ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 45(2): 545-560, (2007).

INTERCROPPING MAIZE WITH PEANUT UNDER PLANT SPACING AND THREE PLANTING DATES

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ABSTRACT

Two field experiments were carried out at Ismailia Agricultural Research Station in 2005 and 2006 seasons. The objective of this study was to evaluate three planting dates of maize (hybrid 310) intercropped with peanut (Giza 6), under three intercropping systems (100 % peanut + 67 % maize, 100 % peanut + 50 % maize and 100 peanut + 33 % maize of the pure stand) at two maize plant spacing (35 cm apart leaving one plant per hill and 70 cm apart leaving two plants per hill)

Data obtained indicated that planting maize on June 5th gave the highest peanut yield and yield components. Intercropping system of 100 % peanut + 33 % a distance of 70 cm apart and thinned maize at two plants/hill gave the highest peanut yield. Significant effects for interaction between intercropping system, plant spacing and planting dates were observed on most component yield of peanut.

Intercropping system of 100 % peanut + 33 % maize recorded the highest values for most growth characters of maize. However, planting maize on May 15th, combined with intercropping system of 100 % peanut + 67 % maize and one plant/hill at 35 cm recorded the highest values of grain yield and yield components of maize. Significant effects for interaction between intercropping system, plant spacing and planting dates were observed on most component yield of maize.

Competitive relationships were studied. Rustled indicated that all the imposed treatments showed yield advantage compared with solid planting. Maximum values of total land equivalent ratio and total net return were obtained when maize was intercropped with peanut at 100 % peanut + 67 %, one plant at 30 cm /hill and planting maize on May 25th.

INTRODUCTION

Intercropping has played an important role in both low input agriculture and high-productivity agriculture with high-input. There are various high-productive intercropping systems in Egypt, such as peanut and maize intercropping.

In Egypt, Peanut (leguminous crop) is considered the main crop in new reclaimed sandy soil. To increase land use efficiency in these areas, farmers are used to grow some non-leguminous crop such as maize and sesame in association with peanut. Maize is has been known as a good companion crop to peanut.

Spatial arrangement of intercrops is an important management practice that can improve radiation interception through more complete ground cover (Reddy *et al.*, 1989). Increased productivity of intercropping over sole cropping has been attributed to better use of solar radiation, nutrients and water (Willey, 1990; Keating and Carberry, 1993; Morris and Garrity, 1993). Keating and Carberry (1993) have suggested that increasing radiation interception, due to better ground cover of intercrops, may be due to sub-optimal sole crop population densities used in comparisons. The availability of nutrients and water enhances exploitation of available solar radiation for greater crop productivity.

The effect of planting date on maize grown solid or intercropped was studied by several investigators. Waffa, KH. (1994) found that earlier sowing (mid May) of intercropping maize and soybean is recommended – if feasible- compared to the later sowing (mid June). The advantage of better land use (LER) should not be neglected in a country like Egypt suffering from insufficient maize grain and edible oils.

The effect of intercropping maize with peanut on growth, yield and yield components of maize were also studied by several investigators. Edje, (1982) and Misbuhulmunir, *et al.* (1989) found that intercropping maize with peanut reduced peanut seed yield, compared to pure stand yields. On other hand, Abd-El- Motaleb, and Yousef, (1998), found that intercropping maize at 25 % or 50 % of its full pure stand density with peanut increased number of pods/plant, 100- seed weight and pod yield/fad of peanut. Ennin, *et al.* (2002) reported that intercropping soybean and maize reduced maize grain yields by 53 to 88 % of sole maize yields in the first season and 31 60% of sole maize yields in the second season as indicated by the relative yields.

Hussein *et al.* (2002) and Sherif, Saher, *et al.* (2005) found that intercropping maize with peanut achieved yield advantage as measured by land equivalent ratio (LER) or by the relative crowding coefficient (RCC). Maize was always the dominant component, while peanut was the dominated. Zohry and Farghaly (2003), reported that plant height, ear height and yield/fad increased with narrowing distance between maize plants, whereas yield components values decreased.

MATERIALS AND METHODS

Two field trails were carried out at the Experimental Research Station, in Ismailia Governorate during 2005 and 2006 seasons. The objective was to study yield and yield components of peanut (var. Giza 6) intercropped at three intercropping systems at two plant spacing and three planting dates of maize (cv. TWC 310). Growing pure stand of both crops was taken as check plots.

Experiment included the following treatments:

I: Three Maize planting dates:

1- Planting on May 15th in the first season and on May 17th in the second season (D1).
2- Planting on May 25th in the first season and on May 28th in the second season (D2).
3- Planting on June 5th in the first season and on June 6th in the second season (D3).

II: Three intercropping systems:

1- 100 % peanut + 33 % maize (growing maize on one side of one ridge and leaving two ridges without intercropping, 6600 plant/fad).
2- 100 % peanut + 50 % maize (growing maize on one side of one ridge and leaving one ridge without intercropping, 10000 plant/fad).
3- 100 % peanut + 67 % maize (growing maize on one side of two ridges and leaving one ridge without intercropping, 13140 plant/fad) and peanut was grown one side of all ridges.

III: Two Plant spacing of maize:

1- Planting maize at 35 cm between hills with one plant/ hill.
2- Planting maize at 70 cm between hills with two plants/ hill.

In addition pure stand for peanut and maize were included for comparison. Intercropped or pure stand of peanut was sown on one side of the ridge at 10 cm apart and thinned at one plant/ hill (70000 plants/fad) on May 1st and May 4th in the first season and second season, respectively. Pure stand of maize was sown in check plots on one side of all ridges at 35 cm apart and thinned at one plant/ hill (20000 plant/fad). Check plots were devoted only to biological and economical evaluation.

The soil texture was sandy and the preceding winter crop was faba bean *(Vicia faba* L.) in both seasons. During land preparation 25 kg P_2O_5 /fad in the form of calcium super phosphate (15 % P_2O_5) were added. Nitrogen fertilizer was used at the rate of 25 kg N/fad for peanut and 120 kg N/fad for maize according to plant density per area unit in the form of ammonium sulfate (20.5 % N) in two equal doses, the first after thinning and the second dose at one month later. Potassium fertilizer was added at the rate of 100 kg K_2O/fad for peanut and 25 kg K_2O/fad for maize in the form of potassium sulfate (48 % K_2O). Normal cultural practices for growing both crops were followed. Harvesting took place on Sep. 23rd and Sep. 25th for peanut in both seasons. Harvesting took place on Sep. 3rd, 11th and 20th for maize, in the first season and Sep 6th, 15th and 23rd in the second season, respectively.

At harvesting, 10 guarded plants were taken at random from each treatment in each replicate to estimate growth characters and yield components, while pod yield of peanut and grain yield of maize were estimated on plot basis and transformed to yield (Ardab/fad).

Peanut data:

Plant height (cm), number of branches/plant, number of pods/ plant, number of seeds/ plant, weight of pods and seeds/ plant (gm), shelling % (weight of seeds/ weight of pods/ plant), weight of 100 seeds (gm), pods yield7fad (ardab) (One Ardab equal 75 kg) and oil percent in peanut seeds.

Maize data:

Plant height (cm), ear height (cm), ear diameter (cm), ear length (cm), number of grains/ ear, number of rows/ ear, ear weight (gm), grains weight/ ear (gm), shelling %, weight of 100 grains (gm) and grain yield/fad (Ardab). One Ardab is equal to 140 kg of shelled grain adjusted to 15.5% moisture content.

Obtained data were statistically analyzed in split- split plot with three replicates for each season. Homogeneity tests for the two seasons error terms were conducted. The main plots were devoted to maize sowing dates, whereas the sub- plots were for maize intercropping systems and the sub-sub plots for plant spacing of maize. The size of sub-sub plot was 24 m^2 (5.0 m long, containing 8 ridges at ridge spacing of 60 cm apart). The combined analysis was made according to Gomez and Gomez (1984) and L.S.D. at 5 % level was used to compare the treatment means.

The competitive relationships for both crops during 2005 and 2006 seasons were calculated.

Competition Relationships:

1- **Land Equivalent Ratio (LER):** Was calculated according to Mead and Willey (1980).
2- **Relative Crowding Coefficient (K):** Was calculated according to De-Wit (1960).
3- **Aggressivity (A):** Was calculated according to Mc-Gilchrist (1965).
4- **Total return/fad** (average of two seasons) was calculated for each treatment in Egyptian pounds LE/fad using the average market prices for both seasons. The average market prices were L.E. 145/Ardab of maize grain and L.E. 3.5 per kg of peanut, respectively according to prices in Agricultural Statistics at 2005 season.

RESULTS AND DISCUSSION

A -Peanut:

A -1: Effect of maize planting date:

Data in Table (1) revealed that delaying maize planting from May 15th to June 5th significantly increased gradually and consistently plant height. The long life cycles of both components live together stimulated peanut height as a result of more shading seemed to be cogent and feasible reason.

The effect of maize planting date was significant for all characters, except number of branches plant, shelling % and seed oil %. Mean values of peanut traits were increased by delaying planting maize.

The results in Table (1) showed that delaying maize planting until June 5th increased yield attributes, i.e. number and weight of pods/plant, number and weight of seeds/plant and weight of 100 seeds as average of both seasons.

Pod yield/fad indicated that delaying maize planting up to June 5th increased pods yield by 10.59 and 16.54 % as average of two seasons planting on May 15th and May 25th, respectively. These results are agreed with those obtained by Wafaa, KH. (1994) and Sherif, Saher *et al.* (2005).

A -2: Intercropping Effects:

Data in Table (1) reveal that intercropping systems had significant effect on all traits of peanut, except number of branches/ plant, shelling % and oil % in seeds. Plant height was significantly affected by intercropping systems. Mean values increased by decreasing maize plant population.

With respect to yield attributes, results indicate that intercropping systems of 100 % peanut + 33 % maize recorded the highest values, followed by 50 % and the lowest values were when 67 % maize was grown in the association. These results may be due to the increased vegetative growth of peanut and consequently increased yield attributes for more light intercepted by peanut when lowering maize ratio to the least (33 %).

The trend of pods yield/fad was similar to peanut yield attributes. Intercropping systems of 100 % peanut + 33 % maize gave the highest yield, followed by 100 % peanut + 50 % maize, whereas the lowest value was obtained with 100 % peanut + 67 % maize intercropping. The pods yield fad^{-1} as compared to peanut pure stand was 65.70, 52.89 and 48.95 % as average of two seasons.

Generally, pure stand of peanut gave the highest pods yield/fad. These results may be due to increasing competition between maize and peanut for solar radiation and shading peanut with increasing maize density which depressed photosynthesis process and consequently diminished pods yield fad^{-1}. These data are in accordance with those recorded by Edje, (1982), Misbuhu lmunir, *et al.* (1989) Abd-El- Motaleb, and Yousef, (1998) and Sherif, Saher *et al.* (2005).

A-3: Effect of maize plant spacing:

Data in Table (1) revealed that plant heights of peanut were tenaciously correlated with shade offered by maize. Highest peanut plants reached maximal when maize was planted 70 cm apart and two plants per hill. Whereas, when peanut plants were shaded by one plant hill^{-1} grown at 35 cm part peanut height reached minimal. These results are true as average of two seasons. The effect of shade crop on plant height of the peanut has been previously demonstrated by Edje (1982) and was interpreted according to light theory. Same trend could be detected for the average number of branches/ plant as influenced by maize plant spacing. The effect was also governed by the magnitude of shading. The average number of branches/plant increased to maximum when shaded by maize grown at 70 cm apart and thinned at two plants/hill, whereas minimum peanut branches

plant^{-1} obtained when the shade crop was orientated at 35 cm apart and thinned at one plant hill^{-1}. It seemed that narrowing the distances between maize plants to 35 cm hill^{-1} diminished light penetration to the base crop rather than leaving 70 cm between plants was the cause and effect. Similar results were obtained by Zohry and Farghaly (2003),

Yield and yield components were also significantly affected by the geometric plant spacing of the shade crop, except number of branches/ plant, number of pods/plant, number of seeds/plant, shelling % and oil % in seeds. The data indicated that all traits followed similar trend, except in case of number of pod/plant, shelling % in peanut seeds where the trend was reversed, but with insignificant differences in case of the average number of pods/ plant and oil percents in seeds. Yield component traits, i.e. the average pods weight/ plant, seeds weight/ plant, 100 -seed weight and the yield of pods (ardab)/fad when maize plants were grown 70 cm apart exceeded those grown at 35 cm apart leaving one plant/hill.

The yield of peanut when shaded with 70 cm apart at one plant/hill exceeded that with 35 cm apart by 3.68 % as average of two seasons. Several investigators concluded that modification of the shade crop population and geometrical plant spacing did influence the spatial variability of solar irradiance intercepted by peanut foliage, Misbuhulmunir, *et al.* (1989) and Sherif, Saher *et al.* (2005).

Table (1): Yield and yield components of peanut as affected by planting dates, intercropping systems and plant spacing of maize (as average of two seasons).

Characters / Treatment	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /plant	Wt. of pods /plant (gm)	Wt. of seeds /plant (gm)	Shelling %	Seed index (gm)	Pod yield /fad (ardab)	Seed oil %
Planting dates										
D1	46.36	6.94	16.96	22.33	22.72	14.75	63.95	67.30	7.72	46.11
D2	54.30	7.54	19.48	24.00	25.40	16.41	65.30	71.00	9.25	46.88
D3	58.00	7.90	20.22	24.99	27.63	18.36	66.70	72.68	10.23	47.53
L.S.D. at 0.05	2.14	N.S	2.17	1.80	1.30	1.15	N.S	1.17	0.81	N.S
Intercropping systems										
100 % + 33 %	51.34	7.42	22.32	25.88	27.18	17.89	64.20	65.76	10.67	47.76
100 % + 50 %	51.63	7.41	20.48	23.98	25.52	16.78	66.91	71.25	8.59	47.28
100 % + 76 %	53.05	7.58	16.90	21.50	23.05	14.86	64.84	73.96	7.95	45.49
L.S.D at 0.05	0.86	N.S	0.42	1.65	1.16	0.64	N.S	2.13	0.75	N.S
Pure stand	55.32	7.62	21.16	27.14	30.11	20.51	68.62	75.10	16.24	47.51
Plant spacing										
One plant at 35 cm	56.78	6.73	19.43	22.64	24.30	15.58	66.27	69.58	8.90	46.84
Two plant at 70 cm	57.78	7.74	20.33	24.90	26.20	17.43	64.36	71.09	9.24	46.85
F. Test	*	N.S	N.S	N.S	**	*	N.S	*	*	N.S

A- 4: Interaction effects:

I -Effects of planting dates and intercropping systems of maize on peanut yield and yield components:

The interaction effects of planting data x intercropping on yield and yield components of peanut are presented in (Table 2). Maximum values were obtained when intercropping system of 100 % peanut + 33 % maize was applied and maize was planted on latest date. Whereas, the minimum values were recorded with intercropping system of 100 % peanut + 67 maize with earliest planting date on mid May.

II -Effects of intercropping systems and plant spacing of maize on yield and yield components of peanut:

Data in Table (3) show that the interaction effect between intercropping system and maize plant spacing on weight of pods/plant, weight of seeds/ plant, weight of 100 seeds and pods yield/fad (ardab) was significant. Maximum values were recorded when maize was spaced at 70 cm apart and thinned at two plants/hill within intercropping system of 100 % peanut + 33 % maize. Whereas, minimum values were obtained when intercropping system of 100 % peanut + 67 % maize was applied and maize was plant spacing at 35 cm apart and thinned at one plant/hill.

Table (2): Yield components of peanut as affected by interaction between planting dates and intercropping systems of maize (as average of two seasons).

Characters / Treatment		Wt. of pods / plant (gm)	Wt. of seeds / plant (gm)	Seed Index (gm)	Pod yield /fad (Ardab)
Intercropping system	Plant date				
33 %	D1	24.75	16.46	70.50	9.83
	D2	27.30	17.33	74.89	10.69
	D3	29.50	19.87	76.49	11.49
50 %	D1	22.97	14.86	67.91	6.91
	D2	27.70	17.06	71.87	8.77
	D3	25.90	18.44	73.98	10.09
67 %	D1	20.45	12.94	63.49	6.44
	D2	25.70	14.86	66.25	8.30
	D3	23.00	16.78	67.55	9.10
L.S.D at 0.05		1.21	0.73	1.39	0.68
Pure stand		30.11	20.51	75.10	13.28

III - Effects of maize planting date and plant spacing:

Data in (Table 4) show that there were significant for studied traits. Maximum values were obtained when maize plant spacing was at 70 cm apart and thinned at two-plants/ hill and seeding maize on June 5th. Whereas, the lowest value was obtained when maize was planted at 35 cm apart on May 15th.

Table (3): Yield components and pod yield of peanut as affects by interaction between intercropping systems and plant spacing of maize (as average of two seasons).

Treatment / Characters		Wt. of pods / plant (gm)	Wt. of seeds / plant (gm)	Wt. of 100-seed (gm)	Pod yield /fad (Ardab)
Plant spacing	Intercropping (Peanut % and maize %)				
35 cm and one plant /hill	100 % + 33 %	26.10	16.64	73.25	10.80
	100 % + 50 %	24.37	15.77	71.59	8.77
	100 % + 76 %	22.43	14.34	68.41	8.15
70 cm and two plants /hill	100 % + 33 %	28.27	19.13	72.11	10.53
	100 % + 50 %	26.67	17.80	70.42	8.41
	100 % + 76 %	23.67	15.37	66.18	7.75
L.S.D at 0.05		1.08	0.32	1.33	0.69
Pure stand		30.11	20.51	75.10	13.28

Table (4): Yield components of peanut as affected by interaction between plant spacing and planting dates of maize (as average of two seasons two seasons).

Treatments / Characters		Wt. of pods /plant (gm)	Wt. of seeds /plant (gm)	Seed index (gm)	Pod yield / fad (Ardab)
Plant spacing	Planting Date				
35 cm and one plant /hill	D1	21.44	13.81	65.30	7.61
	D2	24.53	15.29	70.80	9.03
	D3	26.93	17.65	73.40	10.05
70 cm and two plants /hill	D1	24.00	15.69	68.30	7.84
	D2	26.37	17.54	71.80	9.47
	D3	28.33	19.07	74.50	10.40
L.S.D at 0.05		1.17	1.12	0.98	0.71
Pure stand		30.11	20.51	75.10	13.28

B- Maize:

B-1: Effect of maize planting dates:

Data in Table (5) revealed that there was consistent and gradual decrease in plant height with delaying time of planting maize till June 5th. These results are in accordance with those reported by Waffa, KH. (1994), Khedr *et al.* (1990) and Sherif, Sahar *et al.* (2005).

Yield and yield components of maize were significantly affected by date of planting. Further all studied traits (ear length, ear diameter, number of grains/ ear, weight of ear, grains weight/ear, weight of 100 grains, grain yield/ plant and grain yield/ fad) followed the same general trend. There were increases in the values of these traits with early date of planting, which may be due to the longer

growth period. The data also, evidenced that the yield of maize/fad grown as late as 5th June decreased by 18.36 % as an average of two seasons, as compared with maize planted on May 15th (earliest date) and 5.15 % as compared with maize planted on first of June as an average of two seasons. Similar results were obtained by Malithano and Van (1981).

B-2: Effects intercropping system:

Data in Table (5) indicate that there were gradual increases in maize plant height with increasing maize density in the intercrop. Intercropping system of 100 % peanut + 67 % maize recorded the highest values of plant height, while the lowest values were recorded with 100 % peanut + 33 % maize. These results may be due to inter competition between maize and peanut. Many investigators supported these results (Zohry and Farghally, 2003 and Sherif, Sahar *et al.* 2005). Interpretation for this observation is feasible. Plant to plant competition for light which in turn resulted in taller internodes might owe much to the increase in maize plant height with heavier density of maize plants in the intercrop. The effect on ear height was significant in the combined average. The trend was also regular. Ear height increased with the increased density of the shade crop. These results are in harmony with those reported by Sherif, Sahar *et al.* (2005).

Yield attributes, i.e., ear diameter, number of grains /ear, ear weight /plant, grain weight/ plant and weight of 100 grains significantly increased with the diminishing of maize population in the intercrop. Intercropping of 100 % peanut + 67 % maize recorded the lowest values, whereas the highest values were recorded with 100 % peanut + 33 % maize.

The grains yield/ fad of intercropping system 100 % peanut + 67 % maize gave the highest values, followed by 100 % peanut + 50 % maize, whereas the lowest values were recorded when 100 % peanut + 33 % maize was applied. Explicit interpretation for this trend might fell heavily to the increase of maize stand at harvest in the denser planting of the shade crop, i.e., mainly due to a reduction in maize population rather than to a fierce interplant competition on growth resources.

B-3: Effect of maize plant spacing:

Data in Table (5) revealed that most of the maize traits were insignificantly affected. Plant height and ear height reached highest values when maize was grown at 70 cm apart and leaving two-plants /hil . Whereas, these traits reached lowest values when maize was grown at 35 cm with one plant /hill. Furthermore, number of grains/ ear, weight of ear, weight of grains /ear behaved reversed trend. These results are in agreement with those recorded by Sherif, Sahar *et al.* (2005). They found that growing maize at 30 cm apart at one plant/ hill or at 60 cm apart leaving two plants $hill^{-1}$ showed no any significant differences in both yield and yield components.

Yield per fad of maize crop was insignificantly affected by plant spacing. Several investigators supported these results (El Douby, *et al.*, 2001 and Hussein, *et al.*, 2002). They also revealed that the increases of maize yield components; weight of ear and grains/ plant when the crop was grown at one

plant/ hill over those in two plants might be due to less competition among plants for light intercepted by foliage as well as for mineral and water absorbed by the root system.

Table (5): Effect of intercropping systems, plant spacing and planting dates of maize on maize yield and yield components (as average of two seasons).

Characters / Treatment	Plant height (cm)	Ear height (cm)	Ear diameter (cm)	No of grains /plant	No of rows /ear	Wt. ear (gm)	Grains yield /plant (gm)	Shelling %	Wt. of 100-grains	Grains yield / fad (ardab)
Planting dates										
D1	220.59	122.66	36.83	41.35	12.13	167.17	190.24	76.09	38.06	14.76
D2	210.65	105.56	35.45	39.78	11.69	157.32	180.29	78.14	37.39	13.65
D3	192.15	90.47	32.03	35.97	11.08	146.27	168.41	77.68	36.62	12.05
L.S.D. at 0.05	7.13	6.32	0.85	0.68	2.19	7.42	4.95	0.61	2.53	1.38
Intercropping systems										
100 % + 33 %	201.13	98.19	45.52	40.69	12.51	179.29	207.21	78.02	38.48	8.87
100 % + 50 %	210.86	100.26	45.29	39.15	11.47	153.79	175.17	76.85	37.69	14.00
100 % + 76 %	211.43	101.82	43.49	37.29	10.91	137.68	156.56	77.00	35.90	17.59
L.S.D at 0.05	2.62	1.17	1.15	0.88	N.S	4.23	3.14	0.72	1.12	2.03
Pure stand	220.53	106.64	47.92	43.26	12.93	180.23	219.61	78.37	39.93	23.25
Plant spacing										
One plant at 35m	206.72	11.98	44.72	39.67	11.98	160.37	184.21	77.34	38.00	13.96
Two plant at 70 cm	208.87	110.48	43.81	38.41	11.27	153.47	175.08	77.29	36.71	13.02
F. Test	*	*	N.S	*	N.S	*	*	N.S	N.S	N.S

B- 4 -Interaction effects.

I- Yield components of maize as affected by interaction between intercropping systems and planting dates of maize:

Similarly, the interaction effects of intercropping systems with maize planting dates followed the general tendency of both main variables when behaved alone (Table 6). Maximum values were recorded when intercropping system of 100 % peanut + 33 % maize and planting date on May 15th for ear weight/ plant, grain yield/ plant and weight of 100 grains. On the other hand, intercropping system of 100 % peanut + 67 % maize recorded the lowest values and planting date on June 5th. Whereas, the maximum values for weight of grains/ fad was recorded with 100 % peanut + 67 % maize and planting date on May 15th.

II- Yield components of maize as affects by interaction between intercropping systems with maize plant spacing:

Interaction between intercropping systems and maize plant spacing on weight of ear/ plant, yield of grains/ plant, weight of 100 grains and grain yield/ fad (ardab) were significant (Table 7). However, the course of change of these traits followed the trend of the main treatment effect as a whole. Data on the interaction effect of these traits were governed by the trend predominated the two

main variables, i.e., intercropping systems and maize plant spacing when they behaved individually. Maximum yield was obtained when maize was spaced at 35 cm apart and thinned at one plant/ hill and intercropping system of 100 % peanut + 67 % maize. Whereas, minimum values were observed with intercropping system of 100 % peanut + 33 % maize and plant spacing of 70 cm between plants and thinned at two plan/ hill or 35 cm apart and thinned at one plant/ hill in the combined data, (Table 7).

Table (6): Yield components of maize as affected by interaction between intercropping systems and planting dates of maize (as average of two seasons).

Characters / Treatment		Wt. of ear (gm)	Grains yield/ plant (gm)	Wt. of 100-grain (gm)	Grains yield /fad (ardab)
Cropping systems	Plant date				
33 %	D1	191.33	217.93	39.11	9.88
	D2	180.17	209.01	38.42	9.07
	D3	166.36	194.72	37.93	7.67
50 %	D1	162.85	185.67	38.08	15.46
	D2	153.85	175.07	37.74	14.10
	D3	144.68	164.76	37.25	12.44
67 %	D1	147.33	167.13	36.99	18.95
	D2	137.95	156.80	36.03	17.79
	D3	127.76	145.76	34.67	16.05
L.S.D. at $_{0.05}$		2.27	2.26	1.36	1.54
Pure stand		180.23	219.61	39.93	23.25

Table (7): Yield components of maize as affected by interaction between intercropping systems with maize plant spacing (as average of two seasons).

Characters / Treatment		Wt. of ear (gm)	Wt. of grain yield/ plant (gm)	Wt. of 100 grains (gm)	Grains yield/ fad (ardab)
Plant spacing	Cropping systems				
35 cm	100 % + 33 %	184.98	214.91	39.31	9.15
	100 % + 50 %	155.83	178.00	38.23	14.52
	100 % + 76 %	140.20	159.72	35.46	18.22
70 cm	100 % + 33 %	173.59	199.51	37.66	8.60
	100 % + 50 %	151.59	172.33	37.14	13.48
	100 % + 76 %	135.17	153.40	35.53	16.97
L.S.D. at $_{0.05}$		3.82	2.22	1.86	1.02
Pure stand		180.23	219.61	39.93	23.25

III- Yield components of maize as affects by interaction between of plant spacing of maize and planting dates:

Interaction effects between maize plant spacing with planting dates are shown in Table (8). Maximum values were obtained when maize plant spacing was at 30 cm apart and thinned at one plant/ hill and growing maize on May 15th. While, the lowest values were obtained when maize was planted at 60 cm apart on June 15th.

Table (8): Yield components of maize as affected by interaction between of planting dates and plant spacing of maize (as average of two seasons).

Characters / Treatment		Wt. of ear (gm)	Grain yield/ plant (gm	Wt. of 100-grains (gm)	Grain yield/ fad (ardab)
Plant spacing	Plant date				
35 cm	D1	169.49	193.34	37.54	15.27
	D2	160.40	183.81	36.57	14.06
	D3	151.21	175.48	36.03	12.56
70 cm	D1	164.85	187.14	38.58	14.26
	D2	154.24	176.77	38.22	13.25
	D3	141.32	161.33	37.20	11.55
L.S.D. at 0.05		2.47	2.66	1.42	0.68
Pure stand		180.23	219.61	39.93	23.25

3- Competitive relationships:

3-1- Land Equivalent Ratio:

Results in Table (9) showed that intercropping maize with peanut increased land equivalent ratio in all intercropping systems, since all values exceeded the unit. Intercropping 100 % peanut + 67 % maize when maize plant spacing was at 35 cm apart and one plant/ hill recorded the highest value for (LER) which was 1.40 as average of both seasons. Peanut was the greater contributor with "Lp" values in all intercropping systems except, in case of 100 % peanut + 67 % maize, whereas the lowest value was recorded with intercropping system of 100 % peanut + 33 % when maize plant spacing was at 70 cm apart and two plants/ hill and maize was grown on June 15th. These data is in accordance with those reported by Waffa, KH. (1994), Hussein *et al.* (2002) and Sherif, Saher, *et al.* (2005)

3-2: Relative Crowding Coefficient (K):

Results in Table (9) indicated that relative crowding coefficient had yield advantage in all treatments. The highest RCC values were achieved by the intercropping trait including 100 % peanut + 50 % maize when maize plant spacing was at 35 cm apart and one plant/ hill on May 15th, where K values recorded 15.01 as average of two seasons. A yield advantage occurred because the component crops differ in their utilization of growth resources when grown in association and were able to complement each other and became able to

maximize over all use of macro and micro environmental resources than when grown separately. Similar results were recorded by Waffa, KH. (1994), Hussein *et al.* (2002) and Sherif, Sahar *et al.*, (2005).

3-3 -Aggressivity:

Data on Aggressivity (Table 9) indicated that nor did any intercropping system have any competitive pressure (all values below unit). Peanut was always the dominated intercrop component in all intercropping patterns, while maize was the dominant component. The results also indicate clearly that maize (as the "overstory" intercrop) has higher competitive pressure than peanut (as the "understory" component). Similar results were recorded by Waffa, KH. (1994), Hussein *et al.* (2002) and Sherif, Sahar *et al.*, (2005).

Table (9): Competitive relationships and total income of intercropping maize with peanut as average for two seasons.

Competitive Relationships			Yield/ fad (ardab)		LER			K			Aggressivity		Peanut price (L.E.) Ardab /fad	Maize price (L.E.) Ardab /fad	Total Income
Treatment			Pea-nut	Maize	Lp	Lm	LER	Kp	Km	K	Ap	Am			
35 cm	33 %	D1	9.69	10.23	0.73	0.44	1.17	0.79	0.89	0.70	-0.60	+0.60	2544.7	1483.3	4028.1
		D2	10.49	9.07	0.79	0.39	1.18	0.63	1.24	0.79	-0.39	+0.3	2753.9	1315.1	4069.01
		D3	11.42	8.14	0.86	0.35	1.21	0.54	2.03	1.09	-0.20	+0.2	2997.9	1180.3	4178.2
	50 %	D1	6.77	16.04	0.51	0.69	1.20	2.22	6.76	15.01	-0.86	+0.8	1777.8	2325.8	4103.6
		D2	8.50	16.27	0.64	0.63	1.27	1.73	0.89	1.54	-0.65	+0.6	2231.0	2134.4	4365.4
		D3	9.96	12.79	0.71	0.55	1.26	1.22	1.22	1.49	-0.39	+0.3	2614.5	1854.5	4469.0
	67 %	D1	6.37	19.53	0.48	0.84	1.32	5.23	0.62	3.26	-0.62	+0.6	1673.2	2831.8	4505.1
		D2	8.10	18.83	0.61	0.79	1.40	3.77	1.05	3.96	-0.43	+0.4	2126.4	2665.1	4791.5
		D3	8.76	16.74	0.66	0.72	1.38	2.57	1.30	3.34	-0.29	+0.2	2300.7	2427.3	4728.0
70 cm	33 %	D1	9.96	9.53	0.75	0.41	1.16	0.69	0.99	0.69	-0.49	+0.4	2614.5	1382.2	3996.7
		D2	10.89	9.07	0.82	0.39	1.21	0.64	1.50	0.96	-0.36	+0.3	2858.5	1315.1	4173.6
		D3	11.55	7.21	0.87	0.31	1.18	0.45	2.20	0.99	-0.07	+0.0	3032.8	1045.0	4077.9
	50 %	D1	7.04	14.88	0.53	0.64	1.17	5.90	0.56	3.30	-0.75	+0.7	1847.5	2157.6	4005.1
		D2	9.03	13.48	0.68	0.58	1.26	1.40	1.06	1.46	-0.48	+0.4	2370.4	1753.0	4123.5
		D3	10.23	12.09	0.77	0.52	1.29	1.08	1.68	1.82	-0.27	+0.2	2684.2	1381.8	4066.0
	76 %	D1	6.51	18.37	0.49	0.79	1.28	3.76	0.64	2.41	-0.55	+0.5	1708.1	2663.6	4371.7
		D2	8.50	17.20	0.64	0.74	1.38	2.84	1.19	3.38	-0.33	+0.33	2231.0	2494.0	4725.0
		D3	9.49	15.35	0.71	0.66	1.37	1.94	1.64	3.19	-0.16	+0.1	2475.0	2225.7	4700.7
Pure stand			13.28	23.25	—	—	—						3483.3	3371.35	—

Total return = Total income of intercropping system -Total income of peanut pure stand.
Price of peanut = 3.5 L.E. / kg, Price of maize = 145 L.E. / ardab.

4- Total Return:

The evaluation of different intercropping systems of maize with peanut was made for the two seasons as the net income of the two components and compared with the pure stand due to market price (Table 9). Using intercropping system of 100 % peanut + 67 % maize when maize plant spacing was at 35 cm apart at one plant/hill and planting maize after 10 days of peanut seeding gave the highest net income (4857.1 L.E).

Therefore, it could be recommended that intercropping maize with peanut at 100 % peanut + 67 % maize with plant spacing of maize at 35 cm apart and one plant/ hill and planting maize after 10 days of peanut seeding.

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تحميل الذرة الشامية مع الفول السوداني تحت مسافات زراعة وثلاث مواعيد زراعة

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أجريت تجربتان حقليتان خلال موسمي ٢٠٠٥ و٢٠٠٦ بمحطة البحوث الزراعية بالاسماعيلية لدراسة تأثير تحميل الذرة مع الفول السوداني تحت ثلاثة مواعيد لزراعة الذرة وثلاثة نظم للتحميل ومعدلين من التوزيعات النباتية للذرة الشامية على النمو ومكونات المحصول لكلا الفول السوداني والذرة الشامية. أستخدم ثلاثة نظم للتحميل، ١٠٠ % فول سوداني + ٦٧ % ذرة و١٠٠ % فول سوداني + ٥٠ % ذرة و١٠٠ % فول سوداني + ٣٣ % ذرة. وكانت التوزيعات النباتية هي زراعة الذرة على مسافة ٣٥ سم / نبات واحد بالجورة والزراعة على مسافة ٧٠ سم / نباتين بالجورة. وزرعت الذرة محملة في **وثلاث مواعيد** (١٥، ١٧ مايو٢٥، ٢٨ مايو و٥، ٦ يونيو في كلا الموسمين. أستخدم التصميم الإحصائي القطاعات المنشقة مرتين. وكانت أهم النتائج المتحصل عليها كالتالي:

الفول السوداني: سجل نظام التحميل ١٠٠ % فول سوداني + ٣٣ % ذرة **شامية** أعلا القيم لمحصول الفول السوداني ومكوناتة. كما سجلت التوزيعات النباتية للذرة **الشامية** أعلا القيم للفول السوداني عند الزراعة على مسافة ٧٠ سم وترك نباتين بالجورة. وأظهر ميعاد الزراعة في الميعاد المتأخر للذرة **الشامية** المحملة معه أعلا القيم للمحصول ومكوناتة. أعطى التفاعل بين نظم التحميل والتوزيعات النباتية ومواعيد الزراعة تأثيرا معنويا على معظم مكونات محصول الفول السوداني.

الذرة الشامية: سجل معدل التحميل ١٠٠ % فول سوداني + ٣٣ % ذرة **شامية** تأثيرا ايجابيا على معظم صفات محصول الذرة **الشامية** بينما أظهر نظام التحميل ١٠٠ % فول سوداني + ٦٧ % ذرة **شامية** أعلا القيم لمحصول الفدان من الحبوب. سجل ميعاد الزراعة في الميعاد المبكر أعلى القيم لكل الصفات تحت الدراسة بالمقارنة مع المواعيد الأخرى. أوضح التفاعل بين نظم التحميل والتوزيعات النباتية ومواعيد الزراعة تأثيرا معنويا على محصول الحبوب تللفدان.

كما أظهر تأثير تفاعل نظم التحميل ومواعيد الزراعة للذرة الشامية زيادة فى محصول الحبوب للنبات والفدان وذلك فى الميعاد المبكر لزراعة الذرة الشامية فى كل نظم التحميل.

سجلت العلاقات التنافسية زيادة فى معدل استغلال الأرض لنظام التحميل ١٠٠ % فول سودانى + ٥٠ % ذرة الشامية كما سجل معدل الحشد النسبى بين النباتات ميزة تنافسية بزيادة عن الواحد الصحيح وكان محصول الذرة هوالمحصول السائد لكل نظم التحميل بينما كان محصول الفول السودانى هوالمحصول المسود.

معدل الدخل: - سجل نظام التحميل ١٠٠ % فول سودانى + ٦٧ % ذرة شامية وزراعة الذرة الشامية على مسافة ٣٥ سم / نبات واحد بالجورة أعلا زيادة فى العائد النقدى للمزارع بما يعادل ٤٧٩١,٥ جنيها مقارنة بمعدل ٣٤٨٣,٣، ٣٣٧١,٤ جنيه بالزراعة المنفردة للفول السودانى والذرة الشامية (متوسط للموسمين).

يمكن التوصية بتحميل الذرة مع الفول السودانى بنظام التحميل ١٠٠ % فول سودانى + ٦٧ % ذرة الشامية وزراعة الذرة على مسافة ٣٥ سم وترك نبات بالجورة وزراعة الذرة الشامية بعد الفول السودانى بعشرة أيام