g F.W.)		Total carotenoids (mg/ 100 g F.W.)	
Pure stand of Sewy date palms	0.41	0.44	0.47	0.51	18.0	19.1	4.1	5.1
Intercropping Egyptian clover with palms	0.52	0.57	0.66	0.69	22.2	24.9	7.1	7.4
Intercropping field beans with palms	0.45	0.48	0.57	0.63	19.5	21.0	4.7	5.9
Intercropping fenugreek with palms	0.48	0.52	0.52	0.58	20.9	23.0	5.3	6.4
New L.S.D. at 5%	0.03	0.03	0.04	0.04	1.1	1.2	0.4	0.4

**Table (3): Effect of intercropping some legumes with Sewy date palms on yield as well as some physical and chemical characteristics of the fruits of Sewy date palms during 2012/ 2013 seasons.**

Intercropping treatment	Yield / fed. (tons)		Fruit weight (g.)		T.S.S. %		Total sugars %	
	2012	2013	2012	2013	2012	2013	2012	2013
Pure stand of Sewy date palms	6.51	6.72	10.1	10.3	78.0	27.5	49.1	49.3
Intercropping Egyptian clover with palms	7.31	7.56	11.6	11.8	81.8	81.2	52.1	52.3
Intercropping field beans with palms	6.72	6.93	10.6	10.7	79.0	78.5	50.0	50.3
Intercropping fenugreek with palms	7.00	7.22	11.1	11.1	80.5	80.0	51.0	51.1
New L.S.D. at 5%	0.25	0.24	0.5	0.4	0.9	0.8	0.8	0.7
Character	Reducing sugars %		Non. Reducing sugars %		Total acidity %		Soluble tannins %	
Pure stand of Sewy date palms	25.3	24.8	23.8	24.5	0.400	0.392	0.51	0.50
Intercropping Egyptian clover with palms	27.0	26.8	25.1	25.5	0.271	0.269	0.18	0.19
Intercropping field beans with palms	25.7	25.3	24.3	25.0	0.360	0.350	0.33	0.32
Intercropping fenugreek with palms	26.3	26.0	24.7	25.1	0.315	0.310	0.25	0.24
New L.S.D. at 5%	0.4	0.5	0.3	0.4	0.033	0.035	0.05	0.06

**Table (4): Effect of intercropping some legumes with Sewy date palms on number of nodules per plant, plant height (cm.) and fresh forage (ton/ fed.) of Egyptian clover during 2011/ 2012 and 2012/ 2013 seasons.**

Intercropping treatment	No. of nodules / plant		Plant height (cm.)		Fresh forage yield (ton/fed.)	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
	<b>1<sup>st</sup> cut</b>					
Pure stand of Sewy date palms	9.5	10.0	62.5	61.9	12.0	12.25
Intercropping Egyptian clover with palms*	9.4	10.0	62.3	61.7	11.9	12.15
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS
	<b>2<sup>nd</sup> cut</b>					
Pure stand of Sewy date palms	12.0	12.5	65.0	66.0	13.3	13.5
Intercropping Egyptian clover with palms *	12.0	12.4	65.0	66.0	13.3	13.5
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS
	<b>3<sup>rd</sup> cut</b>					
Pure stand of Sewy date palms	13.0	13.3	81.0	83.0	14.0	14.0
Intercropping Egyptian clover with palms*	13.0	13.3	81.0	83.0	14.0	14.0
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS

\* Sewy date palm cv.

**Table (5): Effect of intercropping some legumes with Sewy date palms on dry forage yield ( tons/ fed.) and percentages of N and P in the forage of Egyptian clover during 2011/ 2012 and 2012 / 2013 seasons.**

Intercropping treatment	Dry forage yield ( ton / fed.)		Forage N %		Forage P %	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
	<b>1<sup>st</sup> cut</b>					
Pure stand of Sewy date palms	7.8	7.9	3.85	3.81	0.33	0.36
Intercropping Egyptian clover with palms*	7.7	8.0	3.85	3.81	0.33	0.36
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS
	<b>2<sup>nd</sup> cut</b>					
Pure stand of Sewy date palms	11.3	11.4	3.91	3.95	0.30	0.31
Intercropping Egyptian clover with palms *	11.2	11.4	3.90	3.94	0.30	0.30
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS
	<b>3<sup>rd</sup> cut</b>					
Pure stand of Sewy date palms	12.2	12.2	3.95	3.95	0.28	0.29
Intercropping Egyptian clover with palms*	12.2	12.1	3.94	3.96	0.27	0.29
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS

\* Sewy date palm cv.

**Table (6): Effect of intercropping some legumes with Sewy date palms on its growth, yield and attributes of fenugreek during 2011/ 2012 and 2012 / 2013 seasons.**

Intercropping treatment	No. of nodules / plant		Plant height (cm.)		No. of branches / plant		No. of leaves / plant	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
	<b>1<sup>st</sup> cut</b>							
Pure stand of fenugreek	10.0	10.5	91.0	93.0	4.5	5.0	21.0	20.0
Intercropping fenugreek with palms*	10.0	10.4	90.8	92.9	4.5	5.0	21.0	20.0
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
	<b>2<sup>nd</sup> cut</b>							
	No. of pods/ plant		Pod length cm		No. of seeds / pod		Seed yield/ plant (g.)	
Pure stand of fenugreek	14.0	14.5	10.5	10.1	12.2	12.5	1.9	2.0
Intercropping fenugreek with palms*	14.2	14.5	10.5	10.0	12.2	12.6	1.9	2.0
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
	<b>3<sup>rd</sup> cut</b>							
	1000 seed weight (g.)		Seed total proteins %		Seed yield (ard/ fed.)		Straw yield (ton / fed)	
Pure stand of fenugreek	14.1	14.3	25.3	25.5	6.66	6.91	5.51	5.55
Intercropping fenugreek with palms*	14.1	14.4	25.3	25.5	6.64	6.91	5.51	5.54
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS

\* Sewy date palm cv

**Table (7): Effect of intercropping some legumes with Sewy date palms on number of nodules / plant, growth, characters , yield and yield attributes of field beans during 2011/ 2012 and 2012 / 2013 seasons.**

Intercropping treatment	No. of nodules / plant		Plant height (cm.)		No. of branches / plant		No. of leaves / plant	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
	<b>1<sup>st</sup> cut</b>							
Pure stand of fenugreek	9.0	10.0	14.5	14.5	3.9	4.0	49.0	50.0
Intercropping fenugreek with palms*	9.0	10.1	14.6	14.6	4.0	4.0	48.0	50.0
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
	<b>2<sup>nd</sup> cut</b>							
	Dry weight of leaves / plant (g.)		Dry weight of stem / plant (g.)		No. of pods / plant		No. of mature pods plant at harvest	
Pure stand of fenugreek	49	50	88.0	90.0	38	39	37	38
Intercropping fenugreek with palms*	50	50	89.0	90.0	38	39	37	38
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS



**Table (8) : Effect of intercropping some legumes with Sewy date palms on mature pods as well as yield and its attributes of pods of field bean during 2011/ 2012 and 2012 / 2013 seasons.**

Intercropping treatment	Mature pods %		Pods length (cm.)		No. of seeds / pod		100 seed weight (g.)	
	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013	2011/2012	2012/2013
	<b>1<sup>st</sup> cut</b>							
Pure stand of fenugreek	97.4	97.4	8.4	8.3	3.9	4.0	80.0	81.0
Intercropping fenugreek with palms*	97.4	97.4	8.5	8.2	4.0	4.0	79.8	81.0
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
	<b>2<sup>nd</sup> cut</b>							
	seed yield / plant (g.)		seed yield / fed( ardab)		straw yield / fed (tons)		seeds total proteins %	
Pure stand of fenugreek	60	59.9	7.88	6.99	2.22	2.10	27.0	27.33
Intercropping fenugreek with palms*	60	60.0	7.91	7.00	2.20	2.09	27.11	27.31
New L.S.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS

**Table (9) : Effect of cropping systems on competitive relationship and gross profit in 2011/ 2012 season.**

Cropping systems	Yield / fed				LER			ATER	Agg (a)	Agg palm	CRA + CR = palm	CR	Gross profit
	Palm (ton)	Clover (ton)	Fenugreek (ardab)	Faba bean (ardab)	LERa+ LER palm =LER								
Pure palm	6.51						1.0						
Pure Egyptian clover		39.3					1.0						
Pure fenugreek			6.66				1.0						
Pure faba bean				7.88			1.0						
Intercropping Egyptian clover with palm	7.31	39.21			0.998	1.123	2.121	1.55	0.99	-0.99	0.870	1.155	2.03
Intercropping Egyptian fenugreek with palm	7.00		6.64		0.997	1.075	2.072	1.49	0.99	-0.99	0.904	1.106	2.01
Intercropping faba bean with palm	6.72			7.91	1.004	1.030	2.040	1.49	0.99	-0.99	0.950	1.053	2.00
New L.S.D. at 5%	0.21	NS	NS	NS	0.002	0.020	0.012	0.05	NS	NS	0.040	0.021	NS

(a) Egyptian clover or fenugreek and faba bean

**Table (10) : Effect of cropping systems on competitive relationship and gross profit in 2012/ 2013 season.**

Cropping systems	Yield / fed				LER			ATER	Agg (a)	Agg palm	CRA + CR = palm	CR	Gross profit
	Palm (ton)	Clover (ton)	Fenugreek (ardab)	Faba bean (ardab)	LERa+ LER palm =LER								
Pure palm	6.72						1.0						
Pure Egyptian clover		39.75					1.0						
Pure fenugreek			6.91				1.0						
Pure faba bean				6.99			1.0						
Intercropping Egyptian clover with palm	7.56	39.66			0.998	1.125	2.123	1.56	+0.99	-0.99	0.910	1.10	2.01
Intercropping Egyptian fenugreek with palm	7.22		6.91		1.00	1.074	2.074	1.50	+0.99	-0.99	0.960	1.05	2.01
Intercropping faba bean with palm	6.93			7.0	1.00	1.031	2.031	1.50	+0.99	-0.99	0.999	1.01	2.01
New L.S.D. at 5%	0.22	NS	NS	NS	0.002	0.021	0.018	0.06	NS	NS	0.031	0.03	NS

(a) Egyptian clover or fenugreek and faba bean

**Table (11) : Economic analysis of different intercropping patterns of Egyptian clover, fenugreek and faba bean with palm in 2011/ 2012 season..**

Cropping systems	Crop Yield				Income (LE / fed.)				Total income (LE fed.)	Total Expenditure (LE/ fed.)	Total profit (LE fed.)
	Palm (ton)	Clover (ton)	Fenugreek (ardab)	Faba bean (ardab)	Palm	Clover	Fenugreek	Faba bean			
Pure palm	6.51				52.80	-	-	-	52080	4000	48080
Pure Egyptian clover		39.3			-	10710	-	-	10710	2620	8090
Pure fenugreek			6.66 (main) 5.52 (secondary)		-	-	4342 622	-	5004	2556	2448
Pure faba bean				7.88 (main) 6.19 (secondary)	-	-	-	5650 743	6393	4502	1891
Intercropping Egyptian clover with palm	7.31	39.21			58480	10710	-	-	6919	6500	62690
Intercropping Egyptian fenugreek with palm	7.00		6.64 (main) 5.50 (secondary)		56000	-	4329 605	-	60934	6450	54484
Intercropping faba bean with palm	6.72			7.91 (main) 6.21 (secondary)	53760	-	-	5672 745	60177	8400	51777

Secondary = Heap of Hay = 250 kg

palm price was 8000 LE/ ton, Egyptian clover price was 3570 LE/ land cutting

faba bean price was 5717 LE / ardab and 120 LE / heap of hay

fenugreek price was 652 LE Ardab and 110 Le/ Heap of hay

Main= Ardab/ fed.

**Table (12) : Economic analysis of different intercropping patterns of Egyptian clover, fenugreek and faba bean with palm in 2012/ 2013 season.**

Cropping systems	Crop Yield				Income (LE / fed.)				Total income (LE fed.)	Total Expenditure (LE/ fed.)	Total profit (LE fed.)
	Palm (ton)	Clover (ton)	Fenugreek (ardab)	Faba bean (ardab)	Palm	Clover	Fenugreek	Faba bean			
Pure palm	6.72				53760	-	-	-	53760	4000	49760
Pure Egyptian clover		39.57			-	10710	-	-	10710	2620	8090
Pure fenugreek			6.91 (main) 5.73 (secondary)		-	-	4505 630	-	5135	2556	2579
Pure faba bean				6.99 (main) 5.49 (secondary)	-	-	-	5012 659	5671	4502	1169
Intercropping Egyptian clover with palm	7.56	39.66			60480	10710	-	-	711900	6500	70540
Intercropping Egyptian fenugreek with palm	7.22		6.91( main) 5.70 (secondary)		57760		4505 627	-	62892	6450	56442
Intercropping faba bean with palm	6.93			7.00 ( main) 5.50 (secondary)	55440	-	-	5019 660	61119	8400	52719

Main= ardab / fed Secondary = heap of Hay 250 kg Palm price was 8000 LE / ton Egyptian clover price was 3570 LE / cutting Faba bean price was 717 LE / ardab and 120 LE / heap of Hay fenugreek price was 652 LE / Ardab and 110 LE / Heap of Hay

#### 4. Discussion

The previous positive action of intercropping with the three legumes on growth and fruiting of the main crop namely Sewy date palms might be attributed to the essential roles of legumes as green manures on stimulating soil fertility in favour of reducing soil pH, soil borne pathogens and salinity stress as well as enhancing soil organic matter, activity of microflora, N fixation, availability of nutrients and water retention (Nijjar, 1985). The slight reduction on growth and yield of legume intercrops was mainly attributed to the depletion and exhaustion of nutrients under intercropping treatments.

These results are in concordance with those obtained by Mcintre *et al.* (2001), Abou El-lail (2001), Akyurt *et al.* (2002); Ahmed and Mansour (2003), Rahman *et al.* (2006), Mansour *et al.* (2012) and Song *et al.* (2013).

#### 5. Conclusion:

Growing Egyptian clover or Balady fenugreek with Sewy date palms could be essential for maximizing net return per unit.

#### References

1. Abou El- Lail, H.I.H. (2001): Studies on intercropping some legume crops with Flame seedless grapevines. M. Sc. Thesis Fac. of Agric. Minia Univ. Egypt.
2. Abou- Rayya, M.S. and Kassem, N.E.(1993): Vegetative growth of peach trees grown in North Sinai under the effect of intercropping of chick-pea, pea and onion crops. J. of Agric. of Sci., Mansoura Univ. 18(3): 883-890.
3. Aboiuziena, H.F.H.; Abd El- Motty- Elham, Z.; Yousef, R.A. and Sahab, A.F. (2010): Efficacy of intercropping mango, mandarin or Egyptian clover plants with date palm on soil properties , rhizosphere micro flora and quality of date fruits. J. of Amer. Sci. vol. 6(12): 230-238.
4. Ahmed, F.F. and Mansour, A.E.M. (2003): Studies on intercropping of Egyptian clover on Anna apple orchard. Unconventional Conf. in Producing and Improving Agricultural Crops pp. 100- 120.
5. Ahmed, F.F. and Morsy, M.H. (1999): A new method for measuring leaf area in different fruit species. Minia, J. of Agric. Res., Develop. 19 pp. 97- 105.
6. Akyurt, M.E.; Rehbini, H.; Bogis, H. and Aljinaidi, A.A. (2002): A Survey of mechanization effects on date palm grown operations. 6<sup>th</sup> Saudi Engineering Conf. Kfupm Ohahrn, Dec. 5:475-489.
7. Association of Official Agricultural Chemists (2000): Official Methods of Analysis (A.O.A.C), 12<sup>th</sup> Ed., Benjamin Franklin Station, Washington D.C., U.S.A. pp. 490-510.
8. Balbaa, S.I. (1981): Chemistry of Drugs laboratory Manual,. Cairo Univ. Chapter 6, 127- 132.

9. El- Hebshi, M.A. (1993): Planning the cropping pattern of the northern governorates in the Yemen Arab Republic Bull. Fac. of Agric. Cairo Univ., 44(3): 501-415.
10. Hiebsch, C.K. (1978): Camping intercrops with monocultures. Agrobomic economic research on soils of the tropics. Annual Report. North Carolina State Univ., Raliegh, N.C.
11. Hiebsch, C.K. (1980): Principles of intercropping " Effect of N fertilization and crop duration on equivalence, ratios in intercrops versus monoculture comparisons." PhD. Thesis North Carolina State Univ., Raliegh, N.C.Y. USA.
12. Hiebsch, C.K. and McCollum, R.E. (1987a): Area- x- time Equ Ratio: A method for evaluating the productivity of intercrops. J. 79:15-22.
13. Hiebsch, C.K. and McCollum, R.E. (1987b): Area-x- Time Equ- Ratio: A method for evaluating the productivity of intercrops. J. 79:945-946.
14. Mahmoudi, H.; Hosseininia, O.; Azadi, H. and Fatemi, M. (2008): Enhancing date palm processing, marketing and pest control through organic culture. J. of organic systems 3 (2): 29-39.
15. Mansour, A.E.M.; Mohamed, A.Y.; Ahmed, F.F. and Eissa, R.A.P. (2012): benefits of intercropping Samany date palms with some fruit crops. J. of Applied Sci., res. 8(4): 2045-2049.
16. Mc- Gilchrist, C.A. (1960): Analysis and competition experiments Bio 21;975-985.
17. Mcintre, B.C.; Gold, I.; Kashaja, H.; Seali Night, E. and Bwamiki, D. (2001): Effects of legume intercrops on soil borne pests, biomass, nutrients and soil water in banana. Biol. Fertile. Soils 34(5): 342-348.
18. Mead, R.; Currnaw, R. N. and Harted, A. M. (1993): Statistics Methods in Agricultural Biology: 2<sup>nd</sup> Ed. Chapman & Hall London.pp.50 - 70.
19. Nijjar, G. S. (1985): Nutrition of Fruit Trees. Kalyani Publishers, New Delhi, India, p. 100.
20. Ouma, G. (2009): Intercropping and its application to banana production. In East Africa, a review J. of Plant Breeding and Crop Sci. Vol. (2): 13-15.
21. Rahman, M.; Zrahmam, M.H.; Haqu, M.E. Ekalar, M.H. and Naber, S.L. (2006): Banana-based intercropping systems in northern part of Bangladesh. J. Agron. 5(2): 228-231.
22. Shirazi, M.P. ; Izadi, M; Khademi, R. (2008): Study that climatical factors effects on bunch fading disorder of date palm in southern Iran and the methods of its control. Amer. Erasian, J. Agric. & Environ. Sci. 4(5): 570-574.
23. Song, B.; Tang, G.; Sang, X.; Zhang, J.; Tao, Y. and Wiggins, N. (2013): Intercropping with aromatic plants hundred the occurrence of Aphis citricola in an apple of orchard system by shifting apple orchard system by shifting pedator-prey abundances. Biocontrol Sci. and Technology Vol. 23 Issue 4 pp 381-395.
24. Von- Wettstein, D. V. C. (1957): Clatale und der Sumbmikro Skopisne Formwechsel de Plastids. Experimental Cell Research, 12 -427.
25. Wilde, S. A.; Corey, R. B.; Layer, J. G. and Voigt, G. K. (1985): Soils and Plant Analysis for Tree Culture. Oxford and IBH publishing Co., New Delhi, India.
26. Willey, R.W. and Osiru, S.O.(1971): Studies on mixture of maize and beans (*Phasolus vulgaris* ) with particular reference to plant populations. J. Agric. Sci. Camb. 79:519-529.
27. Willey, R.W. and Rao, M.R. (1980): Competitive ratio for quantififying competition between intercrops. Exp. Agric., 16: 117-125.

11/23/2014