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EFFECT OF INTERCROPPING SOYBEAN, COWPEA AND GUAR WITH MAIZE ON YIELD AND ITS COMPONENTS.

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ABSTRACT

Two field trials were conducted at Sids Experimental Research Station, Beni Suief Governorate during 2003 and 2004 seasons, to study the effect of intercropping soybean, cowpea and guar (cluster bean) with maize on its yield and yield components. The intercropping systems were 100 % maize + 25 % legume crop (by growing legume crops on one maize ridge and leaving one maize ridge without intercropping), 100 % maize + 25 % legume crop (by growing legume crops on the other side of two maize ridges and leaving two maize ridges without intercropping), 100 % maize + 12.5 % legume crop (by growing legume crops on one maize ridges and leaving three maize ridges without intercropping) and 100 % maize + 37.5 % legume crop (by growing legume crops on three maize ridges and leaving one maize ridge without intercropping). A split plot design was used in three replications.

The results could be summarized as follow:

Maize:

1. Plant height, ear height, number of grains/ row, ear and grains weight/ plant, and weight of 100- grain were significantly affected by different legume crops intercropped with maize. On the other hand, grains yield/ Fed. was insignificant. Data were collected with soybean, cowpea or guar were not significant.
2. Plant height, ear height, ear weight/ plant, grains weight/ plant and weight of 100 grain were significantly affected by intercropping systems. Whereas, grains yield/ Fed. was not significantly affected by intercropping patterns.
3. Interaction effect significantly affected on ear weight/ plant, grain weight/ plant, and weight of 100 grain. The heighest values were recorded by intercropping system of 100 % maize + 12.5 % soybean, while the lowest values were recorded by 100 % maize + 37.5 % guar.

Soybean:

Plant height, number of fruiting branches, number of pods, weight of pods and seed yield/ plant, weight of 100- seed and seeds yield/ fed. were significantly affected by intercropping systems. Intercropping system of 100 % maize + 37.5 % soybean gave the highest values, whereas the lowest values were recorded by 100 % maize + 12.5 % soybean.

Cowpea and guar:

Plant height, number of branches/ plant, leafe area and total fresh yield/ fed were significantly affected by intercropping systems. Intercropping system of 100 % maize + 37.5 % cowpea or guar gave the highest values, whereas the lowest values were recorded by 100 % maize + 12.5 % cowpea or guar.

Competitive relationships

Land Equivalent Ratio (LER) and Relative Crowding Coeffecient (K) were significantly higher at the ratio of 100 % maize + 37.5 % soybean and cowpea or guar. The aggressivity between maize plants and intercropped crops indicated that maize was dominanted crop, whereas legume crops were the dominat. Net return was gatherd by intercropping system of 100 % maize + 37.5 % soybean was 602.14 L.E., but it had not gain profitable from intercropping cowpea or guar with maize.

INTRODUCTION

The need for an intensive cropping culture in Egypt to raise the production per unit of land area is going to be highly required request because the average reserved for especial crops are relatively limited. Maize and legume crops such as soybean and fodder crops like cowpea and guar proved to be one of the successful example for intercropping.

Moursi *et al.*(1983) revealed that growing maize and soybean together resulted in an increase in Land Equivalent Ratio (LER) more than any of them alone. Abd El-Gawad *et al.*(1985) reported that grain yield, shelling percentage and weight of 100 grain for maize plants at a 1 : 1 intercropping ratio surpassed significantly those of 1 : 2 and 1 : 4 intercropping pattern. Vandermeer and Meyrat (1989) found that different root systems of the combined crops are of advantage to higher final yield crops; use nutrients from different parts of the soil and competition is reduced. El - Hawary (1993) stated that intercropping systems reduced maize yield, compared with pure stand. As well as, Relative Crowding Coefficient (k) was higher with 2 : 2 intercropping systems than the other patterns. Moore *et al.*(1991) indicated that increasing plant population of soybean from 70000 to 175000 plant/ fed decreased seed weight, number of branches and pods/ plant and 100- seed weight when intercropped with maize. El- Douby *et al.*(1996) and Kushawaha and Chandel (1997) showed that ear diameter, ear length, number of grains/ row, weight of 100-grain and grains yield/ fed of maize significantly decreased by intercropping maize with soybean. As well as plant height, number of branches/ plant weight of pods, 100- seed weight, seed yield/ plant and / fed significantly reduced by intecropping patterns, compared with sole crop. Rana *et al.*(2001) reported that plant height and grains yield of maize were significantly higher in intercropping systems with soybean, compared to pure maize. As well as, the yield was 30-40 % yield of the corresponding sole crop.

Gunasena (1980) indicated that intercropping cowpea with maize depressed cowpea yields, while maize yield was higher in the intercropping system. Mongi *et al.*(1980) stated that intercropping maize with cowpea in alternate rows, in the same hole and in alternate maize (relay intercropping) did not affect the grain and dry matter yields of maize, but fresh weight of cowpea was significantly decreased by relay intercropping. Sharma *et al.*(1993) and Ocaya *et al.*(2001) reported that intercropping maize with cowpea improved cowpea as a green fodder yields. Pitan *et al.*(2001) mentioned that intercropping maize with cowpea increased yields of both crops by 12-50 % than in the monocrop. Dasaraddi *et al.*(2002) resulted that grain yield of maize increased, compared with maize sole crop, when intercropped with cowpea and such increase was 6 % and not significant. Pramod *et al.*(2003) studied the intercropping maize : cowpea in ratios of 1 : 1, 1 : 2, 2 : 1, 3 : 1, 1 : 3, 2 : 2 and 3 : 3. The best treatment was maize : cowpea both at 2 : 2 (paired row) which produced the highest green forage. This treatment also accounted for the highest net return (24540/ ha) and monetary advantage.

Singh and Kaushik (1987), Gangwar and Sharma (1994) indicated that intercropping maize with guar increased total yield as associated crops and total income, compared to both as sole crop. Toaima *et al.*(2004) mentioned that intercropping guar with sweet sorghum at the treatment of 2 : 2 increased number of tillers and leaf area/ plant, compared with guar pure stand. As well as, higher values of LER and K were remarkable with the system of 2 : 2, whereas the lowest values were recorded with the system of 1 : 1.

The objective of this research was to study the response of some legume crops; soybean, cowpea and guar to intercropping with maize in relation to yield and its component of maize and legume crops under the study.

MATERIALS AND METHODS

Two field trials were carried out at Sids Experimental Research Station, Beni Suief Governorate during 2003 and 2004 seasons to study the response of some legume crops to intercropping with maize on their growth, yield and yield components. The legume crops were soybean (*Glycin max* L.), cv. Giza 846, cowpea (*Vigna unguiculata*) and guar or cluster bean (*Cyamopsis tetragonoloba*) and maize (*Zyea maize* L.) cv. S.C 10. A split plot design was used in three replications and each experiment included 12 treatments in addition to 4 sole crops as follows.

A: Crops intercropped:

1- Soybean
2- Cowpea
3- Guar

B: Intercropping patterns:

P1: 100 % maize + 25 % crops intercropped; growing soybean, cowpea and guar on the other side of one maize ridge and leaving one ridge of maize without intercropping.

P2: 100 % maize + 25 % crops intercropped; growing soybean, cowpea and guar on the other side of two maize ridges and leaving two ridges of maize without intercropping.

P3: 100 % maize + 12.5 % crops intercropped; growing soybean, cowpea and guar on the other side of one maize and leaving three ridges of maize without intercropping.

P4: : 100 % maize + 37.5 % crops intercropped; growing soybean, cowpea and guar on the other side of three maize ridges and leaving one ridge of maize without intercropping.

Solid crops

1- Maize was planted on one side of ridge and leaving one plant/ hill at 30 cm apart between hills either in all intercropping patterns or pure stand.

2- Legume crops were planted on the other side of ridge and leaving two plants/ hill at 20 cm between hills for the intercropping systems and on both sides of ridges without intercropping. Legume crops were planted one month before seeding maize plants.

Maize was seeded on May 15 th and 18 th. in 2003 and 2004 seasons, respectively. Each experimental unit consisted of 8 ridges 5 meter in length and 60 cm in wide (24.0 m^2).

The preceeding crop was wheat in both seasons. Normal cultural practices were applied for crops under study either in pure stand or in intercropping as a recommended for the region. Superphosphate (15.5 % P_2O_5) at a rate of 200 kg/ fed. was added during land preparation. Potassium fertilizer was added at a rate of 24 kg/ Fed. for maize and another 24 kg/ Fed. for each legume crop in a form of potassium sulphate (48 % k_2O).

Nitrogen fertilizer in the form of ammonium nitrate (33.5 % N) was applied for all maize plots at the rate of 120 kg N/ fed. either pure stand or intercropping patterns in two equal doses. The first one was applied at 60 kg N. after 21 days of planting, 60 kg N after one month later. While, legume crops 20 kg N. was added to each crop at the first irrigation. Another 20 kg N was added for each legume crop after the first cut. Two cuts for both cowpea and guar were taken; the first cut after sixty days of seeding and the other cut after fifty days of the first cut.

At harvest: Ten plants of maize and soybean were taken randomly to determine yield parameters, while the yield/ fed was determined from the whole plots and the studied characters were recorded as follows:

For maize: plant height (cm), ear height (cm), ear characters (ear length and diameter, number of grains/ ear, number of rows/ ear), 100-grain weight, shelling percentage, number of ears/ plant and maize grain yield/ fed. (ardab).

For soybean: Plant height (cm), number of branches/ plant, number of pods/ plant, weight of pods/ plant (gm), seeds yield/ plant (gm), filling percentage, weight of 100-seeds (gm) and seed yield/ fed. (kg).

For cowpea and guar, plant height (cm), number of branches/ plant, leaf area (cm^2) were collected from ten plants, while total fresh yield/ fed. (ton) were calculated from all plots.

Competition Relationships:

Land Equivalent Ratio (LER), Relative Crowding Coefficent (K) and Aggressivity (A) were respectively calculated according to Willey (1965), DeWit (1960) and McGilchrist (1974).

Total income: It was calculated due to the market price as follows:145 L.E. for ardab maize, 1650 L.E for ton soybean and 100 L.E for ton cowpea or guar as green fodder.

Net return: It was calculated by subtract total income of maize pure stand from the total income of each intercrop.

Data were statistical analyzed according to the procedure out-lined by Roger (1985).

RESULTS AND DISCUSSION

1- Maize:

A: Effect of intercropped crops:

Data in Table 1 show that the effect of soybean, cowpea and guar intercropped with maize on growth, yield and yield components of maize. Plant height and ear height were significantly affected by using different intercropped legume crops. Soybean gave the highest values, whereas guar

and cowpea intercropped gave the lowest values in both seasons. But, maize sole plants were higher than maize plants intercropping. These results are mainly due to the effect of inter and intra- specific competition among maize plants, as well as between maize and legume crops. Similar results were reported by El- Douby *et al.*(1996).

The effect of legume crops on number of grains/ row, ears and grains weight/ plant and weight of 100 grains were significant in both seasons. Soybean recorded the highest values, while the lowest values were recorded with guar intercropped through both seasons. Maize sole crop was higher than the results which recorded by legume crops intercropped.

With respect to grains yield/ fed, results show insignificant effect was recorded due to using different intercropped legume crops in both seasons. Maize grains yield/ fed were not affected due to intercropping with soybean, cowpea or guar and was closed to maize sole crop.

B: Effect of intercroping patterns

Results in Table 2 indicate the effect of intercropping systems on growth, yield and yield components of maize. Plant and ear height of maize were significantly affected by intercropping systems in both seasons. The heighest values were recorded by intercropping system of 100 % ,maize + 12.5 % legume crops, whereas the lowest valueas were announced by intercropping system of 100 % maize + 37.5 % legume crops, compared with the other intercropping systems.

Ears and grains weight/ plant and weight of 100 grains were clearly significant by using different intercropping systems (Table 2). Intercroping 100 % maize + 12.5 % legume crops gave the highest values, whereas the lowest values were recorded by intercropping pattern of 100 % + 37.5 %.

With regard to grains yield/ fed., intercropping systems significantly reduced grains yield/ fed., compared to maize sole crop. Intercropping systems of 100 % maize + 12.5 % legume crops (P2) gave the highest values, while the lowest values were recorded by the system of 100 % + 37.5 % (P4) in both seasons.

The reductions were 10.95, 10.29, 8.78 and 11.40 % in the first season, and 10.32, 8.93, 7.73 and 10.97 % of sole crop in the second season for P1, P2, P3 and P4, respectively. These results may be attributed that soybean plants can be fixed the N_2 and let maize utilized and turn on maize grains yield (Vandermeer and Meyrat, 1989)

C: Interaction effect.

Data in Table 3 show the interaction effect between intercropping patterns and legume crops on ear and grains weight/ plant, weight of 100 grain and grain yield/ fed. Results show that intercropping system of 100 % maize + 12.5 % soybean gave the highest value, whereas the lowest values were recorded with intercropping system of 100 % maize + 37.5 % guar. The highest grains yield was 21.10 ardab/ fed., whereas the lowest grains yield was 19.65 ardab/fed in the first season and 20.80, 19.00 ardab/ fad in the second season.

The previous results indicate that yield components and grains yield/ fed. of maize were higher when used soybean intercropped, compared to intercropping cowpea or guar. These results may be due to cowpea and guar

are a fast starting crops, and hav strong taproot that can compete effectively with maize for available moisture at all soil depth that led to higher competition with maize than soybean. In addition to cowpea and guar as forage crops have two cuts during their life that led to much consumption the nutrien elements from the soil and then more effective on maize plants than soybean. In consideration, soybean has good effect on soil fertility and physiological properties, therefore significant amount of residual nitrogen for maize plants and encourage maize growth characteristics than cowpea and guar plants

2- On soybean:

Results in Table 4 show that plant height and number of fruiting branches/ plant of soybean were significantly affected by intercropping systems in both seasons. The shortest soybean plants were recorded with the intercropping system of 100 % maize + 12.5 % soybean (P3). Wherever the highest soybean plants were showed when adding 25 % soybean in (P1). Similar results were found by El Douby *et al.*(1996).

This reduction of soybean plants indicate clearly the great competition resulting from maize plants through their shading effects, as well as the effect of intraspecific competition among soybean plants, particularly when intercropping system of 100 % maize + 12.5 % soybean of its pure stand (P3). Similar results were obtained by El Douby *et al.*(1996).

Results on the effect of intercropping maize and soybean on yield components and seed yield of soybean are presented in Table 4. It is clear that intercropping systems significantly reduced number and weight of pods/ plant, and seed yield/ plant and weight of 100- seed in both seasons, compared with sole crop. The lowest values were obtained with intercropping system including 100 % maize + 12.5 % soybean (P3) in both seasons. These results are in agreement with those obtained by Moore *et al.*(1991) who mentioned increasing plant population density of soybean decreased seed weight, number of branches and pods/ plant and 100 seeds weight.

Intercropping systems of soybean and maize significantly reduced seed yield/ fed. of soybean in both seasons (Table 4). The highest soybean intercropped yield was produced with treatment of 100 % maize + 37.5 % of soybean pure stand (P4), while the lowest value recorded with the pattern of 100 % maize + 12.5 % soybean. The present results could be mainly due to the competition of maize plants and the shading effects which reduced the yield components of soybean plants. These results are mainly depend on less adverse effect of soybean with maize, as well as, is directly related to population pressure, more compatible and, less competitive crop for intercropping system. These results are in the same line of those reported by Abd El-Gawad *et al.*(1985).

3- On cowpea:

There were significant reduction to intercropping systems of cowpea with maize on all growth traits; plant height, number of branches/ plant, and leafe area, as well as green forage yield/ fed. (Table 5). The highest reduction in plant height due to intercropping systems were 8.50 % in the first season and 8.56 % in the second season for the intercropping system of P4, compared with pure stand, respectively.

Table(1): Effect of intercropping maize with soybean, cowpea and guar on growth,yield and its components of maize in 2003 and 2004 seasons.

Traits / Intercropped crops	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows/ ear	No. of grains/ row	Ear weight/ plant (gm)	Grains weight/ plant (gm)	Shelling %	Weight of 100-grain (gm)	No. of ears/ plant	Grains yield (ardab) / fed
2003 season												
Soybean	326.75	128.87	19.56	4.83	13.93	42.28	238.85	189.37	25.00	35.72	1.10	20.71
Cowpea	318.00	125.92	19.86	4.77	13.77	42.15	231.79	185.07	79.84	35.17	1.10	20.21
Guar	312.67	123.29	20.10	4.73	13.26	40.26	198.26	157.14	79.25	33.52	1.13	19.74
L.S. D at 5 %	3.60	2.30	N.S	N.S	N.S	1.33	3.16	3.60	N.S	1.60	N.S	N.S
Maize sole crop	326.15	131.03	20.75	4.91	13.60	43.88	263.31	219.03	83.18	40.03	1.20	22.55
2004 season												
Soybean	325.21	129.26	21.22	4.65	13.85	42.47	228.77	181.05	76.81	40.24	1.10	20.12
Cowpea	318.10	127.26	20.74	4.57	13.50	42.88	225.75	176.42	80.98	36.78	1.10	19.32
Guar	311.65	118.84	20.54	4.45	13.43	40.80	201.16	162.90	80.11	34.32	1.00	19.20
L.S. D at 5 %	4.20	1.52	N.S	N.S	N.S	1.45	3.40	3.65	1.50	1.85	N.S	N.S
Maize sole crop	325.66	128.47	21.80	4.73	13.23	43.70	261.35	214.89	82.22	40.22	1.20	21.60

Table 2: Effect of intercropping patterns on growth, yield and its components of maize in 2003 and 2004 season.

Traits / Intercropping patterns	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows/ ear	No. of grains/ ear	Ear weight/ plant (gm)	Grains weight/ plant (gm)	Shelling %	Weight of 100-grain (gm)	No. of ears/ plant	Grains yield ardab / fed
2003 season												
100 % maize + 25 % (P1)	317.09	124.99	19.64	4.68	13.39	41.45	211.51	167.42	79.15	34.39	1.10	20.08
100 % maize + 25 % (P2)	319.18	126.47	19.95	4.77	13.51	41.77	225.11	179.66	79.81	35.86	1.20	20.23
100 % maize + 12.5 % (P3)	321.71	128.25	20.33	4.83	13.57	42.47	250.00	199.44	79.78	36.79	1.20	20.57
100 % maize + 37.5 % (P4)	315.13	122.27	19.43	4.42	13.05	41.03	204.96	162.26	79.17	32.18	1.00	19.98
L.S. D at 5 %	2.38	1.75	N.S	N.S	N.S	N.S	2.58	3.55	N.S	1.20	N.S	N.S
Maize sole crop	326.15	131.03	20.75	4.91	13.60	43.88	263.31	219.03	83.18	40.03	1.20	22.55
2004 season												
100 % maize + 25 % (P1)	317.98	123.71	20.77	4.47	12.77	41.40	209.94	167.18	79.63	37.07	1.00	19.37
100 % maize + 25 % (P2)	319.27	126.61	20.87	4.60	12.93	41.80	223.29	177.97	79.70	37.71	1.10	19.67
100 % maize + 12.5 % (P3)	320.56	127.69	21.20	4.63	12.97	42.07	232.65	187.45	80.57	38.11	1.20	19.93
100 % maize + 37.5 % (P4)	315.48	122.48	20.48	4.32	12.63	41.33	204.38	162.26	79.39	35.56	1.00	19.23
L.S. D at 5 %	2.27	1.84	N.S	N.S	N.S	N.S	2.24	2.38	N.S	1.12	N.S	N.S
Maize sole crop	325.66	128.47	21.80	4.73	13.23	43.70	261.35	214.89	82.22	40.22	1.20	21.60

Table 3: Interaction effect of intercropping patterns with crops intercropped on ear weight/plant, grains weight/ plant, weight of 100 grains and grains yield/ fed. of maize in 2003 and 2004 seasons.

Traits	Ear weight/ Plant (gm)			Grains weight/ Plant (gm)			Weight of 100 grains (gm)			Grains yield(ardab / fed.		
Intercropped crops	Soybean	Cowpea	Guar	Soybean	Cowpea	Guar	Soybean	Cowpea	Guar	Soybean	Cowpea	Guar
2003 season												
100 % + 25 % (P1)	231.11	223.42	180.00	180.59	179.30	142.38	35.64	35.40	34.39	20.60	20.03	19.60
100 % + 25 % (P2)	236.40	233.54	205.40	190.40	185.60	162.98	36.99	36.09	35.86	20.80	20.20	19.70
100 % + 12.5 % (P3)	262.14	252.00	237.00	208.40	200.00	189.92	37.46	36.76	36.79	21.10	20.60	20.00
100 % + 37.5 % (P4)	226.03	218.20	170.66	178.10	175.40	133.28	32.80	32.43	32.18	20.30	20.00	19.65
L.S. D. at (0.05)	2.14			3.12			1.08			0.72		
2004 season												
100 % + 25 % (P1)	224.21	218.40	187.20	176.60	174.75	150.20	40.00	36.60	34.60	19.80	19.20	19.10
100 % + 25 % (P2)	230.16	230.10	209.60	185.10	178.30	170.50	41.00	37.17	34.97	20.30	19.40	19.30
100 % + 12.5 % (P3)	240.20	230.14	227.60	193.30	188.60	180.50	41.29	37.36	35.68	20.80	19.60	19.40
100 % + 37.5 % (P4)	221.13	214.30	177.70	173.20	171.30	142.30	38.66	36.00	32.03	19.60	19.10	19.00
L.S. D. at (0.05)	2.10			2.12			1.15			0.75		

Table 4: Effect of intercropping maize with soybean on soybean yield and its components.

Characters / Intercropping Systems	Plant height (cm)	No. of fruiting branches/ plant	No. of pods/ plant	Weight of pods/ plant (gm)	Seeds yield/ plant (gm)	Shelling %	Weight of 100-seed	Seeds yield/ fed (kg)
Maize + Soybean	2003 season							
100 % + 25 % (P1)	80.33	3.07	46.50	22.00	14.00	63.60	16.80	350.80
100 % + 25 % (P2)	78.33	3.87	48.30	22.40	14.40	64.30	17.20	380.60
100 % + 12.5 % (P3)	74.33	2.27	45.20	20.80	13.00	62.50	16.10	185.75
100 % + 37.5 % (P4)	78.87	3.57	46.10	22.10	14.30	64.70	17.00	450.67
L.S.D at 0.05	2.30	0.27	1.48	1.03	0.23	0.36	0.53	33.42
Soybean sole crop	86.57	3.77	65.00	30.00	18.30	61.00	19.20	1535.40
	2004 season							
100 % + 25 % (P1)	71.67	2.33	46.80	22.40	14.30	63.80	17.10	370.85
100 % + 25 % (P2)	66.67	2.50	48.00	22.60	14.60	64.60	17.80	380.80
100 % + 12.5 % (P3)	63.33	2.00	46.30	20.00	12.70	64.00	16.60	180.25
100 % + 37.5 % (P4)	65.00	2.42	47.20	21.00	13.60	64.76	17.10	490.67
Soybean sole crop	79.17	3.33	63.90	30.10	18.50	61.70	19.40	1551.30
L.S.D at 0.05	2.11	0.33	1.23	1.06	0.26	0.40	0.60	27.06

Whereas, the lowest values were 3.69 and 3.62 % for the intercropping system of P2 in both seasons, respectively. These results are in accordance with those obtained by Gunasena (1980).

Table 5: Effect of intercropping maize with Cowpea on Cowpea yield and its components.

Traits / Intercropping systems	Plant height (cm)		Number of branches/ plant		Leaf area (cm)		Total fresh Yield/ Fed (ton)	
Maize + Cowpea	2003	2004	2003	2004	2003	2004	2003	2004
100 % + 25 % (P1)	75.13	74.00	9.30	9.20	40.13	40.00	3.350	3.800
100 % + 25 % (P2)	78.20	77.10	9.70	9.40	44.16	42.10	3.380	3.850
100 % + 12.5 % (P3)	76.50	76.00	8.60	8.40	33.10	37.60	1.650	1.880
100 % + 37.5 % (P4)	74.30	73.15	9.80	9.50	43.10	42.00	4.500	5.130
L.S.D at 0.05	1.71	1.82	0.38	0.26	1.60	1.24	0.61	0.71
Cowpea sole crop	81.20	80.00	10.50	10.30	48.20	46.10	13.90	15.81

For the number of branches/ plant, the obtained results showed that intercropping systems reduced number of branches/ plant, compared to sole crop. The highest reduction were 11.43 and 10.68 % in both seasons, respectively for the intercopping system of P3. On the other hand, the lowest reduction were 6.67 and 8.74 % for intercropping system of P4. Leafe area and fresh weight/ plant had the same trend of number of branches/ plant. These results are in accordance with those obtained by Mongi *et al.*(1980) and Sharma (1993)..

The decrease in plant growth by intercropping systems with maize is most certainly due to the role of maize in shading vegetative growth. In this connection the effect of intercropping on not accumulation dry matter could also attributed to decreasing N available and photosynthesis, Thomposon and Troeh (1980). Therefore, decreasing leaf area by intercropping with maize reflects the important role of reduction in plant growth, compared with sole crop. These results are in accordance with those obtained by Pramod *et al.*(2003).

With regard to total fresh yield/ fed, intercropping systems significantly decreased green forage yield/ fed. The fresh yield as compared to sole crop were 46.56, 24.10, 24.32, 11.87, and 32.37 % ton/ fed. in the first season and 24.03, 24.35, 11.89 and 32.45 % ton/ fed.in the second season for the intercropping systems of P1, P2, P3 and P4, respectively. These results are in agreement with those obtained by Pramod *et al.*(2003).

In general, maize intercropped with cowpea recorded the highest total fresh yield/ fed. at intercropping system of 100 % maize + 37.5 % cowpea of its pure stand (P3), compared with other crops intercropped. It is good indicator that cowpea is almost a more competitor for maize than soybean and the interspecific competition between both species is almost lower than the intraspecific competition. Similar results were obtained by Pramod *et al.*(2003).

4- On guar:

Results revealed that yield and yield components of guar were significantly affected by intercropping systems in both seasons (Table6).

Plant height exhibited the highest values were recorded by intercropping system of 100 % maize + 37.5 % guar (P4), followed by 100 % maize + 25 % guar (P1), then 100 % maize + 12.5 % guar (P3), while the lowest values recorded with (P2) system. These data are true due to the different in plant population of guar and specific inter-row competition.

With regard to number of branches/ plant, the obtained results indicated that intercropping system of 100 % maize + 12.5 % guar (P3) gave the highest values, whereas the lowest value was recorded with intercropping system of 100 % maize + 37.5 % guar (P4).While the intercropping systems of P2 and P4 showed the highest values for leaf area and fresh yield, respectively ,compared with sole crop. These data clearly show that the intercropping systems had contributing influence on leaf area, primarily through their effect on branches and thus leaf production. These results are in a compatible with those obtained by Singh and Kaushik (1987) , Sharma *et al.* (1993) and Toaima *et al.*(2004).

Concerning yield/ fed. the results show that the highest values were obtained with intercropping system of P4, followed by P2, then P1, while the lowest value recorded with P3 in both seasons. The total fresh yield as compared to sole crop were 24.21, 24.51, 11.74 and 32.06 % in the first season and24.60, 24.80, 12.42 and 32.16 % of the sole crop for intercropping systems of P1, P2, P3 and P4, respectively. These results are in accordance with those obtained by Gangware and Sharma (1994) and Toaima *et al.*(2004).

Table(6): Effect of intercropping maize with guar (Cluster bean) on guar yield and its components.

Traits / Intercropping systems	Plant height (cm)		Number of branches/ plant		Leaf area (cm)		Total fresh yield/fed (ton)	
Maize + Guar	2003	2004	2003	2004	2003	2004	2003	2004
100 % + 25 % (P1)	65.30	64.20	6.00	6.10	33.30	33.00	2.470	2.180
100 % + 25 % (P2)	63.10	62.05	6.20	6.30	35.10	34.80	2.500	2.200
100 % + 12.5 % (P3)	63.70	62.80	6.50	6.60	32.00	32.70	1.200	1.101
100 % + 37.5 % (P4)	65.80	64.70	5.40	5.50	31.00	30.60	3.270	2.850
L.S.D at 0.05	N.S	N.S	0.30	0.29	0.70	0.81	0.68	0.27
Guar sole crop	70.44	69.15	7.80	7.60	40.10	39.00	10.20	8.86

3- Competitive relationships and yield advantage of intercropping:

3-1: Land Equivalent Ratio:

Results in Table 7 indicate that intercropping maize with soybean, cowpea and guar through the combine of the first and second seasons. Intercropping 100 % maize + 37.5 % (p4) soybean, cowpea and guar recorded the highest values for (LER) which were 1.20, 1.20 and 1.19, respectively. Maize was more contributor with "lm" values than soybean, cowpea and guar. Similar results were obtained by Moursi et al (1983), Ocaya *et al* (2001)and Toaima *et al.*(2004). who found that LER values were greater with intercropping system than sole crop of them.

3-2: Relative crowding coefficient (K):

Plant density of intercropping soybean, cowpea and guar with maize (K) is shown in Table 7.

Table 7: Competitive relationships of intercropping soybean with maize (average of both seasons).

Competitive Relationships	Yield/ fed		Land Equivalent Ratio (LER)			Relative Crowding Coefficient (K)			Aggressivity (A)		Total income	Net return
Maize + soybean	Maize	Soybean	Lm	Ls,c,g	LER	Km	Ks,c,g	K	Am	As		
100 % + 25 % (P1)	20.20	360.82	0.91	0.23	1.14	2.69	1.22	3.28	- 0.04	+0.40	3953.64	422.41
100 % + 25 % (P2)	20.55	380.70	0.93	0.25	1.18	3.43	1.31	4.49	- 0.06	+0.06	4049.40	518.20
100 % + 12.5 % (P3)	20.95	183.00	0.95	0.11	1.06	2.53	0.02	0.05	- 0.02	+0.02	3718.00	186.80
100 % + 37.5 % (P4)	19.95	470.67	0.90	0.30	1.20	3.52	1.17	4.12	- 0.09	+0.09	4133.34	602.14
Maize sole crop	22.07	----	---	---	---	---	---	---	---	---	3531.20	---
Soybean sole crop	----	1543..35	---	---	---	---	---	---	---	---	3086.70	---
Maize + Cowpea												
100 % + 25 % (P1)	19.61	3.575	0.89	0.24	1.13	1.99	0.32	0.64	-0.07	+0.07	3495.10	- 36.10
100 % + 25 % (P2)	19.80	3.615	0.90	0.24	1.14	1.67	0.32	0.53	-0.07	+0.07	3529.00	- 2.20
100 % + 12.5 % (P3)	20.10	1.767	0.91	0.12	1.03	1.27	1.08	1.37	-0.04	+0.04	3393.00	- 138.20
100 % + 37.5 % (P4)	19.55	4.815	0.88	0.32	1.20	2.90	1.28	3.71	-0.06	+0.06	3609.00	77.80
Maize sole crop	22.07	---	---	---		---	---	---	---	---	3531.20	---
Cowpea sole crop	---	14.855	---	---		---	---	---	---	---	1535.00	--
Maize + Guar												
100 % + 25 % (P1)	19.35	2.325	0.88	0.24	1.12	1.76	1.29	2.27	-0.10	+0.10	3328.00	- 203.20
100 % + 25 % (P2)	19.50	1.850	0.88	0.19	1.07	1.91	0.96	1.83	-0.10	+0.10	3305.00	- 226.20
100 % + 12.5 % (P3)	19.70	1.300	0.89	0.14	1.03	1.04	1.27	1.32	-0.20	+0.20	3282.00	- 249.20
100 % + 37.5 % (P4)	19.32	3.060	0.87	0.32	1.19	2.64	1.26	3.33	-0.01	+0.01	3397.20	-134.00
Maize sole crop	22.07	---	---	---	---	---	---	---	---	---	3531.20	---
Guar sole crop	---	9.53	---	---	---	---	----	---	---	---	953.00	---

Price of maize was calculated due to market price = 160 L.E./ ardab

Price of soybean was calculated due to market price = 2 L.E./ kg

Price of cowpea was calculated at the market price = 100 L.E /ton as green fodder.

Price of guar was calculated at the market price = 100 L.E /ton as green fodder.

The best values were achieved by intercropping system of maize with 100 % maize + 37.5 % soybean, cowpea and guar (P4) system, where recorded 4.12, 371 and 3.33. Maize was much contributor due to its stable plant population in the all intercropping systems. A yield advantage occur because the component crops differ 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 grown separately. Similar results were obtained by Willey (1965) and El Hawary *et al.*(1993).

3-3: Aggressivity:

Data in Table 7 show that maize was the dominanted intercrop component in all intercropping systems. But, soybean, cowpea and guar was dominat intercrop component in all intercropping systems during the over combined the two seasons.

Similar results were recorded by Pitan *et al.*(2001) and Singh and Kaushik (1987).

4- Total income and net return:

The evaluation of different intercropping systems of soybean, cowpea and guar with maize was made for the two seasons at these combined average as a net income of the two components and compared with maize as a solid crop due to market price (Table 7). Using intercropping system of P4 with soybean gave the highest net return 602.14 L.E., but it was not gain profiable from intercropping cowpea or guar with maize.

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تأثير تحميل فول الصويا و لوبيا العلف والجوار مع الذرة الشامية علي المحصول ومكوناته

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قسم بحوث التكثيف المخصولى - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بسدس محافظة بنى سويف موسمي ٢٠٠٣ و ٢٠٠٤ لدراسة تأثير تحميل كل من فول الصويا ولوبيا العلف والجوار مع الذرة الشامية على المحصول ومكوناته. وأستخدم أربع نظم تحميل هى (١): ١٠٠ % ذرة + ٢٥ % من المحصول المحمل وذلك بزراعة الذرة على كل الخطوط وزراعة المحصول المحمل على خط وترك خط بدون تحميل، (٢): ١٠٠ % ذرة + ٢٥ % من المحصول المحمل وذلك بزراعة الذرة على كل الخطوط وزراعة المحصول المحمل على الجانب الاخر من الخط علي خطين وترك خطين بدون تحميل، (٣): ١٠٠ % ذرة + ١٢,٥ % من المحصول المحمل وذلك بزراعة الذرة على كل الخطوط وزراعة المحصول المحمل على خط وترك ثلاث خطوط بدون تحميل، (٤): ١٠٠ % ذرة + ٣٧,٥ % من المحصول المحمل وذلك بزراعة الذرة على كل الخطوط وزراعة المحصول المحمل على ثلاث خطوط وترك خط بدون تحميل. وأستخدم تصميم القطع المنشقة مرة واحدة فى ثلاث مكررات.

وكانت أهم النتائج كما يلي :-

الذرة:

١- تأثر كل من طول النبات، ارتفاع الكوز، عدد حبوب الكوز، وزن محصول النبات من الكيزان والحبوب، ووزن ال١٠٠ حبة باختلاف المحصول المحمل بينما لم يتأثر حاصل المحصول للفدان. وكانت أعلا النتائج المتحصل عليها عندما حمل فول الصويا مع الذرة بينما كانت أقل النتائج عندما حمل الجوار مع الذرة.

٢- تأثر كل من طول النبات، ارتفاع الكوز، وزن كيزان وحبوب النبات، ووزن ال١٠٠ حبة وحاصل المحصول من الحبوب للفدان معنويا باختلاف نظم التحميل بينما لم يتأثر حاصل المحصول للفدان. سجل نظام التحميل ١٠٠ % ذرة + ١٢,٥ % من المحصول المحمل أعلا ناتج بينما سجل نظام التحميل ١٠٠ % ذرة + ٣٧,٥ % من المحصول المحمل أقل النتائج.

٣- أدى تفاعل المحصول المحمل مع نظم التحميل الى التأثير المعنوى على وزن الكيزان والحبوب للنبات، ووزن ال١٠٠ حبة. وكانت أعلا القيم المتحصل عليها عندما حمل فول الصويا مع الذرة بنسبة ١٠٠ % ذرة + ١٢,٥ % فول الصويا. بينما كانت أقل النتائج المتحصل عليها عندما حمل الجوار مع الذرة بنسبة ١٠٠ % ذرة + ٣٧,٥ % جوار.

فول الصويا:

تأثر كل من طول النبات و عدد الأفرع الثمرية/ النبات و وزن وعدد القرون للنبات وكذلك وزن بذور النبات ووزن ال ١٠٠ بذرة وحاصل محصول الفدان من البذور معنويا باستخدام نظم التحميل المختلفة مع الذرة الشامية. وقد أدى نظام التحميل ١٠٠ % ذرة + ٣٧,٥ % فول الصويا الى الحصول على أعلى عائد للفدان بينما سجل نظام التحميل ١٠٠ % ذرة + ١٢,٥ % فول الصويا أقل عائد للفدان.

لوبيا العلف والجوار:

تأثر كل من طول النبات و عدد الأفرع الثمرية/ النبات ومساحة سطح الورقة وحاصل محصول العلف الأخضر/ الفدان معنويا باستخدام نظم التحميل المختلفة مع الذرة الشامية. وقد أدى نظام التحميل ١٠٠ % ذرة + ٣٧,٥ % لوبيا العلف أو الجوار الى الحصول على أعلى عائد للفدان بينما أدى نظام التحميل ١٠٠ % ذرة + ١٢,٥ % لوبيا العلف أو الجوار الى الحصول على أقل عائد للفدان.

العلاقات التنافسية:

أظهر معدل استغلال الأرض ومعدل التزاحم للنباتات أعلا معدل عند التحميل بنسبة ١٠٠ % ذرة + ٣٧,٥ % فول الصويا أو لوبيا العلف أو الجوار . أظهر معدل التنافس بين الذرة والمحاصيل المحملة الى السيادة للمحاصيل المحملة بينما كان الذرة هو المسود. وسجل أعلا صافى للعائد النقدي للمزارع بمقدار 602.14 جنية مصرى عند تحميل الذرة مع فول الصويا بينما لم يظهر كل من لوبيا العلف أو الجوار أى ميزة من التحميل.