J. Agric. Sci. Mansoura Univ., 34 (3): 2097 - 2114, 2009

EFFECT OF INTERCROPPING SUNFLOWER WITH PEANUT UNDER DIFFERENT RATES OF NITROGEN FERTILIZATION ON YIELD COMPONENTS OF BOTH CROPS.

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ABSTRACT

Two field experiments were carried out at Agricultural Research Stations in Ismailia Governorate during 2005 and 2006 seasons to study the effect of six intercropping patterns ,sunflower was planted on other side of the second ridge of peanut at 20, 40 and 60 cm apart between hills and thinned on one , two , and three plants / hill respectively to give 50 % of its pure stand , and on the third ridge of peanut at 20 , 40 and 60 cm a part between hills respectively and thinned on one , two and three plants / hill to give 33 % of its pure stand and three nitrogen fertilizer levels (40 ,50 , and 60 kg N / fed) on growth , yield and yield components and seed oil % of peanut and sunflower . A split – plot design was used with three replications.

The main obvious results of this study can be summarized as follows.

Peanut:

The results revealed that plant height, number and weight of pods /plant and pods yield / fed of peanut were significantly affected by different intercropping patterns in both seasons, whereas number of branches / plant ,shilling % and seed oil % were not significantly affected in both seasons; and weight of 100 seeds were significantly affected in the second season only. Intercropping patterns 100 % peanut +33 % sunflower gave the highest value for yield of peanut in both seasons.

All studied characters of peanut were significantly affected by increasing N fertilizer levels from 40 to 50 up to 60 kg N / fed in both seasons, except numbers of branches/ plant were not significantly affected in the first season.

Interaction between intercropping patterns and N fertilizer levels significantly affected on number of pods / plant and weight of seeds / plant in both seasons, weight of pods / plant and pods yield/ fed in the second season.

Sunflower:

All studied characters of sunflower were significantly affected by intercropping patterns in both seasons, except numbers of leaves / plant and seed oil% were not significantly in both seasons, whereas stem diameter was significantly affected in the first season only. Intercropping pattern 100 % peanut + 50 % sunflower gave the highest value for yield of sunflower in both seasons.

Growth, yield and yield components of sunflower as well as seed oil% were significantly affected by increasing N fertilizer levels from 40 to 50 up to 60 kg N / fed in both seasons, except number of leaves / plant was not significantly affected.

Interaction between intercropping patterns and N fertilizer levels significantly affected number of seeds / head, seed yield /fed and oil % in both seasons and head diameter in the second season only.

Competitive relationship:

Results revealed also that intercropping pattern of 100 % peanut +50 % sunflower (planting sunflower on the second ridge of peanut at 20 cm apart between hills and thinned on one plant / hill) recorded the highest values for Land Equivalent Ratio (LER), which reached 1.48 and 1.57 in the first and second seasons, respectively, Relative Crowding Coefficient (RCC) achieved advantageous by

intercropping pattern in both seasons. Sunflower crop was the dominant in all intercropping patterns and peanut was the dominated in both seasons.

Intercropping patterns 100 % peanut + 50 % sunflower on the second ridge at 20 cm between hills and thinned on one plant/ hill achieved the highest value for total income in both seasons being 28.85 and 33.03 % compared to peanut alone in the first and second seasons , respectively .

INTRODUCTION

Intercropping is one of the most important practices as a way to increase the productivity per unit land area .Peanut as a leguminous crop is considered the main crop in sandy soil. Sunflower is promising oil crop to cover the increase in the demand for edible oils due to high oil content. Intercropping oil crops are an avenue of approach to solve the problem of oil deficiency gap. Moreover, both peanut and sunflower is the most suitable crop which can grow in the newly reclaimed soils and has potential for production increase. Intercropping patterns generally produce more total yields of the mixed crops per unit area than individual crops are grown in single stand. Nour EL-Din *et al.(*1983) found that distance between sunflower plants had no effect on plant height and head diameter of sunflower but the 100-seed weight and seed yield/plant were increased with increasing distance between plants, Nikam *et al.*(1984) stated that sunflower intercropped with peanut under different sowing systems increased the weight of pods and seed yield /ha , Sankaran and Kuppuswamy (1992) reported that intercropping sunflower with peanut in different patterns reduced peanut yields to 1.01- 1.27 ton /ha and gave lower peanut seed equivalent yields than peanut alone. Itnal *et al.*(1996) showed that intercropping in the row ratio 4:2 produced mean peanut and sunflower seed yields of 0.85 and 0.49 t/ha respectively, and the highest land equivalent(1.38) and highest returns as compared with 2:1,3:1 and 5:1 row ratios. Rajashekhar *et al.*(1997) showed that sunflower intercropped with peanut at ratio of 100 % peanut + 50, 75or 100 % of sunflower gave 1700-2340 kg /ha as peanut pod yield and 1193-1411 kg /ha sunflower seed yield as compared to peanut sole crops(2950 kg/ha) and sunflower seed yield (2124 kg /ha). Abd- Alla and EL-Sawy (2003) reported that Giza 6 var recorded 25.03, 48.50 206.88 g and 79.8 g for number of pods/plant ,number of seeds /plant ,100-pod weight and 100-seed weight.Toaima et al (2004) found that Giza 6 var surpassed those obtained for Giza 5 var in yield component and pods yield /fed when intercropped with sesame .EL-Sawy *et al* .(2006) indicated that intercropping system of 100 % peanut + 25 % sunflower gave the highest values for yield components of peanut and sunflower ;However ,the intercropping system of 100 % peanut + 100 % sunflower recorded the lowest and they added that intercropping system of 100 % peanut + 100 % sunflower gave the highest values for Land equivalent ratio (LER), Relative crowding coefficient (RCC) and net income.

This research aimed to study the effect of intercropping sunflower with peanut and different rate of N fertilization on its yields and yield components in this respect .Samui *et al.* (1984) indicated that intercropping of peanut with

sunflower in ratio of 1:1, 2:1, 1:2 or 1:3 and were given 40, or 80 kg N/hg gave total yields about 80, 52, 50 and 5% higher for the 4th ratios, respectively, than were obtained by growing the crops alone. Sorour andAttia (1988) showed that sunflower plant height, head diameter, seed yield /plant and seed yield /fed increased by increasing N fertilizer .Zaky (1994) studied the effect of that intercropping sesame with peanut and application nitrogen and phosphorus fertilizer levels. He found that the land equivalent ratio (LER) ranged from 1.35 to 1.38, 1.33 to 1.36 and 1.32 to 1.35 for seed yield, oil yield and protein yield, respectively .Abd El- wahed (1996) reported that 60 kg N/fed of sunflower resulted in the maximum plant height ,head diameter, seed yield/ plant, weight of 100 seeds and seed yield /fed . Mahalonumberbis *et al.*(1999) mentioned that groundnut yield, number of pods /plant and 100-seed weight increased with fertilizer rate up to 60 : 50 kg NP , then decreased, while sesame yield, number of capsules/plant and number of seeds/capsule increased with increasing fertilizer rate under intercropped at 2:1 or 1:2 row ratio and were given 30:25, 60:50 or 90:75 kg NP/ha. Farghly (2001) indicated that seed yield of sunflower with 75 kg N / fed was higher than 45 kg N/ fed. and Abd-EL-Samie *et al.*(2002) reported that increasing nitrogen level up to 60 kg N/fed increased seed yield/fed as well as oil yield/fed on sunflower .

The aim of this investigation is to contribute in reducing oil efficiency gap and increasing land usage by different intercropping patterns and effect of different rates of nitrogen fertilization on sunflower intercropped with peanut on of its yields and yield components.

MATERIALS AND METHODS

The present investigation was conducted at the Experimental Station at Ismailia Agricultural Research Station during 2005 and 2006 seasons. The experiment included 18 treatments which were the combinations of six intercropping patterns and three nitrogen fertilizer levels on growth, yield and yield components of peanut and sunflower, as well as, growing pure stand of both crops as check plots. A split –plots design with three replications was used. The main plots were devoted to intercropping patterns of sunflower with peanut. Whereas, the sub- plots were allocated for nitrogen levels (40, 50 and 60 kg N/fed). The area of each sub- plot was 18 m^2 (6 ridges with distance 60 cm and 5m long).

Intercropping patterns:-

P1- 100 % peanut + 50 % sunflower (planting sunflower on the other side of the second peanut ridge at 20 cm apart and thinned sunflower on one plant / hill).

P2 - 100 % peanut + 50 % sunflower (planting sunflower on the other side of the second peanut ridge at 40 cm apart and thinned sunflower on two plants / hill) .

P3 -100 % peanut + 50 % sunflower (planting sunflower on the other side of the second peanut ridge at 60 cm apart and thinned sunflower on three plants / hill)

P4 - 100 % peanut + 33 % sunflower (planting sunflower on the other side of the third peanut ridge at 20 cm apart and thinned sunflower on one plant/hill).

P5 - 100 % peanut + 33 % sunflower (planting sunflower on the other side of the third peanut ridge at 40 cm apart and thinned sunflower on two plants / hill).

P6 - 100 % peanut + 33 % sunflower (planting sunflower on the other side of the third peanut ridge at 60 cm apart and thinned sunflower on three plants /hill).

Solid planting (control):-

Pure stand of each peanut was grown on one side of the ridge at 10 cm apart with one plant /hill and pure stand of sunflower was grown on other side of the ridge at 20 cm apart with one plant/hill.

The experimental soil was sandy in texture. Mechanical and chemical analysis of the soil is presented in Table 1.

Table 1: Physical and chemical analysis of experimental soil during in 2005 and 2006 seasons.

Seasons / Physical and chemical analysis	2005	2006
Coarse sand %	27.13	27.20
Fine sand %	67.61	67.10
Silt %	3.81	3.92
Clay %	1.45	1.78
Soil texture	sandy	sandy
pH	7.64	7.76
$CaCO^3$	1.35 %	1.50 %
N	19.12	18.25
P	2.51	2.36
K	37.78	39.31

***Available N, P and K were determined according to Black (1965).**
In general, soil content of N, P and K was low.

Peanut variety Giza 5 was grown at 10 cm apart of all ridges and was sown on May 5th in both seasons, while the sunflower variety Sakha 53. was sown after 15th days from peanut planting during the two seasons . Calcium super phosphate (15.5 % P2 O5) was applied during soil preparation at the rate of 100 kg /fed .The nitrogen fertilizer at rate of 40, 50 and 60 kg N/ fed in the form of ammonium nitrate (33.5 % N) was applied in two equal doses. The first and second doses were added when sunflower was planted and just before the first irrigation of sunflower. Normal cultural practices for growing both crops were followed .Harvesting took place on Sep 20th for peanut and Sep 27 th, 2 th and Sep 7th for sunflower, in both seasons .

Studied Characters:

At harvest 10 guarded plants were randomly taken from each sub plot to determine yield and yield components of peanut and sunflower.

1-peanut:

Plant height (cm), numbers of branches and pods / plant, weights of pods and seeds / plant (g), 100 -seed weight (g), shelling **(%)**, seed oil % and Pod yield / fed (ardab) taken from all whole and calculated to feddan.

$$\text{Shelling percentage} = \frac{\text{weight of seeds/plant (g)}}{\text{weight of pods/plant (g)}} \times 100$$

2-Sunflower:

Plant height (cm), number of leaves / plant, Stem and head diameter (cm), number of seeds / head, weight of seeds / plant (g), seed oil % and Seed yield / fed (kg).

3-Competitve relationship:

1-Land Equivalent Ratio (LER) as described by Willey and Osera.(1979).
2-Relative Crowding Coefficient (RCC) as mentioned by De wit.(1960).
3-Aggressivity (A), as mentioned by Mc-Gilchrist.(1965).

4-Economic Evaluation:

The total income from each treatment was calculated in Egyptian pound at market price of peanut = 229.8 L.E / ardab and sunflower = 1898 L.E / ton. (Agricultural Statistics, 2006).

Dried mature seeds were ground into very fine powder to estimate oil % using the modified Soxohelt apparatus with pure petroleum ether as solvent according to A.O.A.C.(1970).

The collected data were statistically analyzed according to Sendecor and Cochran.(1980) and treatment means were compared by the least significant differences (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

A –Peanut

1-Effect of intercropping patterns:-

Data presented in Table 2 indicated that growth; yield and yield components of peanut were significantly affected by intercropping patterns of peanut characters under study in both seasons, while number of branches / plant, shelling percent and seed oil% were not significantly affected in both season. Plant height of peanut decreased by increasing number of sunflower plants / hill with doubling distance between hills either when sunflower was planted at the second or third peanut ridge as shown in Table 2 .This result may be due to reduce intra competition between sunflower and peanut for light and nutrient by doubling distance sunflower plants. Similar results were obtained by Nikam *et al.* (1984), number of branches /plant and shelling percentage did not reach the 5 % level of significance in both seasons. This result may be due to genetic factors which were rarely affected by intercropping treatments. These results are also in accordance with the results obtained by Toaima *et al.* (2004).

Table 2: Effect of intercropping patterns on yield and yield components of Peanut during 2005 and 2006 seasons.

Characters / Treatments		Plant height (cm)	Number of branches/ Plant	Number of pods/ plant	Weight of pods/ plant(g)	Weight of seeds/ plant(g)	100-seed weight (g)	Shelling (%)	Pods yield (ardab) /fed	Oil %
Intercropping patterns Peanut : Sunflower						**2005 season**				
P1 100% +50 %	one plant/ hill 20 cm	59.37	7.59	21.67	40.62	25.60	67.41	63.02	11.36	47.87
P2 100% +50 %	two plants/hill 40 cm	55.96	7.64	19.84	37.74	23.22	64.29	61.53	10.89	47.93
P3 100% +50 %	three plants/hill	54.07	7.09	17.57	34.57	20.53	60.42	59.38	10.23	48.11
P4 100% 33%	one plant/ hill	61.48	7.75	23.73	41.56	27.30	69.61	65.68	12.77	47.67
P5 100%+33%	two plants/hill 40 cm	56.81	7.40	21.52	38.19	24.29	65.63	63.60	11.11	47.64
P6 100% 33%	three plants/hill	55.68	7.28	18.80	35.89	22.02	62.68	61.35	10.40	47.84
LSD at 5%		3.89	N .S	1.51	1.33	1.69	2.99	N .S	1.34	NS
C.V %		3.20	2.85	3.50	4.64	3.73	3.44	4.17	3.90	3.32
Pure stand		62.14	8.56	29.06	44.19	27.43	65.20	62.07	13.56	47.95
Intercrop patterns Peanut : Sunflower						**2006 season**				
P1 100% +50 %	one plant/hill 20 cm	57.47	7.46	22.67	35.60	24.24	67.75	68.08	10.78	47.94
P2 100% +50 %	two plants/hill 40 cm	53.77	6.78	19.82	33.88	22.52	65.29	66.46	10.06	48.06
P3 100% +50 %	three plants/hill	52.70	6.07	18.41	31.04	20.08	64.74	64.69	9.21	48.31
P4 100%+33%	one plant/ hill 20 cm	58.28	7.86	20.10	40.72	25.69	71.67	63.08	11.34	47.65
P5 100% 33%	two plants/hill 40 cm	56.88	7.42	20.74	36.41	23.71	68.07	65.11	10.62	47.69
P6 100%+33%	threeplants/hill	55.18	6.43	22.00	35.73	21.44	68.03	60.00	9.77	47.86
LSD at 5 %		3.23	N .S	2.44	3.16	1.12	3.14	N .S	0.77	NS
C.V %		3.80	3.19	3.11	4.14	3.18	3.81	4.39	4.27	3.14
Pure stand		61.17	9.37	26.00	42.75	25.55	69.42	59.76	12.78	48.53

Yield attributes of peanut such as number of pods / plant, weights of pods and seeds / plant ,100-seed weight and pods yield /fed were significantly affected by intercropping patterns in both seasons as shown in Table 2 .Intercropping patterns(P4) which including 100 % peanut +33 % sunflower and thinned on one plant per hill at 20 cm apart gave the highest value for peanut in both seasons .Whereas third pattern(P3) which including 100 % peanut +50 % sunflower and thinned on three plants per hills at 60 cm apart gave the lowest values for peanut in both seasons. These result may be due to increasing competitive between peanut and sunflower for solar radiation and shading on peanut due to higher sunflower population and hence ,affected photosynthesis process .These results are in agreement with those obtained by Sankarn and Kuppuswamy (1992) , Rajashekhar *et*

al.(1997) and Toaima *et al.*(2004).Table 2 showed that 100- Seed weight was significantly influenced by intercropping patterns in both seasons. In both seasons, the increases in 100- seed weight (P4) were achieved when sunflower was planted at wide distances and its population decreased. A similar result was obtained with Abd-Alla and EL-Sawy *et al.* (2003), Pods yield of peanut / fed was significantly affected by intercropping patterns in both seasons as shown in Table 2.

In general, (P4) gave the highest value for peanut pods yield ardab/fed in both seasons, compared with other intercropping. Pods yield P1, P2, P3, P4, P5 and P6 were 16.27, 19.69, 24.34, 5.83, 18.07 and 23.30 % less than pure stand in the first seasons, and 15.65, 21.28, 27.93, 11.27, 16.91 and 23.55% in the second season. These results coincide with those obtained by Toaima *et al.*(2004) and EL-Sawy *et al.*(2006).

Data in Table 2. indicated that seed oil % of peanut was not significantly affected by intercropping patterns in both seasons. Means of oil % were increased by decreasing sunflower plants intercropped with peanut, also by doubling sunflower plants between hills. Sunflower plants which more require for N fertilization than peanut. Similar results were obtained by Nikam *et al.*(1984).

2-Effect of N -levels:

All studied traits of peanut were significantly affected by increasing N fertilizer in both seasons, except number of branches/plant and oil % were not significantly in first season as shown in Table 3. Growth and all yield components of peanut increased by increasing N level from 40 to 50 up to 60 kg N /fed in both seasons .The highest values were recorded with 60 kg N/fed followed by 50 kg, whereas 40 kg N/ fed gave the lowest value in both seasons .

Although, peanut is a legume crop, which needs 45 kg N/fed as recommended, but it is responded to adding 60 kg N/fed. When sunflower was intercropped with peanut under different intercropping patterns. This result may be due to sunflower consumptive all nitrogen fertilizer in the soil .Pods yield of peanut/fed was increased significantly by increasing N levels in both seasons as shown in Table 3. This result may be a reflect of yield attributes which increased by increasing N levels in both seasons.

3- Interaction effects:

Table 4 showed that number of pods / plant and weight of seeds / plant in both seasons, weight of pods / plant and pods yield/ fed in the second season were significantly affected by the interaction between intercropping patterns and N fertilizer levels.

Table 4: Effect of the interaction between the intercropping patterns and nitrogen levels on some peanut characters during 2005 and 2006 seasons.

Characters / Intercropping Patterns Peanut : sunflower		Nitrogen levels	Number of pods /plant		Weight of seeds/ plant (g)		Weight of pods/plant (g)	Pods yield/ fed
			2005	2006	2005	2006	2006	2006
P1 100% +50 %	**20 cm**	40	21.45	19.22	22.93	21.46	39.29	10.14
		50	21.14	23.52	25.81	24.33	40.17	11.24
		60	22.71	25.26	28.06	26.94	42.41	12.69
P2 100% +50 %	**40 cm**	40	19.58	17.65	21.64	19.41	36.58	9.80
		50	19.47	20.09	23.18	22.72	37.18	11.05
		60	20.48	21.71	24.85	25.37	39.46	11.81
P3 100% +50%	**60 cm**	40	16.03	16.80	18.62	18.35	32.27	9.39
		50	17.99	18.70	20.47	20.26	34.76	10.50
		60	18.70	19.73	22.51	21.64	36.68	10.79
P4 100% +33%	**20 cm**	40	20.91	20.42	23.66	23.62	39.22	10.22
		50	23.97	19.74	27.86	25.39	41.60	13.52
		60	26.32	26.13	30.38	28.08	43.86	14.55
P5 100% +33%	**40 cm**	40	21.03	18.56	21.97	20.66	35.71	9.69
		50	21.38	20.42	24.43	24.11	38.03	11.04
		60	22.15	23.25	26.48	26.37	40.80	12.59
P6 100% +33%	**60 cm**	40	17.92	17.92	20.21	19.68	34.48	9.03
		50	18.95	20.41	22.31	21.84	36.25	10.19
		60	19.54	21.67	23.54	22.80	36.80	11.19
LSD at 5 %			0.11	0.37	0.43	0.91	0.35	0.67

The highest values when sunflower plants were planted at the third ridge with peanut plants and thinned one plant / hill under 60 kg N/fed (P4) , whereas the lowest values for these characters were showed when sunflower was planted at the third ridge with peanut and thinned three plants / hill with adding 40 kg N/fed (P6). The results may be due to the inter and intra competition between sunflower and peanut plants for lights and N fertilization.

B- Sunflower:

1-**Effect of intercropping patterns.**

Growth, yield and yield components of sunflower were significantly affected by the different intercropping patterns in both seasons, except stem diameter in the second season, while number of leaves/plant and oil % were not significantly affected in both seasons as shown in Table 5.Plant height was decreased by increasing plant population from 33 to 50 % of its pure stand Table 5. Data indicated that increasing number of plants / hill from one up to three plants decreased plant height. These results may be due to intar-competition between sunflower plants to light and nutrient. Similar results were obtained by Nikam *et al.*(1984) and Sorour and Attia (1988) Sunflower population density of 33 % pure stand (4,5 and 6 patterns) recorded higher values than of (1,2 and 3 patterns).

5

Sunflower was thinned on one plant / hill, recorded the highest value followed by two plants / hill, while three plants / hill showed the lowest values in both seasons. This is completely true for stem diameter, number of leaves/ plant, head diameter, number of seeds / head and weight of seeds / plant. This result may be due to increase vegetative growth and photosynthesis for sunflower plants by increasing distances between hills in (2,3, 5 and 6 patterns) and reducing number of plants / hill (1and 4 patterns). Similar results were obtained by Nour EL-Din *et al.* (1983).

Yield components characters i.e head diameter, number of seeds / head and weight of seeds / plant recorded the highest values as compared with sunflower alone. Yield attributes characters behaved the same trend of stem diameter and number of leaves/ plant. Mean value of seed yield / fed in pure stand exceeded seed yield / fed of all intercropping patterns as shown in Table5. This reduction of sunflower seed yield in intercropping patterns was due to the reducing of plant population which did not exceeded than 50 % of its pure stand. Intercropping pattern (100 % peanut + 50 % sunflower P1) and thinned one plant/ hill gave the highest value of sunflower seed yield / fed which was 67.98 % of its pure stand in the first season and was 77.09 % in the second season . Whereas the lowest values were obtained with intercropping pattern (100 % peanut +33 % P6) sunflower and thinned on three plants/hill, which were 41.46 % and 44.23 % in the first and second season, respectively. These results are in accordance with those obtained by EL-Sawy *et al.* (2006).

Data recorded in Table 5 show that seed oil % of sunflower was not significantly affected by intercropping patterns, this results may be due to a quantitative genetic character and rarely affected by agricultural practices .Similar results were reported by Nikam *et al* .(1984) .

2 – Effect of N- levels:

Data presented in Table 6 indicated that all sunflower attributes were significantly affected by increasing nitrogen fertilization levels from 40 up to 60 kg N/fed in both seasons, except number of leaves /plant in both seasons .Results also indicate that raising N rate gradually increased plant height up to 60 kg N/ fed.

The increase in plant height due to the increase in nitrogen application may be attributed to the increase in meristematic activity, stimulation of cell elongation and maximum production .These results are in accordance with those obtained by Sorour and Attia (1988), Adel-Wahed (1996) and Farghly (2001).

Data in Table 6 revealed that sunflower plants fertilized with 60 kg N/fed gave the highest values in growth and all yield components followed by those fertilized 50 kg N/fed; simultaneously by 40 kg N/ fed fertilized sunflower plants showed the lowest value . This was completely true in yield attributes such as head diameter, number of seeds / head and weight of seeds / head. These results reflect the importance of N application as an essential element for fruiting and seed development. Such results agreed with those reported by Samui *et al.* (1984) and Mahalonumberbis *et al.* (1999).

Table 6: Effect of nitrogen levels on yield and yield components of sunflower during 2005 and 2006 seasons.

Characters / Treatments	Plant height (cm)	Stem diameter (cm)	Number of leaves /plant	Head diameter (cm)	Number of seeds/ head	Weight of seeds/ plant (g)	Seed yield/fed (kg)	Oil %
Nitrogen levels					**2005 season**			
40 kg N / fed	104.18	1.88	13.59	14.36	749.80	35.81	625.72	35.38
50 kg N / fed	112.83	2.05	14.28	15.45	781.94	37.36	657.24	35.18
60 kg N / fed	115.94	2.24	14.72	16.44	807.08	38.61	689.97	34.90
LSD at 5%	2.21	0.33	N.S	0.29	6.17	0.73	4.80	0.07
C.V	4.10	2.70	3.19	2.50	5.20	3.15	5.57	3.47
Pure stand	113.09	1.81	17.23	15.49	795.29	35.55	1150.15	35.46
Nitrogen levels					**2006 season**			
40 kg N /fed	110.52	1.88	15.59	12.99	753.58	35.25	617.70	35.54
50 kg N / fed	113.16	2.07	16.43	13.93	783.94	36.82	657.22	35.33
60 kg N / fed	117.01	2.16	16.77	15.08	812.03	38.02	686.80	35.11
LSD at 5%	1.06	0.13	N.S.	0.32	5.70	0.36	5.72	0.03
C.V	4.33	2.45	3.50	2.73	5.60	3.28	5.84	3.25
Pure stand	114.2	1.89	16.76	14.92	817.75	36.18	1030.16	35.52

Data in Table 6 indicated clearly that 60 kg N/ fed treatment were the favorable which recorded the highest means of seed yield/fed. It was followed by 50 kg N/fed, while 40 kg N/fed came in the third rank after 60 and 50 kg N/fed in the first and second seasons. The observed increase in yield attributes may be due to the accumulation of nutrients in the reproductive organs leading to well developed heads and seeds. Similar results were reported by Sorour and Attia. (1988). Oil % in sunflower seeds was significantly affected by increasing N fertilization levels from 40 to 50 up to 60 kg N/fed in both seasons as shown in Table 6 .Oil seed % of sunflower was decreased slightly by increasing N fertilization in both seasons . Similar trend was noticed with Zaky (1994) and Abd EL-Sámie *et al.*(2002).

3-Interaction effects:

Data presented in Table 7 indicated that head diameter in the second season, number of seeds / head ,seed yield /fed and oil % in both seasons were significantly affected by the interaction between intercropping patterns and N fertilization levels. The highest values of head diameter and number of `seeds / head were obtained from the interaction between p4 and 60 kg N / fed, whereas the lowest values were showed with p2 and 40 kg N/fed for head diameter and from p3 and 40 kg N/ fed for number of seeds / head in both seasons. With respect to seed yield / fed the highest value were recorded at p3 and 60 kg N / fed and the lowest value was showed with p4 and 40 kg N / fed in both seasons, oil seed content of sunflower was inferences by the interaction between intercropping patterns and N fertilizer levels in both seasons .

Table 7: Effect of the interaction between the intercropping patterns and nitrogen levels on some sunflower characters during 2005 and 2006 seasons.

Characters / Intercropping pattern Peanut : sunflower	Nitrogen levels	Head diameter (cm)	Number of seeds / head		Seed yield / fed (kg)		Oil %	
		2006	2005	2006	2005	2006	2005	2006
P1 100%+50% 20 cm	40	13.67	770.29	777.65	706.96	723.27	35.39	35.68
	50	15.65	791.55	809.98	739.80	759.08	35.14	35.50
	60	16.79	825.40	834.29	773.33	778.27	35.00	35.33
P2 100%+50% 40 cm	40	13.36	759.78	733.84	730.50	719.76	35.31	35.49
	50	14.54	761.18	772.99	768.23	772.94	35.11	35.28
	60	15.85	789.98	797.95	809.25	810.05	34.89	35.11
P3 100%+50% 60 cm	40	13.44	680.42	719.63	740.37	729.60	35.28	35.21
	50	14.49	727.53	752.41	783.40	802.20	35.10	35.02
	60	15.66	750.72	796.95	822.16	850.32	34.96	34.87
P4 100%+33% 20 cm	40	15.60	772.74	793.76	450.02	436.67	35.60	35.74
	50	16.44	834.36	826.03	473.58	455.61	35.48	35.48
	60	17.58	862.62	854.48	506.98	474.88	35.25	35.40
P5 100%+33% 40 cm	40	15.30	769.29	765.60	534.57	510.54	35.46	35.66
	50	16.46	803.65	794.61	562.89	543.50	35.29	35.21
	60	16.89	817.07	815.30	587.11	579.20	34.75	35.20
P6 100%+33% 60 cm	40	14.74	746.30	728.00	591.91	566.39	35.24	35.46
	50	15.18	768.35	743.67	615.54	609.97	34.96	35.16
	60	15.90	796.66	763.26	641.01	848.07	34.56	34.77
LSD at 5%		0.19	8.23	7.71	5.24	6.57	0.11	0.07

C: Competitive relationships and yield advantage of intercropping:

1-Land Equivalent Ratio:

Results in Table 8 indicated that intercropping sunflower with peanut increase land equivalent ratio in all intercropping systems in both seasons.

Intercropping 100 % peanut + 50 % sunflower, with planting one sunflower plant / hill at the second ridge of peanut (p1), recorded the highest value for (LER) which were 1.48 and 1.57 in the first and second season, respectively .Whereas, intercropping 100 % peanut + 33 % sunflower by planting one or three plants / hill at the third ridge of peanut (p6 and p4), recorded the lowest value in the first and second seasons, respectively which were 1.29 and 1.33.

In all intercropping patterns, peanut was more contributor than sunflower. This maybe due to peanut including 100 % in all intercropping patterns compared with sunflower which included less 100 % (50 – 33 % of its pure stand) . Similar results were recorded by Zaky (1994) and Itnal *et al.* (1996).

2-Relative Crowding Coefficient (K):

Data presented in Table 8 indicated that relative crowding coefficient had higher than the unit advantage in all intercropping patterns in both seasons.

The best results for (K) were achieved by the intercropping patterns which include 100 % peanut + 33 % sunflower , where sunflower was intercropped with peanut on the third ridge and thinned on three plants / hill in the first season , and thinned on one plant / hill in the second season .

Table 8: Competitive relationships and yield advantages of peanut and sunflower sunflower as affected by intercropping patterns during 2005/ 2006sasons.

Intercropping pattern Peanut : Sunflower	Land equivalent ratio			Relative crowding coefficient			Aggressivity	
	Lp	Ls	LER	Kp	Ks	RCC	Ap	As
	2005 season							
P1 100%+50%	0.84	0.64	1.48	2.54	6.37	16.18	- 0.70	0.70
P2 100%+50%	0.80	0.67	1.47	2.01	3.66	7.36	- 0.83	0.83
P3 100%+50%	0.75	0.68	1.43	1.51	4.59	6.93	- 0.93	0.93
P4 100%+33%	0.94	0.41	1.35	5.38	4.31	23.19	- 0.41	0.41
P5 100%+33%	0.82	0.49	1.31	1.51	2.12	3.02	- 0.86	0.86
P6 100%+33%	0.75	0.54	1.29	0.99	2.86	2.83	- 1.14	1.14
Intercropping pattern						2006 season		
P1 100%+50%	0.84	0.73	1.57	2.66	5.53	14.71	- 0.96	0.96
P2 100%+50%	0.79	0.75	1.54	1.82	5.93	10.80	- 1.08	1.08
P3 100%+50%	0.72	0.77	1.49	1.27	6.82	8.66	- 1.26	1.26
P4 100%+33%	0.89	0.44	1.33	3.90	2.84	11.06	- 0.59	0.59
P5 100%+33%	0.83	0.53	1.36	2.41	3.36	8.10	- 1.00	1.00
P6 100%+33%	0.76	0.59	1.35	1.59	4.32	6.87	- 1.34	1.34

A yield advantage occurred because the component crops differed in their utilization of growth resources in such a way that when they are grown in association, they are able to compliment each other and to work better over all use environmental resources than when they were grown separately. Similar results were recorded by EL-Sawy *et al.* (2006).

3- Aggressivity:-

Data in Table 8 shows that sunflower was the dominant intercrop component in all intercropping patterns in both seasons, the best results for (A) were achieved by intercropping patterns which including 100 % peanut + 33 % sunflower , where sunflower was intercropped with peanut on the third ridge and thinned on one plants / hill in both seasons . While peanut was the dominated component, the present results indicate clearly that sunflower as the over story. Intercrop has higher competitive ability than peanut as the under story component Similar results were recorded by Rajashekhar *et al.* (1997).

D:-Economic Evaluation:-

Data presented in Table 9 indicated that the advantage of intercropping patterns peanut and sunflower as economic expresser in terms of the farmer. Total income increased in all intercropping patterns compared to total income of peanut as control treatment.

The highest values of net income (L.E./fed) could be achieved by (p1) the pattern of 100 % peanut + 50 % sunflower(899.02 L.E.)and (970.62 L.E.), where sunflower was intercropped at the second ridge of peanut and thinned on one plant / hill in the first and second season . On the contrary, the lowest value was achieved by (p6) which including 100 % peanut + 33 % sunflower (383.53 L.E.) and (462.56 L.E.), where sunflower was intercropped with peanut at the third ridge and thinned three plants / hill in both seasons. The increase in total income were 28.85 and 33.05% for the highest values in the first and second season, respectively compared to total income of peanut as pure stand . Similar results were recorded by Itnal *et al.* (1996) and EL-Sawy *et al.* (2006).

Conclusion

It could be concluded that intercropping patterns (100 % peanut + 50 % sunflower) by planting sunflower on the other side of second peanut ridge at 20 cm apart and thinned sunflower on one plant/hill obtained the best Land equivalent ratio and net income compared with growing peanut as solid crop.

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تـأثير تحميـل عبـاد الشـمس مـع الفـول السـودانى والتسـميد الازوتـى علـى كـلا المحصولين ومكوناتهما

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قســـم بحـــوث التكثيـــف المحصـــولي – معهـــد بحـــوث المحاصـــيل الحقليـــة- مركز البحوث الزراعية – الجيزة – مصر

أقيمت تجربتان حقليتان بمحطة بحوث الإسماعيلية خلال موسمي ٢٠٠٥ و ٢٠٠٦ لدراسة تأثير ٦ نظم تحميل لعباد الشمس مع الفول السوداني وذلك بزراعة عباد الشمس علي مسافة ٢٠ و ٤٠ و ٦٠ سم والخف على نبات ونباتين وثلاث نباتات بالجورة علي الترتيب و الزراعة علي خط وترك خط لتعطي ٥٠ % من الكثافة النباتية المنفردة لعباد الشمس وعلي خط وترك خطين لتعطي ٣٣ % مع دراسة ثلاث مستويات للتسميد الازوتي ٤٠ و ٥٠ و٦٠ كجم أزوت / فدان بجانب الزراعة المنفردة لكلا المحصولين واستخدم نظام القطع المنشقة مرة واحدة في ثلاث مكررات وكانت أهم النتائج المتحصل عليها كالاتي :-

الفول السوداني -

أدى تحميل عباد الشمس مع الفول السوداني الي تأثيرمعنوى علي كل من طول النبات وعدد ووزن قرون وبذورالنبات وزن ١٠٠ بذرة ومحصول القرون/ للفدان خلال موسمى الدراسة بينما لم يتأثر عدد فروع النبات ومعدل التصافى والنسبة المئوية للزيت بالبذور خلال موسمى الزراعة .

وأدى زيادة معدل التسميد الازوتى من ٤٠ الى ٥٠ حتى ٦٠ وحدة ازوت للفدان الى زيادة معنوية لكل صفات الفول السوداني المحمل خلال موسمي الدراسة.

أدى التفاعل بين عاملى الدراسة الى التاثير المعنوى على كل من عدد القرون على النبا ت ووزن البذور على النبا ت في كلا الموسمين ووزن القرون على النبا ت و محصول القرون/ للفدان فى الموسم الثاني .

عباد الشمس-

تـأثرت كل صفات عباد الشمس تحت الدراسة تاثيرا معنويا بنظم ا لتحميل المختلفة فى كلا الموسمين ما عدا عدد الاوراق/ نبات والنسبة المئوية للزيت في كلا الموسمين و سمك الساق التي تأثرت معنويا فى الموسم الثاني فقط وسجلت المعاملة (١٠٠ % فول سوداني+٥٠%عباد الشمس مع الخف على نبات واحد بالجورة) أعلى القيم لمحصول عباد الشمس حيث أعطت ٦٧,٦٨% و ٧٧,٠٩% فى الموسم الأول والثاني على الترتيب.

وأدت زيادة التسميد الازوتى إلى التأثيرالمعنوى علي صفات النمو والمحصول لكلا الموسمين ما عدا عدد أوراق النبات .

وأدى التفاعل بين عاملى الدراسة الى التاثير المعنوى على كل من عدد البزور على القرص و محصول البذور/ للفدان والنسبة المئوية للزيت وقطر القرص فى الموسم الثاني فقط .

العلاقات التنافسية -

سجل نظام التحميل الاول (تحميل ٥٠ % عباد الشمس مع الفول السوداني و الخف على نبات واحد بالجورة أعلي القيم لمعامل استغلال الارض في كلا الموسمين حيث وصلت إلى ١,٤٨ و ١,٥٧ في الموسم الأول و الثاني علي الترتيب وحققت كل نظم التحميل ميزة محصولية لمعامل الحشد النسبي في كلا الموسمين . وكان محصول عباد الشمس هو السائد فى كل نظم التحميل بينما كان الفول السوداني هو المسود فى كل نظم التحميل في كلا الموسمين.

- حقق نظام التحميل الاول (٥٠ % عباد الشمس + ١٠٠ % فول سوداني مع الخف على نبات واحد نبات بالجورة على أعلي عائد مادي فى كلا الموسمين بنسبة زيادة ٢٨,٨٥ و ٣٣,٠٥ % مقارنة بمحصول الفول السوداني المنفرد فى الموسم الأول و الثاني على الترتيب .

الخلاصة :

مما سبق يمكن التوصية بتحميل عباد الشمس مع الفول السوداني على خط وترك خط و الخف على نبات واحد بالجورة (١٠٠ % فول سوداني + ٥٠ % عباد الشمس) وذلك للحصول على أفضل قيمة لكل من معامل استغلال الأرض والعائدالمادى مقارنة بزراعة الفول السودانى منفردا .

Table 3: Effect of nitrogen levels on yield and yield components of peanut during 2005 and 2006 seasons.

Characters / Treatments	Plant height (cm)	Number of branches /plant	Number of pods /plant	Weight of pods/plant (g)	Weight of seeds/plant (g)	100-seed weight (g)	Shelling %	Pods yield (ardab) /fed	Oil %
Nitrogen levels				**2005 season**					
40 kg N / fed	54.30	7.03	19.48	36.26	21.51	62.56	59.32	9.71	47.70
50 kg N / fed	55.88	7.42	20.48	38.00	24.01	65.09	63.18	11.26	47.63
60 kg N / fed	61.48	7.47	21.65	40.00	25.97	67.35	64.17	12.27	48.00
LSD at 5%	1.04	N.S.	0.71	0.42	0.51	0.57	1.35	0.27	NS
C.V	3.20	2.85	3.50	4.64	3.73	3.44	4.17	3.90	3.32
Pure stand	62.14	8.56	29.06	44.19	27.43	65.20	62.07	13.56	48.26
Nitrogen levels				**2006 season**					
40 kg N / fed	53.28	6.31	18.43	34.47	20.53	65.01	59.55	9.29	47.76
50 kg N / fed	55.81	7.40	20.48	36.47	23.11	66.80	63.36	10.47	47.90
60 kg N / fed	58.06	8.29	22.95	38.75	25.20	70.96	65.03	11.13	48.10
LSD at 5%	0.56	0.25	0.87	0.62	0.45	1.89	0.93	0.24	0.05
C.V	3.80	3.19	3.11	4.14	3.18	3.81	4.39	4.27	3.14
Pure stand	61.17	9.37	26.00	42.75	25.55	69.42	59.76	12.78	47.85

Table 5: Effect of intercropping patterns on yield and yield components of sunflower during 2005 and 2006 seasons.

Characters / Treatments		Plant height (cm)	Stem diameter (cm)	Number of leaves /plant	Head diameter (cm)	Number of seeds/ head	Weight of seeds/plant (g)	Seed yield/fed (kg)	Oil %
Intercropping patterns Peanut : sunflower				**2005 season**					
P1 100%+50%	one plant/hill 20 cm	117.80	2.05	14.18	15.21	775.44	36.54	781.97	35.12
P2 100%+50%	two plants/hill 40 cm	114.32	1.86	14.02	14.58	765.30	36.48	769.34	35.10
P3 100%+50%	three plants/hil 60 cm	114.24	1.85	13.40	14.50	719.56	33.53	740.03	35.18
P4 100%+33%	one plant/hill 20 cm	108.63	2.37	14.69	16.55	823.24	40.29	616.18	34.92
P5 100%+33%	two plants/hill 40 cm	107.55	2.10	14.49	16.21	797.41	38.56	561.52	35.16
P6 100%+33%	three plants/hill 60 cm	103.55	2.08	14.40	15.37	796.67	38.16	476.86	35.44
LSD at 5%		2.11	0.21	N.S	1.87	5.29	1.95	6.10	NS
C.V %		4.10	2.70	3.19	2.50	5.20	3.15	5.57	3.47
Pure stand		123.09	1.81	17.23	14.49	465.29	31.55	1150.15	35.59
Intercropping patterns Peanut : Sunflower				**2006 season**					
P1 100%+50%	one plant/hill 20 cm	117.52	1.95	16.05	13.46	768.26	36.10	794.04	35.03
P2 100%+50%	two plants/hill 40 cm	114.50	1.94	15.65	13.30	756.33	35.45	767.58	35.29
P3 100%+50%	three plants/hill 60 cm	114.05	1.92	15.48	13.07	744.98	34.65	753.54	35.30
P4 100%+33%	one plant/hill 20 cm	113.25	2.28	16.94	15.24	830.42	38.40	608.14	35.13
P5 100%+33%	two plants/hill 40 cm	112.02	2.09	16.93	14.30	807.30	38.39	544.42	35.36
P6 100%+33%	three plants/hill60 cm	110.00	2.01	16.62	14.07	791.84	37.13	455.72	35.54
LSD at 5%		2.24	NS	N.S	1.01	6.19	0.97	7.65	NS
C.V %		4.33	2.45	3.50	2.73	5.60	3.28	5.84	3.25
Pure stand		127.11	1.89	16.76	12.92	707.75	30.18	1030.16	35.61

Table 9: Total income of peanut and sunflower as advantages of intercropping pattern during 2005 and 2006 seasons.

Intercropping pattern		Gross return of peanut	Grossl return of sunflower	Total Gross return	Net income	Increase %	Gross return of peanut	Gross return of sunflower	Total Gross return	Net income	Increase %
Peanut : Sunflower		**2005 season**					**2006 season**				
P1 **100%+50%**	20 cm	2610.53	1404.58	4015.11	899.02	28.85	2477.24	1430.22	3907.46	970.62	33.05
P2 **100%+50%**	40 cm	2502.52	1460.19	3962.71	846.62	27.17	2311.79	1456.83	3768.62	831.78	28.32
P3 **100%+50%**	60 cm	2350.85	1484.18	3835.03	718.94	23.07	2116.46	1506.75	3623.21	686.37	23.37
P4 **100%+33%**	20 cm	2819.65	905.08	3724.73	608.64	19.53	2605.93	864.96	3470.89	534.05	18.18
P5 **100%+33%**	40 cm	2553.08	1065.76	3618.85	502.76	16.13	2454.26	1033.29	3487.55	550.71	18.75
P6 **100%+33%**	60 cm	2330.17	1169.45	3499.62	383.53	12.31	2245.15	1154.25	3399.40	462.56	15.75
Peanut alone		3116.09	-------	3116.09	-------	-------	2936.84	---------	2936.84	-------	---------
Sunflower alone		------	2182.98	2182.98	-------	-------	---------	1955.24	1955.24	-------	----------

*** Net income = total gross intercropping pattern – gross return of peanut**
**** Price of Peanut = 229.8 L.E. / ardab, Price of Sunflower = 1898 L.E. / Ton .**
*****Agricultural Statistics, V. 2 Summer and Nili Crops, June 2006.**
Ministry of Agricultural and lands reclaim.