PRODUCTIVITY OF WHEAT AND FABA BEAN UNDER DIFFERENT INTERCROPPING SYSTEMS

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ABSTRACT

Two field experiments were carried out at Agric. Exp. and Res. Stat., Fac. Agric., Cairo Univ., Giza, Egypt in 1997/98 and 1998/99 seasons. The objective is studying the productivity of two faba bean (*Vicia faba* L.) cultivars (Giza 716 and Giza 3) and two wheat (*Triticum aestivum* L.) cultivars (Gemmeiza 9 and Sakha 8) under three intercropping systems in comparison with sole plantings. For cropping patterns, spike length, grains weight / spike and 1000 grains weight were statistically the same under all tested cropping systems. Solid cultivation produced the highest values of number of spikes/ m^2 and grain yield from sowing wheat alone followed by 2:2, 4:4 and 3:3 intercropping sowing patterns, respectively. The highest straw yield was obtained from 2:2 system followed by 3:3 and 4:4 systems. Planting faba bean alone gave the highest seed yield/ plant and seed yield/ faddan in comparison with intercropping sowing patterns. However faba bean with wheat in 2:2 intercropping pattern gave the highest values of plant height, 100- seed weight and straw yield/ faddan.

Concerning cultivars, wheat cultivars, Gemmiza 9 and Sakha 8 were significantly different in plant height, number of spikes/ m^2, grain and straw yields/ fad. Gemmeiza 9 surpassed significantly Sakha 8 by 6 and 9% for grain and straw yields of wheat, respectively. Grains/ spike weight and 1000 grains weight of wheat did not significantly differ according to cultivars in both seasons. Giza 716 surpassed significantly Giza 3 cultivar in number of pods/ plant, seed yield/ plant, 100 seed weight and faba bean seed yield/ feddan. Differences between the two cultivars were not significant in number of branches/ plant.

Land use efficiency was increased by 91%, 65% and 83 % in the first season and 91%, 71% and 85% in the second season over the mono cultures when wheat was intercropped with faba bean in 2:2, 3:3 and 4:4 systems, respectively. Also, sowing patterns, 2: 2 produced the highest relative crowding coefficient (618.89), while the lowest value (37.95) was obtained with 3: 3 pattern. The highest value for aggressivity was obtained from 3: 3 pattern, while the lowest value was that of 2: 2 pattern. Cultivars differed in the aggerssivity values.

Key words: Wheat; *Triticum aestivum* L.; faba bean; *Vicia faba* L.; cultivars; intercropping; patterns; Land use efficiency; relative crowding coefficient; aggressivity; monoculture.

INTRODUCTION

Intercropping a legume crop with a non- legume one proved to be a successful system owing to the ability of legumes to fix considerable quantities of atmospheric N, which would be available to the associated non- legumes. EL-Monufi (1984), stated that intercropping wheat with faba bean decreased grain weight, straw and grain yields of wheat / feddan, as well as plant height, branches and pod number / plant, straw and seed yield / feddan of faba bean. On the other hand plant height and 100 – grain weight of wheat as well as 100 – seed weight, harvest index and productivity score of field bean were lower under sole planting. Many investigators found that the land use efficiency was increased and yield advantage was produced by intercropping faba bean as a legume crop with non legume crops such as wheat (Ali *et al.*, 1986, Saleh *et al.*, 1986 and Abd EL-Gawad, 1988), fodder beet (EL- kassaby *et al.*, 1985 and Abdel- Aal *et al.* 1989) and barely (Abo- Shetaia, 1990). Abo- shetaia, 1990 reported that the individual yields of faba bean and barley per faddan decreased with 1:1, 1:2, 2:2 and 3:3 intercropping patterns. Pattern 3:3 produced the highest yield advantage for each crops, which amounted to 60 %, more than the sole croppings. EL-Mihi *et al.*, 1991 found that data of competitive relationships revealed that in mixture (2: 2), land use efficiency was rather less than other intercropping systems mainly due to a higher aggressivity pressure. Saleh *et al.*,1986 found that intercropping legume with wheat in 2:2 intercropping system significantly increased plant height, No. of spikes / m^2 and grain yield / fad of wheat than monoculture and the other two intercropping systems (3: 3 and 4: 4).Monoculture in faba bean produced highest No. of pods and seeds / plant as compared to the intercropping systems. On the other hand, growing wheat and faba bean in 2: 2 intercropping system produced yield advantages and increased land usage by about 90 % followed by 3: 3 and 4: 4 systems (about 80 %). Wheat was the dominant intercrop component under the different systems.

Eid *et al.*, 1988 found that the intercropping wheat with faba bean in 1: 1 pattern gave the maximum values of land equivalent ratio (LER) and relative crowding coefficient (RCC). Intercropped wheat with field bean in1: 1 pattern, revealed significantly the highest grain yield in both crops. Studying the productivity of two cultivars of both wheat and faba bean under different sowing patterns as well as the competitive relationships was the aim of this investigation.

MATERIALS AND METHODS

Two field experiments were carried out at the Agricultural Experimental and Research Station of the Faculty of Agriculture, Cairo University, Giza, Egypt. The objective is studying the productivity of two faba bean (*Vicia faba* L.) cultivars (Giza 716 and Giza 3) and two wheat (*Triticum aestivum* L.) cultivars (Gemmeiza 9 and Sakha 8) under four intercropping systems in comparison with sole plantings during 1997 / 98 and 1998 / 99 seasons . The studied sowing patterns were:

1) Two ridges of wheat alternated with two ridges of faba bean (2W :2F).
2) Three ridges of wheat alternated with three ridges of faba bean (3W: 3F.).
3) Four ridges of wheat alternated with four ridges of faba bean (4W: 4F).
4) Wheat monoculture (W).
5) Faba bean monoculture (F).

The treatments were arranged in split plot design with four replications where the intercropping systems occupied the main plots. Cultivars of both crops were randomly allocated in the sub plots.

In both seasons, each plot consisted of 8 ridges, 6 m long and 0.6 m in width. Two sound seeds of faba bean were sown in hills 20 cm apart on both sides of the ridge also, 3-5 grains of wheat were sown in hills spaced 10 cm apart on both sides of the ridge at a rate of 60 kg grains / fad. Calcium super phosphate fertilizer (15.5 % P_2O_5) was added at rate of 100 kg / fad before sowing. Nitrogen fertilizer in form of ammonium nitrate (33.5 %N) in two equal doses was drilled at rate of 67 kg N/ fad on ridges of wheat before the first and second irrigations.

At maturity, each crop was harvested separately. The following measurements were recorded:

1. Wheat: Plant height, spike length, number of spikes / m^2, Grain weight / spike, 1000 grains weight, grain and straw yields / fad.
2. Faba bean: Plant height, number of branches/ plant, number of pods/ plant, 100- seed weight, seed yield/ plant and yield/ fad of seeds and straw.
3. Competitive relationships and land use efficiency:

   In order to have knowledge about the nature and degree of competition between wheat and faba bean and the yield advantage of the intercropping systems, the following parameters were calculated:

3.1.Land equivalent ratio (LER) was determined as the sum of the fractions of the yields of the intercrops relative to their sole crop yields according to Willely (1979).

$$LER = \frac{Y_{wf}}{Y_{ww}} + \frac{Y_{fw}}{Y_{ff}}$$

3.2.Relative crowding coefficient (RCC) was determined for wheat (RCC_w), faba bean (RCC_F) and the two crops (RCC) according to de Wit (1960)

$$RCC_w = \frac{Y_{wf} \times Z_{fw}}{(Y_{ww} - Y_{wf}) \times Z_{wf}}$$

$$RCC_f = \frac{Y_{fw} \times Z_{wf}}{(Y_{ff} - Y_{fw}) \times Z_{fw}}$$

$$RCC = RCC_W \times RCC_f$$

3.3 Aggressivity (A) was determined according to McGilchrist (1965).

$$A_{wf} = \frac{Y_{wf}}{Y_{ww} \times Z_{wf}} - \frac{Y_{fw}}{Y_{ff} \times Z_{fw}}$$

Where:

Y_{ww} and Y_{ff} = Sole yield of wheat and faba bean, respectively.

Y_{wf} and Y_{fw} = Mixture yield of wheat and faba bean, respectively.

Z_{wf} = Sown proportion of wheat (in mixture with faba bean).

Z_{fw} = Sown proportion of faba bean (in mixture with wheat).

These three parameters were calculated by using actual grain and seed yields / fad. for wheat and faba bean, respectively.

All data obtained were statistically analyzed according to procedures outlined by Snedecor (1965), L.S.D. at 0.05 probability level was used to compare the treatment means.

RESULTS AND DISCUSSION

1) Effect of intercropping systems:

a) Wheat:

The data presented in Table 1 indicate that intercropping wheat with faba bean at different intercropping systems i.e. 2:2, 3: 3 and 4: 4 significantly affected plant height, yields of wheat and its components. Wheat plant height increased significantly by intercropping with faba bean

in both growing seasons, where 2:2 intercropping system gave the tallest plants followed by 3:3 and 4:4 systems. Otherwise, wheat plants of solid cultural were the shortest. These results hold fairly true in both growing seasons. On the other hand, the effect of intercropping on spike length, grains weight / spike and 1000 grain weight were statistically the same under all tested cropping systems in the two seasons.

Concerning number of spikes per square meter, solid cultivation produced the highest number of spikes/ $m^{2,}$ followed by 2:2 intercropping system in both seasons. The 3:3 and 4:4 systems gave lower number of spikes/ m^2 without any significant difference between them in (1998/99) season. These results were in harmony with those of EL- Monufi (1984) and Saleh *et al.* (1986).

The differences in straw yield of wheat due to the effect of sowing patterns were significant in both seasons. The highest straw yield was obtained from 2:2 system followed by 3:3 and 4:4 systems, while the pure stand of wheat plants gave the lowest values of straw yield in both seasons. Saleh *et al.*(1986) obtained similar results, while EL- Monufi (1984) indicated that solid wheat cultivation produced the higher straw yield compared with the intercropping with faba bean systems

Also, data recorded in Table 1 show that all intercropping patterns gave significant reduction in grain yield, which ranged from 3.21 to 8.27% as compared to wheat growing alone. The highest grain yield was obtained from sowing wheat alone followed by 2:2, 4:4 and 3:3 intercropping sowing patterns, respectively in both seasons. They concluded that planting wheat in pure stand gave the highest grain yield compared with the intercropping sowing systems. 2:2 intercropping system outyielded 3:3 and 4:4 intercropping systems. The results are in harmony with the findings of EL-Monufi (1984), Ali *et al.* (1986), Saleh *et al.* (1986), Eid *et al.* (1988) and EL- Mihi *et al.* (1991).

b) Faba bean:

The data in Table 2 show that intercropping wheat with faba bean significantly affected plant height, 100 seed weight, seed yield/ plant seed yield/ fad. and straw yield/fad. Whereas it had insignificant effect on number of branches/plant and number of pods/ plant in both seasons. Number of branches and pods per plant were not significantly affected by sowing patterens. EL- Monufi (1984) stated that intercropping faba bean with wheat significantly decreased number of pods/ plant. The data also indicated that planting faba bean alone gave the highest seed yield/ plant and seed yield/ faddan in comparison with intercropping sowing patterns.

Table (1): Plant height, yield and yield components of wheat as affected by intercropping wheat with faba bean in 1997/ 98 and 1998/ 99 seasons.

Traits	Seasons	Intercropping patterns			
		2W: 2 F	3W: 3F	4W: 3F	Pure culture
Plant height (cm)	1997/ 98	108.31 a	102.97 b	98.72 c	95.23 d
	1998/ 99	112.62 a	106.95 b	103.23 c	99.50 d
Spike length (cm)	1997/ 98	10.55 a	10.57 a	10.93 a	11.02 a
	1998/ 99	10.23 a	10.25 a	10.58 a	10.64 a
Spikes/ m^2 (No)	1997/ 98	286.00 b	268.33 d	276.67 c	294.67 a
	1998/ 99	291.17 b	275.67 c	283.33 c	301.33 a
Grains spike (g)	1997/ 98	1.61 a	1.50 a	1.54 a	1.71 a
	1998/ 99	1.73 a	1.62 a	1.65 a	1.90 a
1000 grain weight (g)	1997/ 98	43.98 a	43.16 a	43.31 a	43.53 a
	1998/ 99	42.35 a	41.91 a	41.82 a	42.23 a
Grain yield/ fad. (ardab)	1997/ 98	16.69 b	15.77 d	16.17 c	17.26 a
	1998/ 99	17.14 b	16.29 d	16.73 c	17.69 a
Straw yield/ fad. (tons)	1997/ 98	3.01 a	2.82 b	2.57 c	2.41 d
	1998/ 99	2.88 a	2.70 b	2.44 c	2.31 d

Means values in each row followed by the same litter (s) are not significantly different at 5% level of probability.

Table (2): Plant height, yield and yield components of faba bean as affect by intercropping wheat with faba bean in 1997/ 98 and 1998/ 99 seasons.

Traits	Seasons	Intercropping patterns			
		2W: 2 F	3W: 3F	4W: 3F	Pure culture
Plant height (cm)	1997/ 98	141.13 a	130.49 b	123.50 c	117.74 d
	1998/ 99	148.91 a	140.27 b	132.65 c	123.78 d
Branches / plant (No)	1997/ 98	2.62 a	2.82 a	2.66 a	2.93 a
	1998/ 99	2.80 a	3.01 a	2.85 a	3.05 a
Pods / plant (No)	1997/ 98	14.98 a	14.76 a	14.58 a	15.23 a
	1998/ 99	16.02 a	15.80 a	15.67 a	16.21 a
100- seed weight (g)	1997/ 98	81.42 a	78.13 c	76.98 d	79.93 b
	1998/ 99	83.41 a	80.68 c	78.56 d	82.07 b
Seed yield / plant (g)	1997/ 98	20.45 b	18.71 c	16.85 d	22.31 a
	1998/ 99	23.04 b	21.22 c	19.16 d	25.02 a
Seed yield/ fad. (ardab)	1997/ 98	10.28 ab	8.05 c	9.59 b	10.78 a
	1998/ 99	10.54 b	8.84 c	10.09 b	11.24 a
Straw yield/ fad. (tons)	1997/ 98	4.25 a	3.78 b	3.37 c	3.01 d
	1998/ 99	4.53 a	4.15 b	3.72 c	3.25 d

Means values in each row followed by the same litter (s) are not significantly different at 5% level of probability.

On the other hand, 2:2 intercropping sowing pattern gave the highest values of plant height, 100- seed weight and straw yield/ faddan whereas, planting faba bean alone resulted in the shortest plants and the lowest straw yield in both seasons. Similar results were obtained by EL- Monufi (1984), Ali *et al.* (1986), Saleh *et al.*(1986) and Abd El- Gawad *et al.*(1988).

2) Effect of cultivars:

a) Wheat:

Results in Table 3 show that wheat cultivars Gemmiza and Sakha 8 were significantly differed in plant height, spike length, number of spikes/ m^2, grain and straw yields / fad in both seasons. Gemmeiza 9 cultivar surpassed Sakha 8 in all previous traits. The difference in plant height among varieties might be attributed to the difference in number/or length of internodes reflecting the genetical make up (Abd EL- Gawad *et al.*, 1986). Gemmeiza 9 surpassed significantly Sakha 8 by 6 and 9% for grain and straw yields, respectively. This is mainly due to its taller spikes and number of spikes/ m^2.

On the other hand, no significant differences between both varieties grain weight/ spike and 1000- grain weight were observed in both seasons (Table 3). Significant differences between wheat cultivars were observed by Roshdy (1988)

b) Faba bean:

Concerning the differences between faba bean cultivars, data presented in Table 4 showed that Giza 3 surpassed significantly Giza 716 in plant height
and straw yield/ faddan in both seasons. Giza 716 surpassed significantly Giza 3 cultivar in number of pods/ plant, seed yield/ plant, 100 seed weight and seed yield/ feddan in both seasons. On the other hand, no difference between the two cultivars was observed in number of branches/ plant in both seasons. The variability among faba bean varieties for growth, yield and yield components, was observed by Abdel- Aal (1990), while Hammam (1995) found that seed yield, yield components and growth characters were not significantly affected by faba bean variety.

Table (3): Plant height, yield and yield components of two wheat cultivars in 1997/ 98 and 1998/ 99 seasons.

Cultivars	Plant height (cm)	Spike length (cm)	Spikes/ m^2 (No)	Grains / Spike (g)	1000 grain weight (g)	Grain yield/ fad. (ardab)	Straw yield/ fad. (tons)
	1997- 98						
Gemmeiza 9	105.08 a	11.31 a	285.50 a	1.60 a	43.71 a	16.95 a	2.82 a
Sakha 8	97.53 b	10.22 b	276.33 b	1.56 a	43.28 a	16.00 b	2.59 b
	1998 – 99						
Gemmeiza 9	109.59 a	11.02 a	292.00 a	1.78 a	42.21 a	17.52 a	2.71 a
Sakha 8	101.56 b	9.83 b	283.75 b	1.67 a	41.95 a	16.41 b	2.45 b

Means values in each column followed by the same litter (s) are not significantly different at 5% level of probability.

Table (4): Plant height, yield and yield components of two faba bean cultivars in 1997/ 98 and 1998/ 99 seasons.

Cultivars	Plant height (cm)	Branches/ plant (No.)	Pods/ Plant (No.)	100-seed weight (g)	Seed yield/ plant (g)	Seed yield/ fad. (ardab)	Straw yield/ fad. (tons)
	1997- 98						
Giza 716	115.01 b	2.80 a	15.64 a	84.70 a	23.09 a	9.98 a	3.29 b
Giza 3	141.42 a	2.71 a	14.13 b	73.53 b	16.07 b	9.37 b	3.91 a
	1998 – 99						
Giza 716	122.86 b	2.98 a	16.73 a	87.04 a	24.90 a	10.53 a	3.67 b
Giza 3	149.95 a	2.87 a	15.12 b	75.32 b	19.31 b	9.82 b	4.16 a

Means values in each column followed by the same litter (s) are not significantly different at 5% level of probability.

Effect of interaction:

The interaction between intercropping systems and cultivars was significant for plant height, number of spikes/ m^2, grain yield/ fad and straw yield/ fad of wheat and plant height, 100- seed weight, seed yield/ plant, seed yield/ fad and straw yield/ fad of faba bean in both seasons (Tables 5 and 6), respectively. The others studied traits for both crops, were not significantly affected by the interaction between the two factors of the study.

The highest wheat grain yield/ fad. was obtained with sowing Gemmeiza cultivar as a sole crop, while the lowest grain yield was obtained by growing Sakha 8 in three ridges alternating with three ridges of faba bean (3W: 3F) in both seasons (Table 5).

Concerning the interaction effect on faba bean seed yield / fad., the data presented in Table 6 show that faba bean plants grown alone

Table (5): Plant height, yield and yield components of wheat as affected by interaction between intercropping systems and wheat cultivars in 1997/ 1998 and 1998/ 1999 seasons.

Traits	Gemmeiza 9				Sakha 8			
	2W: 2F	3W: 3F	4W:3F	Pure culture	2W: 2 F	3W: 3F	4W:3F	Pure culture
	1997- 98							
Plant height	112.40 a	106.61 b	102.61 c	98.90 d	104.21 c	99.52 d	94.83 e	91.55 f
Spikes/ m^2 (No)	291.00 b	271.00 e	282.33 cd	301.67 a	281.00 d	265.67 e	271.00 e	287.67 bc
Grain yield/fad.	17.24 ab	16.17 c	16.45 c	17.92 a	16.13 c	15.36 d	15.88 cd	16.61 bc
Straw yield/fad.	3.12 a	2.93 b	2.70 c	2.52 d	2.89 b	2.71 c	2.44 d	2.31 e
	1998 – 99							
Plant height	116.94 a	110.23 b	107.00 c	104.18 d	108.29 bc	103.66 d	99.47 e	94.82 f
Spikes/ m^2 (No)	294.67 b	278.00 d	288.33 c	307.00 a	287.67 c	273.33 d	278.33 d	295.67 b
Grain yield/ fad.	17.79 ab	16.72 cde	17.18 bc	18.36 a	16.48 de	15.86 f	16.27 ef	17.01 cd
Straw yield/ fad.	3.02 a	2.82 b	2.60 c	2.40 d	2.74 bc	2.57 cd	2.28 ef	2.21 f

Table (6): Plant height, yield and yield components of faba as affect by interaction between intercropping systems and faba bean cultivars bean in 1997/ 98 and 1998/ 99 seasons.

Traits	Giza 716				Giza 3			
	2W: 2 F	3W: 3F	4W: 3F	Pure culture	2W: 2 F	3W: 3F	4W: 3F	Pure culture
	1997- 98							
Plant height	130.46 d	117.65 e	109.19 f	102.74 f	151.80 a	143.33 b	137.80 bc	132.73 cd
100-seed weight	85.85 a	84.51 ab	83.64 b	84.81 ab	76.98 c	71.75 e	70.32 e	75.06 d
Seed yield/plant	23.83 b	21.77 c	20.87 c	25.91 a	17.07 e	15.65 e	12.84 f	18.71 d
Seed yield/ fad.	10.58 abc	8.62 e	9.80 c	10.90 a	9.97 bcd	7.48 f	9.39 de	10.67 ab
Straw yield/fad.	4.01 bc	3.37 d	3.00 cd	2.77 f	4.50 a	4.18 ab	3.73 c	3.24 de
	1998 – 99							
Plant height	137.29 c	127.06 d	118.01 e	109.07 f	160.52 a	153.47ab	147.30 b	138.48 c
100-seed weight	89.28 a	86.07 c	84.90 d	87.91 b	77.53 e	75.28 g	72.22 h	76.23 f
Seed yield/ plant	25.71 b	23.75 c	21.98 d	28.17 a	20.37 e	18.69 f	16.34 g	21.86 d
Seed yield/ fad.	10.63 b	9.58 c	10.27 bc	11.64 a	10.45 bc	8.10 d	9.90 bc	10.85 ad
Straw yield/ fad.	4.22 bc	3.96 cd	3.50 e	3.00 f	4.84 a	4.34 b	3.94 d	3.50 e

Means values in each row followed by the same litter (s) are not significantly different at 5% level of probability.

surpassed those intercropped with wheat plant in all tested intercropping systems,(2W : 2F, 3W: 3F and 4W: 4F).Moreover, it can be noticed that Giza 716 cultivar produced the highest seed yield/ fad. The lowest value appeared with cultivating faba bean Giza 3 cultivar in three ridges alternating with three ridges of wheat in both seasons (Table 6).

Competitive relationships and yield advantage:

The data presented in Tables 7,8 and 9 show the competitive relationships and yield advantage, i.e. Land Equivalent Ratio (LER), Relative Crowding Coefficient (RCC) and Aggressivity (A) as affected by intercropping wheat with faba bean during 1997/98 and 1998/99 seasons.

a) Land Equivalent Ratio (LER):

The data show that LER values of intercropping wheat with faba bean in 2:2, 3:3 and 4:4 systems were 1.91, 1.65 and 1.83 in the first season and 1.91, 1.71 and 1.85 in the second season. This showed considerable yield advantage from intercropping wheat and faba bean. It was evident that land use efficiency was increased by 91%, 65% and 83% in the first season and 91%, 71% and 85% in the second season over the mono cultures where wheat were intercropped with faba bean at 2:2,3:3 and 4:4 systems, respectively. The results presented in Table 7 indicate that intercropping wheat and faba bean produced LER of 1.82 and 1.79 under for the two cultivars in 1997/98 season, respectively. In 1998/99 season, values of LER were 1.81 and 1.82 under the two cultivars (Table 8). The averages of LER in both years were 1.82 and 1.80 for the two cultivars, respectively (Table 9). These data also indicate clearly that intercropping Gemmeiza 9 wheat cultivar with Giza 716 faba bean cultivar recorded an average increase of land efficiency estimated of 82% in both seasons (Table 9).

The results in Table 9 reveal that sowing two faba bean rows alternating with two rows of wheat, with the second cultivar increased land use by 92% on the average of both seasons. In this respect, wheat was equal to that obtained from 96.80 % of the sole cropping area. Faba bean, on the contrary, was an inferior intercrop component where the yield obtained was only76.66% of that produced under sole cropping. It could be concluded that under the present experimental conditions, wheat and faba bean could be considered as compatible intercrop components under second cultivar and sowing two rows of faba bean alternating with two rows of wheat. EL-Monufi (1984) and Saleh *et al.* (1986) reported similar results for intercropping wheat and faba bean. Eid *et al.* (1988) found that land equivalent ratio (LER) was more than one by the intercropping of wheat with faba bean patterns. Saleh *et al.* (1986) found that growing wheat and

Table (7): Land Equivalent Ratio, Relative Crowding Coefficient and Aggressivity values for intercropping wheat and faba bean under different cultivars in 1997/ 98 season.

Sowing Patterns	Cultivar	Land Equivalent Ratio (LER)			Relative Crowding Coefficient (RCC)			Aggressivity (A)	
		L_w	L_f	LER	RCC_w	RCC_f	RCC	A_w	A_f
$W_2 f_2$	V_1	0.96	0.97	1.93	25.35	33.06	838.07	+0.02	- 0.02
	V_2	0.97	0.93	1.90	33.60	14.24	478.46	+0.08	- 0.08
Mean		0.96	0.95	1.91	29.48	23.65	658.26	+0.05	- 0.05
$W_3 f_3$	V_1	0.90	0.79	1.69	9.24	3.78	34.9[illegible]	+0.22	- 0.22
	V_2	0.92	0.70	1.62	12.29	2.34	28.76	+0.45	- 0.45
Mean		0.91	0.74	1.65	10.76	3.06	31.84	+0.34	- 0.34
$W_4 f_4$	V_1	0.92	0.90	1.82	11.19	8.91	99.70	+0.03	- 0.03
	V_2	0.96	0.88	1.84	21.75	7.34	159.65	+0.15	- 0.15
Mean		0.94	0.89	1.83	16.47	8.12	129.68	+0.09	- 0.09
Overall Mean	V_1	0.93	0.89	1.82	15.26	15.25	324.23	+0.09	- 0.09
	V_2	0.95	0.84	1.79	22.55	7.79	222.29	+0.23	- 0.23

Table (8): Land Equivalent Ratio, Relative Crowding Coefficient and Aggressivity values for intercropping wheat and faba bean under different cultivars in 1998/ 99 season.

Sowing Patterns	Cultivars	Land Equivalent Ratio (LER)			Relative Crowding Coefficient (RCC)			Aggressivity (A)	
		L_w	L_f	LER	RCC_w	RCC_f	RCC	A_w	A_f
$W_2 f_2$	V_1	0.97	0.91	1.88	31.21	10.52	328.33	+0.11	- 0.11
	V_2	0.97	0.96	1.91	31.09	26.13	830.67	+0.02	- 0.02
Mean		0.97	0.94	1.91	31.15	18.33	579.50	+0.07	- 0.07
$W_3 f_3$	V_1	0.91	0.82	1.73	10.20	4.65	47.43	+0.17	- 0.17
	V_2	0.93	0.75	1.68	13.79	2.95	40.68	+0.37	- 0.37
Mean		0.92	0.79	1.71	12.00	3.80	44.06	+0.27	- 0.27
$W_4 f_4$	V_1	0.94	0.88	1.82	14.56	7.50	109.20	+0.11	- 0.11
	V_2	0.96	0.91	1.87	25.17	10.42	262.27	+0.10	- 0.10
Mean		0.95	0.90	1.85	19.87	8.96	185.74	+0.11	- 0.11
Overall Mean	V_1	0.94	0.87	1.81	18.66	7.56	161.65	+0.13	- 0.13
	V_2	0.95	0.87	1.82	23.35	13.17	377.87	+0.16	- 0.16

Table (9): Land Equivalent Ratio, Relative Crowding Coefficient and aggressivity values for intercropping wheat and faba bean under different cultivars in 1997/ 1998 and 1998/1999seasons.

Sowing Patterns	Cultivars	Land Equivalent Ratio (LER)			Relative Crowding Coefficient (RCC)			Aggressivity (A)	
		L_w	L_f	LER	RCC_w	RCC_f	RCC	A_w	A_f
$W_2 f_2$	V_1	0.97	0.94	1.91	28.28	21.79	583.20	+0.07	- 0.07
	V_2	0.97	0.95	1.92	32.35	20.19	654.57	+0.05	- 0.05
Mean		0.97	0.95	1.92	30.32	20.99	618.89	+0.06	- 0.06
$W_3 f_3$	V_1	0.91	0.81	1.71	9.72	4.22	41.18	+0.20	- 0.20
	V_2	0.93	0.73	1.65	13.04	2.65	34.72	+0.41	- 0.41
Mean		0.92	0.77	1.68	11.38	3.44	37.95	+0.31	- 0.31
$W_4 f_4$	V_1	0.93	0.89	1.82	12.88	8.21	104.45	+0.07	- 0.07
	V_2	0.96	0.90	1.86	23.46	8.88	210.96	+0.13	- 0.13
Mean		0.95	0.90	1.84	18.17	8.55	157.71	+0.10	- 0.10
Overall Mean	V_1	0.94	0.88	1.82	16.96	11.41	242.94	+0.11	- 0.11
	V_2	0.95	0.86	1.80	22.95	10.57	300.08	+0.20	- 0.20

faba bean in 2 : 2 intercropping system produced yield advantages and increased land use efficiency by about 90 % followed by 3 : 3 and 4 : 4 systems.

b) Relative crowding coefficient (RCC):

In general data in Tables 7, 8 and 9 show that wheat and faba bean as intercrop components produced more yield than expected at all sowing patterns and cultivars in both seasons. The best crowding coefficient (300. 08) had been obtained by the second cultivar in both season (Table 9).

The data also indicate that sowing patterns 2W: 2F produced the highest relative crowding coefficient (618.89), while the lowest value (37.95) was obtained with 3W: 3F (Table 9). It is also clear that wheat crop has higher relative crowding coefficient in both seasons as compared to the faba bean. This means that wheat was a dominant intercrop component in wheat and faba bean intercropping pattern. In this respect, Saleh *et al.* (1986) found that intercropping wheat with faba bean increased RCC Values more than one. Abd EL- Gawad *et al.*(1988) found that intercropping faba bean with wheat in 1 : 1 system gave the highest RCC value followed by 3 : 3 , 1 : 2 and 2: 2 systems. Abo– shetaia (1990) reported that RCC values were greater than one by intercropping faba bean with barley in favor of 2 : 2 and 3 : 3 patterns.

C) Aggressivity (A):

The data in Tables 7,8 and 9 show that Aggressivity values for wheat were positive whereas that of faba bean were negative under all intercropping systems and cultivars.

The results in Tables 7, 8 and 9 show clearly that wheat was the dominate intercrop component and faba bean was the dominated one at all patterns and cultivars in both seasons.

Regarding the average means of sowing patterns in both seasons, the highest value for aggressivity was obtained from 3W: 3F sowing pattern, while the lowest value was that of 2W: 2F sowing pattern. Cultivars differed in the aggerssivity values. Wheat gemmeiza 9 cultivar and faba bean 716 cultivar showed the lowest values of aggerssivity (Table 9). Similar results were obtained by EL- Monufi (1984) and Saleh *et al.*(1986).

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الملخص العربى

إنتاجية القمح والفول البلدي تحت نظم تحميل مختلفة

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أجريت تجربتان حقليتان بمحطة التجارب والبحوث الزراعية بكلية الزراعة جامعة القاهرة بالجيزة خلال موسمي ١٩٩٧ /٩٨ ،١٩٩٨/٩٩ بهدف دراسة إنتاجية صنفين من الفول البلدي (جيزة ٧١٦ ، جيزة ٣) وصنفين من القمح (جميزة ٩ ، سخا ٨) تحت ٣ نظم من التحميل مقارنة بالزراعة المنفرده٠ لم يكن هناك اختلافات معنوية في طول السنبلة ، وزن الـ ١٠٠٠ حبه من القمح تحت النظم المدروسة ٠ الزراعة المنفردة لمحصول القمح أعطت أعلى القيم لكلا من عدد السنابل /م٢ ، محصول الحبوب/ الفدان تلاها نظم التحميل ٢:٢ ، ٤:٤ ، ٣:٣ على الترتيب٠ أعلى محصول قش/ الفدان تحصل عليه من نظام التحميل ٢:٢ تلاه النظم ٣:٣ ، ٤:٤ ٠

زراعة الفول البلدي منفردا أعطت أعلى محصول من البذور على النبات ، الفدان٠ بينما تحميل الفول مع القمح بنظام ٢:٢ أعطى أعلى القيم من ارتفاع النبات ، وزن الـ ١٠٠ بذره ، محصول القش/ الفدان٠

أصناف القمح جميزة ٩ ، سخا ٨ اختلفت معنويا في ارتفاع النبات، عدد السنابل /م٢ ، محصول الحبوب والقش / الفدان٠ الصنف جميزة ٩ تفوق معنويا على الصنف سخا ٨ في محصول الحبوب والقش بمقدار ٦،٩ % بالترتيب٠ ولم تكن هناك اختلافات معنوية بين صنفي القمح في وزن حبوب السنبلة ، وزن الـ ١٠٠٠ حبه في الموسمين٠ الصنف جيزة ٧١٦ من الفول البلدي تفوق معنويا على الصنف جيزة ٣ في عدد القرون/ النبات، محصول البذور/ النبات، وزن الـ ١٠٠ بذرة، محصول البذور/ الفدان٠ ولم تكن هناك اختلافات معنوية بين صنفي الفول البلدي في عدد الفروع/ النبات٠

معدل مكافئ الأرض زاد بمقدار ٩١%، ٦٥%،٨٣% في الموسم الأول ، ٩١%، ٧١%، ٨٥% في الموسم الثاني عن الزراعة المنفردة عند اتباع نظم التحميل ٢:٢، ٣:٣ ، ٤:٤ بالترتيب٠ أعلى معدل حشد نسبى قدر (٦١٨،٨٩) تم الحصول عليه عند التحميل بنظام ٢:٢ بينما أقل قيمه (٣٧،٩٥) تم الحصول عليها عند التحميل بنظام٣:٣ ٠ أعلى قيمه للمنافسة تم الحصول عليها بأتباع نظام التحميل ٣:٣ بينما أقل قيمه تم الحصول عليها بأتباع نظام التحميل ٢:٢ ٠وقد اختلفت الأصناف في قيم التنافس٠