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COMPETITION INDICES FOR WHEAT AND FABA BEAN INTERCROPPED TOGETHER UNDER SANDY SOIL CONDITIONS.

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ABSTRACT

Egyptian faba bean cultivar Sakha 1 was planted either solely or intercropped with four Egyptian wheat varieties *i.e.*, Giza 168, Sakha 94, Gemmiza 9 and Sids 1 by seven cropping patterns. The cropping patterns *i.e.*, sowing wheat at three seeding rates(300,350and 400 grains/m^2) solely and intercropped with faba bean as well as solid faba bean plantings, were tested for each wheat variety in alternative rows 20 cm apart (1:1). The main objective of this work was to determine the suitable (wheat /faba bean) intercropping treatment for maximizing the land productivity of sandy soil through calculating the degree of competition indices for both crops. Hence, both faba bean seed yield and wheat grain yield tons/ ha were used to calculate the degrees of competition indices in terms of Land Equivalent Ratio (LER), Aggressivity (Ag) and Relative Crowding Coefficient (RCC). Two field experiments were carried out at the Experimental Station Farm of the Faculty of Agriculture, Damanhour University, El-Bostan Region, El- Behera Governorate, Egypt, during 2009/2010 and 2010/2011 seasons. A split–plot design with four replicates was used in both seasons. Wheat varieties were randomly assigned to the main–plots, while intercropping patterns were allocated in the sub–plots. The obtained results can be summarized as follows:

- LER was insignificantly affected by the four studied wheat varieties in both seasons. Meanwhile, the intercropping patterns significantly affected LER values, in both seasons. LER values averaged of both seasons were greater than one (1.40) for intercropping plantings.
- Values of aggressivity of wheat varieties were significantly differed in the second season only. Sakha 94 was the most aggressive wheat variety compared with the other studied varieties in both seasons. The data also, revealed that the aggressivity values of faba bean were positive, while that of wheat was negative, under intercropping treatments in both seasons.
- RCC for wheat and faba bean was insignificantly affected among wheat varieties, in both seasons. The higher values of RCC_w were produced when using Giza 168 (wheat variety) meanwhile, the lowest RCC_f values were produced by Sids 1 variety in both seasons.

A significant interaction was detected between wheat varieties and cropping patterns (Vx C_1) for the relative yield of wheat, in the first season only.

In general, it could be concluded that intercropping any studied wheat variety with seeding rate of 300 grains/m^2 with Sakha 1 faba bean cultivar at 166667 plants/ ha in alternative rows 20 cm apart (1:1) could be recommended to maximizing the productivity of land unit area under sandy soil conditions, in El-Bostan Region, El- Behera Governorate, Egypt.

Key words: *aggressivity, faba bean, intercropping patterns, land equivalent ratio, relative crowding coefficient, wheat varieties.*

1. INTRODUCTION

The intercropping crops compete for different below and above soil environmental factors. Intercropping legume crop with non-legume one proved to be a successful system owing to the ability of legume to fix considerable non-legume (El-Metwally *et al.,* 2002*).* Many researches reported that land use efficiency was increased and yield advantage was produced by intercropping faba bean with wheat (Ali *et al.,* 1986; Saleh *et al.,* 1986*;* Abd El-Gawad *et al.,* 1988 and El-Metwally *et al.,* 2002*).* Saleh *et al.* (1986*)* stated that growing wheat and faba bean in 2:2 intercropping system increased land usage by about 90%. Eid *et al*. (1988) reported that the intercropping wheat with faba bean in 1:1 pattern gave the maximum values of (LER) and (RCC). El-Metwally *et al.* (2002) intercropped wheat and faba bean under different systems. They found that LER was increased by 91% over the monoculture in 2:2 pattern. Also, intercropping pattern, 2:2 produced the highest RCC (618.89), while the highest value for Aggressivity (Ag) was obtained from 3:3 pattern. Therefore, measuring the degree of competition relationships in terms of LER, Ag and RCC for intercropping wheat with faba bean using different wheat varieties and cropping patterns to determine the best suitable (wheat /faba bean) combination treatment for maximizing the land productivity under sandy soil conditions was the aim of this investigation.

2. MATERIALS AND METHODS

Two field experiments were carried out in two successive winter seasons of 2009/2010 and 2010/2011 at the Experimental Farm of the Faculty of Agriculture, Damanhour University, El-Bostan region, El- Behera Governorate, Egypt. The main objective of this work was to study the effect of four Egyptian wheat varieties (Giza 168, Sakha 94, Gemmiza 9 and Sids 1) in seven cropping patterns of wheat and faba bean on the competition indices of wheat and faba bean to determine the best intercropping treatment to maximize the productivity of unit area in sandy soil conditions.

The seven cropping patterns were as follows:

1-Sole wheat plantings at a rate of 300 grain/m^2 (W_LF_0).

2- Sole wheat plantings at a rate of 350 grain/m^2 (W_mF_0).

3- Sole wheat plantings at a rate of 400 grain/m^2 (W_hF_0).

4-Intercropped wheat with faba bean at a rate of 300 grain of wheat/m^2 (W_LF_1).

5-Intercropped wheat with faba bean at a rate of 350 grain of wheat/m^2 ($W_m F_1$).

6-Intercropped wheat with faba bean at a rate of 400 grain of wheat/m^2 (W_hF_1).

7- Sole faba bean plantings (W_0F_1).

Soil samples taken from the experimental sites were analyzed mechanically (Piper, 1950) and their characteristics are presented in Table (1).The area of sub–plots was 7.0 m^2 (3.5 m length and 2.0 m width) included 10 rows , 20 cm apart , where wheat seeds were hand drilled, while faba bean was hand planted in hills, in both seasons. Faba bean (Sakha 1 cultivar) intercropped with wheat in alternate rows(1:1). The plant population of faba bean was about 166667 plants/ ha. The respective plant population was maintained through thinning seedlings to one plant/ hill, spaced at 30 and 15 cm for solid and intercropping treatments, respectively. Both crops were sown on the 5*th* of Nov. in both seasons. Phosphorus fertilizer was broadcasted during soil preparation in the form of calcium super-phosphate (15.5P_2O_5%) at the rate of 75.0 kg P_2O_5 ha^{-1}. Potassium sulphate (48% K_2O) was dressed at the rate of 60.0 kg K_2O ha^{-1} before the first irrigation. Ammonium sulphate (20.5% N) at the rate of 240 kg N/ha was added in three portions (1/5) broadcasted after sowing before irrigation and (4/5) was dressed at two equal doses before the 1st and 2nd irrigation. All other cultural practices were applied as usually recommended for wheat and faba bean fields in El-Bostan Region. Plants were harvested at maturity stage and at 155 days from sowing for faba bean and wheat, respectively, to determine the faba bean seed yield and wheat grain yield in tons/ha and used to calculate the following three competitive relations:

Table (1): Soil mechanical analysis of the experimental sites at El-Bostan region during 2009/2010 and 2010/2011 seasons.

Characteristic	Season	
	2009/2010	2010/2011
Sand (%)	77.37	74.25
Silt (%)	4.66	5.11
Clay (%)	17.97	20.64
Texture class	Sandy	

1-Land Equivalent Ratio (LER): was determined according to Willey's equation (1979), as follows:

$$RY_w = Y_{iw} / Y_{ww}$$
$$RY_f = Y_{if} / Y_{ff}$$
$$LER = RY_w + RY_f$$

Where:

RY_w = Relative yield of wheat.

RY_f = Relative yield of faba bean.

Y_{iw} = Intercrop yield of wheat.

Y_{if} = Intercrop yield of faba bean.

Y_{ww} = Solid crop yield of wheat.

Y_{ff} = Solid crop yield of faba bean.

2- Aggressivity (Ag): It was calculated according to McGilchrist's (1965) equation, as follows:

$$Ag_w = (Y_{iw} / Y_{ww}) - (Y_{if} / Y_{ff}).$$
$$Ag_f = (Y_{if} / Y_{ff}) - (Y_{iw} / Y_{ww}).$$

Where, Ag $_w$ and Ag $_f$ are the aggressivity values for wheat and faba bean, respectively.

3-Relative Crowding Coefficient (RCC): It was calculated, for wheat and faba bean according to the equation, as described by Willey and Osira (1972).

$$RCC_w = Y_{iw} / (Y_{ww} - Y_{iw}).$$

$$RCC_f = Y_{if} / (Y_{ff} - Y_{if}).$$

Where, RCC_w and RCC_f are the Relative Crowding Coefficient of wheat and faba bean, respectively.

In the present study, the grain yield of solid Giza 168 wheat variety seeded by 350 grains/m^2 and the seed yield of solid faba bean were used, as a control to calculate the relative yields of wheat (RY_w) and faba bean (RY_f) in both seasons. It should be noted that during both seasons, wheat was considered as the main crop while faba bean was the secondary crop.

Five orthogonal comparisons were done among cropping patterns for relative yields of wheat *i.e.*, C_1: solid vs. intercropping wheat plantings; C_2: low density of solid wheat plantings vs. both the medium and high densities of solid wheat plantings { W_LF_0 *vs.* (W_mF_0 and W_hF_0)}; C_3: the medium density of solid wheat plantings *vs*., high density of solid wheat plantings (W_mF_0 *vs*., W_hF_0); C_4: : low density of intercropped wheat plantings vs. both medium and high densities of intercropped wheat plantings { W_LF_1 vs. (W_mF_1 and W_hF_1)} and C_5: medium density of intercropped wheat plantings vs. high density of intercropped wheat plantings (W_mF_1 vs. W_hF_1). With respect to the Land Equivalent Ratio (LER), another additive orthogonal comparison was done to compare between the solid faba bean plantings *vs.* the solid wheat planting. On the other hand, other six orthogonal comparisons were done for the interactions *i.e.*, I × (C_1, C_2, C_3, C_4, C_5 and C_6). The obtained data were statistically analyzed according to Steel and Torrie (1980).

3.RESULTS AND DISCUSSION

3.1.Advantage of intercropping

3.1.1. Relative yield of wheat (RY_w)

The results presented in Tables 2 and 3 indicated that insignificant differences were detected among the studied wheat varieties for the relative yields of wheat (RY_w) in both seasons. Wheat solid plantings *vs*. intercropped with faba bean (C_1), showed a highly significant increase in RY_w of solid plantings in both seasons compared with intercropping culture (Tables 2 and 3). This result may be mainly attributed to more area actually planted by solid wheat plantings (100%) than intercropping wheat plantings (50%). These findings are parallel with those obtained by (El-Monufi 1984; Saleh *et al.*, 1986 and El-Metwally *et al.*, 2002). For the second comparison(C_2), the results summarized in Tables 2 and 3 showed that sole wheat plantings at a rate of 300 grain/m^2 (W_LF_0) significantly decreased RY_w by about 4.33%, as an average of both seasons, compared with sole wheat plantings at rates of (350 and 400 grains/ m^2). Concerning the third comparison (C_3), data presented in Tables 2 and 3 showed that RY_w insignificantly affected by planting wheat solely seeded by 350 or 400 grain/ m^2. The fourth comparison (C_4), intercropping faba bean with wheat by seeding wheat at 300 grain/ m^2 *vs*. (faba bean /wheat) intercropping patterns by seeding wheat at 350 and 400 grains/m^2, the data in Tables 2 and 3 revealed that the two treatments were statistically similar to the relative yields of wheat (RY_w) in both studied seasons. Regarding intercropping faba bean with wheat by seeding wheat at 350 grain/ m^2 *vs.* the same intercropping pattern but seeding wheat at a rate of 400 grain/ m^2 (C_5), both patterns gave statistically the

Table (2): Mean squares of relative yields for wheat (RY_w) intercropped with faba bean in 2009/2010 and 2010/2011 seasons.

Sources of variations	D.F	Season	
		2009/10	2010/11
Replications	3	0.276**	1.369**
Wheat varieties (V)	3	0.062	0.113
Error "a"	9	0.037	0.031
Cropping patterns (I)	5	0.245**	0.302**
+ C_1	1	1.090**	1.173**
+ C_2	1	0.116**	0.251**
+ C_3	1	0.001	0.003
+ C_4	1	0.011	0.066
+ C_5	1	0.006	0.016
V x I	15	0.019	0.018
V C_1	3	0.047*	0.026
V C_2	3	0.009	0.002
V C_3	3	0.019	0.024
V C_4	3	0.007	0.013
V C_5	3	0.013	0.022
Error "b"	60	0.016	0.022

C_1: Solid vs. intercropping wheat plantings.

C_2: Low density of solid wheat plantings vs. both medium and high densities of solid wheat plantings (W_LF_0 vs. (W_mF_0 and W_hF_0).

C_3: Medium density of solid wheat plantings vs. high density of solid wheat planting (W_mF_0 vs. W_hF_0).

C_4: Low density of intercropped wheat plantings vs. both medium and high densities of intercropped wheat plantings { (W_LF_1 vs. (W_mF_1 and W_hF_1)}.

C_5: Medium density of intercropped wheat plantings vs. high density of intercropped wheat plantings (W_mF_1 vs. W_hF_1).

* and ** are significant at 0.05 and 0.01 level, respectively.

Table (3): Means of relative yields of wheat (RY_w) as affected by different wheat varieties (V) and (wheat/ faba bean cropping patterns (I) in 2009/2010 and 2010/2011 seasons.

Seasons	Wheat varieties (V)				Comparisons among (wheat/ faba bean) cropping patterns (I)										Mean
	Giza 168	Sakha 94	Gemmiza 9	Sids1	C_1: Solid vs. intercropping wheat plantings		C_2: {W_LF_0 vs. (W_mF_0 and W_hF_0)}		C_3: (W_mF_0 vs. W_hF_0)		C_4: W_LF_1 vs. (W_mF_1 and W_hF_1)		C_5: (W_mF_1 vs. W_hF_1)		
					Solid	Intercropping	W_LF_0	(W_mF_0 and W_hF_0)	W_mF_0	W_hF_0	W_LF_1	(W_mF_1 and W_hF_1	W_mF_1	W_hF_1	
1st	0.780a(1)	0.690a	0.762a	0.678a	0.834a	0.621b	0.765b	0.869a	0.865a	0.873a	0.559a	0.632a	0.646a	0.619a	0.728
2nd	0.808a	0.698a	0.763a	0.653a	0.841a	0.620b	0.739b	0.892a	0.883a	0.902a	0.568a	0.646a	0.669a	0.624a	0.731

(1) Means followed by the same letter within each row, for each comparison, are not significantly different at 0.05 level.
(W_LF_0; W_mF_0 and W_hF_0) = Sowing wheat as sole crop at rates of (300, 350 and 400 grains/m^2), respectively.
(W_LF_1 ;$W_m F_1$ and $W_h F_1$)= Intercropped wheat with faba bean by seeding wheat of (300, 350 and 400 grains/$m^{2)}$, respectively.

same(RY_w) means in both studied seasons (Tables 2 and 3).

3.1.2. Relative yield of faba bean (RY_f)

The variations among the studied wheat varieties did not reach the level of significance for Relative yield of faba bean (RY_f), in both seasons (Table 4). Concerning the first comparison (C_1), Relative yield of faba bean (RY_f), in both seasons (Table 4). Concerning the first comparison (C_1), faba bean solid plantings *vs.* faba bean intercropped with wheat, the data in Tables(4 and 5) showed that intercropping wheat with faba bean significantly decreased the Relative yield of faba bean (RY_f), in both seasons. These results might be expected, where low plant population for faba bean monoculture decreases the plant competition, thus leads to increase the ability of plants to uptake both soil water and nutrient elements with its good deeply roots and laterally distribution since there is a good balance between plant density and soil sources especially of the experimental farm soil which is sandy (75.81%) and its often poor fertility level with verged to organic matter, macro and micronutrients. The above mentioned trend was true for the two comparisons *i.e.,* (C_2) and (C_3), where intercropped faba bean with lower density of wheat increased values of Relative yield of faba bean (RY_f) compared with the same treatment but under higher density of wheat (Table 5). These results can explain the basis of the lower wheat plant density under intercropping with faba bean which led to decrease the inter and intra specific competitions and favored more utilization of faba available environmental resources. This in turn simulated growth and photosynthetic activity of bean plants and consequently increased (RY_f) trait compared with intercropping both crops with higher wheat plant density.

Table (4): Mean squares of relative yields for faba bean (RY_f) intercropped with wheat in 2009/2010 and 2010/2011 seasons.

Sources of variation	D.F	Season	
		2009/10	2010/11
Replications	3	0.026	0.074*
Wheat varieties (V)	3	0.002	0.031
Error "a"	9	0.035	0.014
Cropping patterns (I)	3	0.235**	0.305**
+ C_1	1	0.562**	0.582**
+ C_2	1	0.096**	0.259**
+ C_3	1	0.047	0.074*
V x I	9	0.001	0.005
V C_1	3	0.001	0.011
V C_2	3	0.001	0.003
V C_4	3	0.001	0.001
Error "b"	36	0.010	0.015

C_1: Solid vs. intercropping faba bean plantings.
C_2: Intercropping faba bean with low density of wheat plantings vs. intercropping faba bean with both medium and high densities of wheat plantings (W_LF_1 vs. (W_mF_1 and W_hF_1).
C_3: Intercropping faba bean with medium density of wheat plantings vs. intercropping faba bean with high density of wheat planting (W_mF_1 vs. W_hF_1).

3.1.3. Land Equivalent Ratio (LER)

The analysis of variance showed that the LER was insignificantly affected by the four studied varieties in both seasons. Meanwhile, the intercropping patterns were highly significant on the LER, in both seasons (Table, 6). Regarding the monoculture *vs.* intercropping patterns (C_1),the data indicated that intercropping was significantly superior over the monoculture plantings in both seasons as shown in Table (7).The estimated values of LER for intercropping patterns were greater than one (1.40),as an average of both seasons (Table, 7). This means that, under studied conditions about 140% of land area was needed for solid wheat and faba bean to produce the same yields obtained from intercropping both crops together. Solid plantings of faba bean *vs.* solid plantings of wheat (C_2), indicated that solid plantings of the former significantly increased by about 19.40%, as an average of both seasons, compared with the solid plantings of the latter (Tables 6 and 7). Regarding to the third comparison (c_3), solid the latter plantings at seeding rate 300 grains/m^2 compared with the solid plantings by more seeding rates for wheat *i.e.,* (350) and 400 grains/m^2), the data presented in (Table 6 and 7), revealed that solid the later plantings by higher seeding rates more than 300 grains/m^2 significantly increased the LER by about 23.74% , as an average of both seasons, compared with the wheat solid plantings . With respect to the fourth comparison C_4: solid plantings of wheat seeded by 350 grains/m^2 *vs.* solid plantings of wheat by 400 grains/m^2 , the data in Tables (6 and 7) revealed that LER insignificantly increased with increasing seeding rates in both seasons. Concerning the fifth comparison C_5: intercropped wheat with faba bean at seeding rate 300 grain/m^2 compared with intercropped wheat with faba bean by more seeding rates for wheat *i.e.,* (350 and 400 grain/m^2), the data in Tables 6 and 7 showed insignificantly decreased in LER with increasing seeding rates in both seasons. With regard to the sixth comparison C_6; namely, the medium density of intercropping wheat with faba bean plantings (350 grain/m^2) *vs.* the high density of intercropping wheat with faba bean plantings (400 grain/m^2); *i.e.,* W_m F_1 vs. W_hF_1, it is clear that LER value was significantly decreased with

Table (5): Means of relative yields of faba bean (RY_f) as affected by different wheat varieties (V) and (wheat/ faba bean) intercropping patterns (I) in 2009/2010 and 2010/2011 seasons.

Season	Wheat varieties (V)				Cropping patterns(I)						Mean
	Giza 168	Sakha 94	Gemmiza 9	Sids 1	C_1: Solid vs. Intercropping faba bean plantings		C_2; W_lF_1 vs. ($W_mF_1$and W_hF_1)		C_3; (W_mF_1 vs. W_hF_1).		
					Solid	Inter-cropping	W_lF_1	(W_mF_1+ W_hF_1	W_mF_1	W_hF_1	
1st	0.824a (1)	0.846a	0.828a	0.842a	1.00a	0.780b	0.843a	0.748b	0.778a	0.719a	0.835
2nd	0.773a	0.871a	0.838a	0.858a	1.00a	0.780b	0.884a	0.728b	0.776a	0.679b	0.835

(1)Means followed by the same letter within each row, for each comparison, are not significantly different at 0.05 level.
(W_LF_1; $W_m F_1$ and W_hF_1)= Intercropped faba bean with wheat at seeding rates of (300, 350 and 400 wheat grains/m^2), respectively.

Table (6): Mean squares of the Land Equivalent Ratio (LER) for wheat and faba bean intercropped by different wheat varieties and cropping patterns in 2009/2010 and 2010/2011 seasons.

Sources of variations	D.F	Seasons	
		2009/2010	2010/2011
Replications	3	0.234**	1.456**
Wheat varieties (V)	3	0.044	0.044
Error "a"	9	0.027	0.023
Cropping patterns (I)	6	1.352**	1.362**
+ C_1	1	7.568**	7.388**
+ C_2	1	0.329**	0.303**
+ C_3	1	0.116*	0.251*
+ C_4	1	0.001	0.003
+ C_5	1	0.041	0.064
+ C_6	1	0.059	0.161*
V x I	18	0.017	0.024
V C_1	3	0.039	0.034
V C_2	3	0.020	0.025
V C_3	3	0.009	0.002
V C_4	3	0.019	0.024
V C_5	3	0.004	0.023
V C_6	3	0.012	0.035
Error "b"	72	0.020	0.037

C_1: Solid plantings vs. intercropping plantings
C_2: Solid faba bean plantings vs. solid wheat plantings.
C_3: Low density of solid wheat plantings vs. both medium and high densities of solid wheat plantings [W_LF_0 vs. (W_mF_0 and W_hF_0)].
C_4: Medium density of solid wheat plantings vs. high density of solid wheat plantings (W_mF_0 vs. W_hF_0).
C_5: Low density of intercropped wheat plantings vs. both medium and high densities of intercropped wheat plantings { W_LF_1 vs. (W_mF_1 and W_hF_1)}.
C_6: Medium density of intercropped wheat plantings vs. high density of intercropped wheat plantings (W_mF_1 vs. W_hF_1).
*and ** are significant at 0.05 and 0.01 level, respectively.

increased wheat seeding rates from 350 to 400 grain/m^2 in the second season (Tables 6 and 7).

These results are in line with those of (El-Monufi,1984;Abd El-Gawad *et al* . ,1986; Saleh *et al* .,1986 and Eid *et al* . ,1988).

3.2. Aggressivity

Data in Table (8), present the values of aggressivity for wheat and faba bean crops as affected by both studied factors *i.e.,* wheat varieties and intercropping patterns in 2009/2010 and 2010/2011 seasons. It was evident from Table (8) that the four wheat varieties were significantly different in the second season only. It is clear that the wheat Sakha 94 variety was the most aggressive compared with the other studied varieties in both seasons. In addition, the data revealed that the aggressivity values of faba bean were positive, while of wheat was negative, under the three intercropping treatments in both seasons. This means that faba bean was dominate intercrop component and wheat was the dominated at three intercropping treatments in both seasons. Similar results were reported by (El-Monufi, 1984; Saleh

Table (7): Means of Land equivalent ratio (LER) for wheat and faba bean intercropped together as affected by different wheat varieties (V) and cropping patterns (I) in2009/2010 and 2010/2011 seasons

Seasons	Wheat varieties (V)				Comparisons among(wheat/ faba bean) cropping patterns (I)												Mean
	Giza 168	Sakha 94	Gemmiza 9	Sids1	C_1; Solid plantings vs. intercropping plantings		C_2; Solid faba bean plantings vs. solid wheat plantings		C_3; {W_LF_0 vs. (W_mF_0 and W_hF_0)}		C_4; (W_mF_0 vs.W_hF_0)		C_5; W_LF_1 vs. ($W_mF_1$and W_hF_1)		C_6; (W_mF_1 vs. W_hF_1).		
					Solid plantings	Intercropping plantings	Solid faba bean plantings	Solid wheat plantings	W_LF_0	W_mF_0 and W_hF_0	W_mF_0	W_hF_0	W_LF_1	W_mF_1 and W_hF_1	W_mF_1	W_hF_1	
1st	1.140a (1)	1.075a	1.126a	1.063a	0.876b	1.401a	1.00a	0.834b	0.765b	0.869a	0.865a	0.873a	1.443a	1.380a	1.423a	1.338a	1.10
2nd	1.134a	1.096b	1.133a	1.050b	0.881b	1.400a	1.00a	0.841b	0.739b	0.992a	0.883a	0.902a	1.451a	1.374a	1.445a	1.303b	1.103

(1)Means followed by the same letter within each row, for each comparison, are not significantly different at 0.05 level.
(W_LF_0; W_mF_0 and W_hF_0) = Sowing wheat as sole crop at rates of (300, 350 and 400 grains/m^2), respectively.

(W_LF_1; $W_m F_1$ and W_hF_1)= Intercropped wheat with faba bean at seeding wheat by (300, 350 and 400 grains/m^2), respectively.

Table (8) : Aggressivity values for yields of wheat (Ag_w) and faba bean (Ag_f) as affected by wheat varieties and intercropping patterns in 2009/2010 and 2010/2011 seasons.

Studied factors	2009/2010 season		2010/2011 season	
	Ag_w	Ag_f	Ag_w	Ag_f
Wheat varieties (v)				
Giza 168	- 0.142	0.142	- 0.008	0.008
Sakha 94	- 0.234	0.234	- 0.271	0.271
Gemmiza 9	- 0.087	0.087	- 0.140	0.140
Sids 1	- 0.172	0.172	- 0.243	0.243
F-test	NS	NS	*	*
Intercropping patterns(I)				
W_lF_1	- 0.243	0.243	- 0.316	0.316
W_mF_1	- 0.132	0.132	- 0.124	0.124
W_hF_1	- 0.100	0.100	- 0.056	0.056
F-test	NS	NS	**	**
Interaction(VxI)	NS	NS	NS	NS

(W_lF_1 W_m F_1 and W_0F_1)= Intercropped faba bean with wheat at seeding rates of (300, 350 and 400 wheat grains/m^2), respectively.
NS, * and ** are not significant, significant at 0.05 and 0.01 level, respectively.

Table (9) : Relative Crowding Coefficient values for yields of wheat (RCC_w) and faba bean (RCC_f) as affected by wheat varieties and intercropping patterns in 2009/2010 and 2010/2011 seasons.

	2009/2010 season		2010/2011 season	
	RCC_w	RCC_f	RCC_w	RCC_f
Wheat varieties (v)				
Giza 168	2.208	31.429	-6.476	-18.239
Sakha 94	1.438	4.489	19.683	-1.513
Gemmiza 9	1.975	2.571	4.276	7.710
Sids 1	2.050	-1.773	4.292	10.288
F-test	NS	NS	NS	NS
Intercropping patterns(I)				
W_lF_1	1.801	7.516	0.412	11.486
W_mF_1	2.659	24.845	2.509	7.552
W_hF_1	1.293	-4.824	13.410	2.619
F-test	NS	NS	NS	NS
Interaction(VxI)	NS	NS	NS	NS

(W_LF_1 W_m F_1 and W_0F_1)= Intercropped faba bean with wheat at seeding rates of (300, 350 and 400 wheat grains/m^2), respectively
NS= not significant at 0.05 level.

et al., 1986; Eid *et al.*, 1988 and El-Metwally *et al.*, 2002).

3.3.Relative Crowding Coefficient (RCC)

As shown in Table (9), the data indicated that wheat and faba bean Relative Crowding Coefficient (RCC) was not significantly affected by wheat varieties, in both seasons. It was clear that, higher values of RCC_w were reported by Giza 168 wheat variety، meanwhile, the lowest RCC_f values were reported by Sids 1 variety in both seasons. It was evident that intercropped faba bean with wheat seeded by 350 grain/ m^2 produced the higher values of RCC for wheat in both seasons. Meanwhile, intercropped faba bean with wheat seeded at rates of 400 and 300 wheat grain/ m^2 produced the higher values of RCC for faba bean in the first and second seasons, respectively (Table 9).

In general, it could be concluded that intercropping any studied wheat variety seedling by 300 grain/$m^2$with Sakha 1 faba bean cultivar at 166667 plant/ ha in alternative rows 20 cm apart (1:1) could be recommended to maximize the productivity of land unit area under sandy soil conditions, in El-Bostan Region, El- Behera Governorate, Egypt.

4.Effect of the interaction between wheat varieties and cropping patterns:

Table (10): Means of relative yields for wheat (RY_w) intercropped with faba bean as affected by the wheat varieties and intercropping patterns (VxC_1) in 2009/2010 season.

C_1: Solid wheat plantings vs. intercropping wheat plantings	Wheat varieties (V)			
	Giza 168	Sakha 94	Gemmiza 9	Sids 1
Solid wheat plantings	0.937	0.821	0.841	0.739
Intercropping wheat plantings	0.624	0.560	0.683	0.618
L.S.D$_{(0.05)}$ for the two levels of (I) under the same wheat cultivar	0.140			

There was a significant effect for the interaction between wheat varieties and first comparison (C_1), namely, solid wheat plantings vs. intercropping wheat plantings, for the relative yield of wheat , in the 1st season as shown in Table(2). The data show that the highest mean relative yield of wheat was obtained by solid plantings of wheat under wheat variety Giza 168 , while, the lowest mean relative yield of wheat was obtained by intercropping plantings under wheat variety Sakha 94 (Table 10).

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المدلولات التنافسية للقمح والفول البلدي المحملين معا تحت ظروف الاراضى الرملية

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ملخص

تم زراعه الفول البلدي (صنف سخا 1) منفردا ومحملا مع أربعه أصناف من قمح الخبز (جيزة 168 وسخا 94 و جميزه9 و سدس 1) في سبعه نظم زراعيه وذلك باستخدام نظام التحميل في سطور متبادلة (1:1) على مسافات 20سم بين

السطور. تمثلت النظم الزراعية في زراعه القمح بثلاث معدلات من التقاوي 300 و350 و400 حبه/م^2 زراعه منفردة وكذا محمله يالاضافه إلى زراعة الفول البلدي منفردا حيث تم تقييم هذه النظم الزراعية مع كل صنف من أصناف القمح . وقد تم استخدام الناتج المحصولي من القمح والفول البلدى (طن/هكتار) لتقدير المدلولات التنافسية بين المحصولين من خلال تقدير معد ل إنتاجيه الأرض الزراعية والعدوانية ومعامل الحشد النسبي بهدف تحديد أفضل معاملات التحميل تحت الدراسة والتي تؤدى إلى تعظيم الناتج المحصولي من وحده المساحة تحت ظروف الاراضى الرملية. أقيمت تجربتان حقليتان –بمحطة البحوث الزراعية بكلية الزراعة - جامعة دمنهور- بمنطقه البستان – محافظه البحيرة – جمهوريه مصر العربية خلال موسمي 2010/2009 و 2011/2010. و نفذت الدراسة في تصميم القطع المنشقة مرة واحدة بأربع مكررات حيث خصصت القطع الرئيسية لأصناف القمح الأربع بينما وزعت النظم الزراعية السبع عشوائيا على القطع الفرعية . ويمكن تلخيص أهم النتائج المتحصل عليها على النحو التالي:-

أظهرت النتائج أن معدل كفاءة إنتاجيه الأرض الزراعية لم يتأثر معنويا بأصناف القمح خلال موسمي الدراسة، في حين أن النظم الزراعية كان لها تأثيرا عالي المعنوية على معدل كفاءة إنتاجيه الأرض الزراعية في كلا موسمي الدراسة. فقد زادت قيمه معدل إنتاجيه الأرض الزراعية عن الوحدة (1.40)- كمتوسط لكلا موسمي الدراسة- مما يؤكد على حدوث تحقق ميزه محصوليه قدرها حوالي 40% نتيجة تحميل المحصولين معا (تحت ظروف الدراسة) مقارن ة بزراعة أي من المحصولين بصوره منفردة.

كانت قيم العدوانية معنوية بين أصناف القمح في الموسم الثاني من الدراسة وقد تميز الصنف سخا 94 بأنه أشد أصناف القمح الأربع عدوانيه في كلا موسمي الدراسة. كذلك أظهرت النتائج أن الفول البلدى كان هو المحصول السائد بينما كان القمح هو المحصول المسود في كلا موسمي الدراسة حيث كانت قيم العدوانية سالبه للقمح وموجبه للفول البلدى.

لم تصل الفروق بين أصناف القمح الأربع بالنسبة لصفه معامل الحشد النسبي إلى مستوى المعنوية في كلا موسمي الدراسة، وقد سجل الصنف جيزة 168 أعلى معامل حشد نسبى لمحصول القمح حال تحميله مع الفول البلدى في حين سجل الفول البلدى أقل معامل حشد نسبى له حال زراعته محملا مع الصنف سدس 1.

كان التفاعل بين أصناف القمح و النظم الزراعية معنويا فقط بالنسبة لصفة الإنتاجية النسبية لمحصول القمح (فى الموسم الأول).

وعموما فانه بناءا على نتائج هذه الدراسة تتضح أهميه التوصية بامكانيه زراعه أيا من أصناف القمح التى تم دراستها و ذلك بمعدل تقاوى 300 حبة/م^2 تحميلا مع الفول البلدي صنف سخا 1 بكثافة 166667 نبات/هكتار حال استخدام نظام التحميل في سطور متبادلة (1:1) على مسافات 20سم بين السطور حيث أعطى هذا التطبيق أفضل إنتاجيه محصوليه من وحده المساحة الارضيه تحت ظروف الدراسة وذلك في الاراضى الرملية بمنطقه البستان- بمحافظه البحيرة – جمهوريه مصر العربية.

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