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EFFECT OF INTERCROPPING OF SOME CHICKPEA VARIETIES WITH ONION UNDER UPPER EGYPT CONDITIONS

Abo EL-Hamd . A.S [1]; M.M Ibrahim[1]; N. A. E. Azzaz [2]; R.A Marey[3] and A.H A. Ibrahim[1]

[1]Dept of Agronomy, Fac. Agric., Al-Azhar Univ.,Assiut, Egypt.

[2]Dept of Chemistry, Fac. Agric., Damietta Univ., Damietta, Egypt.

ABSTRACT

Two field experiments was carried out under Sohag Governorate conditions during 2010/2011 and 2011/2012 seasons, to study the effect of intercropping three chickpea varieties with onion at four chickpea intercropping systems (onion+2 rows of chickpea, onion+3 rows of chickpea, onion+4 rows of chickpea, onion+5 rows of chickpea and chickpea alone), on yield and yield components of both crops.

The obtained results could be summarized as follows:

1- Tallest plants and highest No. of leaves/plant of onion were attained under intercropping with chickpea variety of Giza-4 while the lowest values were obtained under intercropping with chickpea variety Giza- 3, in both seasons.

2- Intercropping onion with five rows of chickpea gave the tallest plants and highest No. of leaves/plant of onion, while intercropping with two rows of chickpea gave the lowest values in both seasons.

3- Giza-3 variety achieved highest total yield/fed and marketable yield/fed of onion, while Giza-2 achieved the lowest values, in both seasons.

4- Intercropping onion with two rows of chickpea produced highest marketable yield/fed and total yield/fed. as compared to other intercropping system, while intercropping with five rows of chickpea produced the lowest values, in both seasons.

5- Giza-4 variety attained highest No. of branches/plant, No. of pods/plant, and seed yield/fed, while Giza-2 attained the lowest values, in both seasons.

6- Maximum seed yields/fed were observed by cultivating chickpea variety Giza-4 or Giza-3 in pure stand, in the first and second seasons, respectively.

7- The highest combination between the two factors in respect to LER was obtained under chickpea variety Giza-3 when intercropped with onion at system of three rows, in both seasons.

It could be stated that intercropping chickpes of Giza-3 variety with onion at three rows maximized seed yield per unit area under Sohag Governorate condition.

INTRODUCTION

Intercropping is considered to be one of the most important methods of agriculture intensification. Intercropping has gained interest because of potential advantages it offers over yielding, it is a way to achieving intensive utilization for both edaphic and climatic factors. The area that allocated for single onion production in Egypt in 2013 was 117178 fed, while the area that allocated for intercropped onion production in Egypt was 9114 fed as mentioned by the yearly book of Economics and Statistics of the Ministry of Agriculture. Many investigators studied the effect of intercropping with onion. Ghobashi and El-Aweel (1999) found that intercropping onions with chickpeas reduced onion yields by 29.0% in 1996/97. Changing from garlic to

onion production would increase profitability by 85.6%. El-Kalla *et al* (1999) grew faba beans and onions as pure stands or in some intercropping systems. They showed that yield of both crops was highest in pure stands. Land equivalent ratio was greater than 1 in all intercropping systems, and was highest (1.52) in the 2:4 faba bean : onion system. Mondal *et al.* (2004) assessed the feasibility of intercropping groundnut with onion. They cleared that monoculture produced the highest yields of individual crops. However, the highest land equivalent ratio (1.65) was obtained from the treatment with two rows of onion in between two rows of groundnut.

The area that allocated for chickpea production in Egypt was 1382 fed in 2013, as mentioned by the yearly book of Economics and Statistics of the Ministry of Agriculture, in Egypt. Moreover, the crop area is expected to decrease in the future because of strong competition with other winter crops occupied the land such as wheat, clover, onion, etc. Consequently, intercropping it with other main crops proved to be the opportunity for the crop expansion. Reddy and Mohammad (1992) found that mean chickpea yield was 1.14 t/ha in pure stands and 0.48-0.75 t in intercrops. Intercropped yield was highest in a 5:1 chickpea : safflower row proportion. Singh *et al.* (1992) cleared that chickpeas sown as a pure stand in single rows (30 cm) produced a mean seed yield of 1.42 t/ha compared with 2.15 t under paired rows (30/60 cm). Chickpeas + mustard (75+25% seed mixture) produced the highest chickpea equivalent yield of 3.20 t. El-Gergawi and Abou-Salama (1994) intercropped sugarcane G. T. 9/54 with chickpeas cv. Giza-2 or lentils cv. Giza-9 in a 1:1 or 1:2 row ratio. They found that intercropping reduced the yield (cane or seed) of the individual crops compared with sole cropping, however sugar yield/feddan was unaffected by intercropping. Land equivalent ratio was highest when sugarcane was intercropped with 2 rows of lentils. Kulmi and Chundawat (1997) found that sole crop of chickpea recorded the highest seed yield of 2591 kg/ha. Maximum reduction in yield of chickpea was noted in chickpeas + Brassica juncea (2:2), followed by chickpeas + wheat (2:2), while minimum reduction in yield was observed in chickpeas + safflower (8:2), followed by chickpeas + Linum usitatissimum (8:2). Ghobashi and El-Aweel (1999) intercropped onions or garlic with *faba bean* or chickpeas. They found that Intercropping onions with chickpeas had no effect on chickpea yields. When garlic and chickpeas were intercropped garlic yields were unaffected but chickpea yields fell by 36.2%. Kedar Prasad *et al.* (2000) cleared that intercropping of mustard with chickpea variety KWR-108 in 2:8 row ratio produced significantly higher grain yield of chickpea (26.76 q/ha). Higher chickpea equivalent yield of 35.56 q/ha with net profit of Rs. 35356/ha was recorded with this combination. The adverse effect of mustard on grain yield of chickpea varieties varied from 0.57 to 4.09%. Singh and Rathi (2003) found that nodule number, dry weight, grain yield, protein content and yield were higher in monocrop chickpea compared with intercropping. Among row ratios, except for protein content in grain, all the above parameters were significantly higher in the 4:1 intercropping of chickpea + mustard. Kedar Prasad *et al* (2006) cleared that intercropping of mustard cultivars with chickpea reduced the grain yield of chickpea to the extent of 10.15, 9.40, 5.01, 5.50, 9.44, 5.05 and 8.31% with Varuna, Vaibhav,

Urvashi, Kanti, Vardan, Basanti and Rohini, respectively. Banik *et al* (2006) cleared that Chickpea yield was significantly reduced by wheat when intercropped. However, total productivity and land use efficiency were higher under the intercropping system as compared to monocrops of either species. Govind Kumar and Ravi Nandan (2007) intercropped chickpea and mustard to find out appropriate spatial row arrangement of component crops for yield potential and land utilization. They reported that Among various intercropping systems, the highest chickpea equivalent yield were obtained at 6:1 row ratio. So, it is possibly to plant chickpea intercropped with onion, as this leads to an increase in the total production; also it benefits soils due to the role of legume crops in fixation of atmospheric nitrogen in soils. This study was mainly carried out to determine the best intercropping system which gives the highest yield, quality for the two crops.

MATERIALS AND METHODS

This study was carried out at special farm at El-Monshah city - Sohag Governorate (Upper Egypt) during 2010/2011 and 2011/2012 seasons. The objective of this study was aimed to investigate the response of three chickpea (*Cicer arietinum* L.) varieties to intercropping with onion (*Allium cepa* L.) under intercropping systems in relation to yield and yield components of both crops and the advantages for this intercropping. A split plot design with three replicates was used. The main plots were devoted to three chickpea varieties i.e. Giza-2, Giza-3 and Giza-4, whereas, the sub plots were allocated for intercropping treatments of chickpea with onion i.e, onion + two rows chickpea, onion + three rows of chickpea, onion + four rows of onion, onion + five rows of onion and chickpea alone. In addition to onion alone as a control under intercropping onion was transplanted on the two sides of the terrace, while chickpea was planted on the deck of terrace. The area sub plot was 10.8 m^2 with 3.6 m long and 3 m wide, consisting of three terrace 120 cm wide. In both seasons onion was transplanting in the first week of November and chickpea seeds were sown in the same time. The cultivar Giza-6 Mohassan of onion was used in this investigation. All cultural practices concerning onion and chickpea production were followed as recommended in the area.

The measured data were as follows:

A- Onion characteristics:

After 120 days from transplanting, ten guarded plants were selected randomly from each plot to measure plant height (cm), number of leaves/plant and bulb diameter (cm). While at harvest the measured characters were total yield (ton/fed), marketable yield (ton/fed), culls yield (ton/fed), percentage of double bulbs, percentage of bolters and percentage of total soluble solids (T.S.S) by using a hand refractometer,.

B- Chickpea characters:

The measured characters were, plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pods, 100-seeds weight (g), straw yield (ton/fed), seed yield (ardab/fed), protein% which

determined by Kjeldahl apparatus as described by A.O.A.C. (1970) and Protein yield (kg/fed) which calculated according to the following equation: Protein yield = seed yield x protein%.

C- Land equivalent ratio (LER):

LER is determined as the sum of the fractions of the yield of intercrops relative to their sole crop yield (Willey and Osiru 1972) as follow: LER = Yoc/Yoo +Yco/Ycc

Where: Yoo is pure stand yield of onion, Ycc is pure stand yield of chickpea, Yoc is mixture yield of onion (when combined with chickpea) and Yco yield of chickpea (when combined with onion).

Statistical analysis:

The collected data were subjected to proper statistical analysis of split plot design according to the procedure outlined by Snedecor and Cochran (1980). Means were compared using the L.S.D. at 5% level of significance according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A- Effect of chickpea varieties and intercropping treatments on onion characteristics.

1-Plant height (cm):

Results in Table (1) showed that chickpea varieties significantly affected on plant height of onion plant in both seasons. Tallest plants were obtained by intercropping onion with chickpea variety Giza-4, while the shortest plants were obtained by intercropping with chickpea variety Giza-3, in the two seasons. Intercropping treatments had significant effect on plant height of onion, in the two seasons. Intercropping five rows of chickpea with onion appeared the tallest plants of onion followed by intercropping with four rows, whereas the shortest plants appeared by intercropping with two rows, in both seasons. These results might be due to the increase in plant density of chickpea which resulted in more competition for light which caused an increase in elongation of the plant. Plant height of onion was significantly affected by the interaction between the two factors in the first seasons only. The highest combination for plant height was obtained by intercropping onion by chickpea variety Giza-4 under density of four rows, while the lowest combination was obtained by intercropping chickpea variety Giza-3 under system of two rows, in both seasons.

2- No. of leaves/plant:

The results in Table (1) showed that No. of leaves/plant of onion was significantly affected by chickpea varieties in the second seasons only. Highest No. of leaves/plant were attained under intercropping with chickpea variety of Giza-4 while the lowest values were obtained under intercropping with chickpea variety Giza-3. This reflect the differences between chickpea varieties in their growth nature and in turn in their effect on onion plants growth. Intercropping treatments affected significantly on No. of leaves/plant in the first season, respectively. Intercropping onion with five rows of chickpea gave the highest No. of leaves/plant, while intercropping with two

rows of chickpea gave the lowest values, in the two seasons. The interaction between the two factors affected significantly on No. of leaves/plant in the first seasons only. In the first season the highest values of No. of leaves/plant were obtained by intercropping chickpea variety Giza- 2 or Giza-4 under density of five rows of chickpea. While in the second seasons the highest value was obtained by intercropping chickpea variety Giza-4 under system of three rows.

Table (1): Effect of chickpea varieties and intercropping treatments on plant height (cm), No. of leaves/plant and bulb diameter (cm) of onion during 2010/2011 and 2011/2012 seasons.

Chickpea varieties	Intercropping systems	2010/2011			2011/2012		
		Plant height (cm)	No. of leaves/ plant	Bulb diameter (cm)	Plant height (cm)	No. of leaves/ plant	Bulb diameter (cm)
Giza- 2	Onion+2 rows chickpea	68.57	7.90	6.78	65.80	7.87	6.56
	Onion+3 rows chickpea	67.20	8.20	6.75	68.13	8.37	6.39
	Onion+4 rows chickpea	68.33	8.67	6.43	68.67	8.40	6.35
	Onion+5 rows chickpea	68.33	8.93	6.39	68.80	8.57	6.34
Mean		68.11	8.43	6.59	67.85	8.30	6.41
Giza- 3	Onion+2 rows chickpea	65.70	8.20	7.10	65.27	8.07	6.85
	Onion+3 rows chickpea	67.20	8.23	6.79	66.93	7.90	6.83
	Onion+4 rows chickpea	68.87	8.10	6.81	66.87	8.20	6.51
	Onion+5 rows chickpea	66.53	8.57	6.54	67.13	8.23	6.63
Mean		67.08	8.28	6.81	66.55	8.10	6.71
Giza- 4	Onion+2 rows chickpea	66.77	8.83	6.90	68.07	9.00	6.84
	Onion+3 rows chickpea	69.40	8.80	6.59	67.20	9.37	6.51
	Onion+4 rows chickpea	67.60	8.73	6.61	67.93	9.13	6.59
	Onion+5 rows chickpea	72.20	8.93	6.34	69.33	9.17	6.43
Mean		68.99	8.83	6.61	68.13	9.17	6.60
Intercrop. treatm. mean	Onion+2 rows chickpea	67.01	8.31	6.92	66.38	8.31	6.75
	Onion+3 rows chickpea	67.93	8.41	6.71	67.42	8.54	6.58
	Onion+4 rows chickpea	68.27	8.50	6.62	67.82	8.58	6.48
	Onion+5 rows chickpea	69.02	8.81	6.42	68.42	8.66	6.47
Onion alone		67.40	8.33	6.59	67.93	8.43	6.45
L.S.D. 5%	Chickpea varieties (A)	1.24	N.S	N.S	1.17	0.53	0.08
	Intercrop. treatments(B)	1.08	0.22	0.29	1.32	N.S	0.19
	Interaction (A x B)	1.87	0.39	N.S	N.S	N.S	N.S

3- Bulb diameter (cm):

The results in Table (1) showed that bulb diameter was significantly affected by the different chickpea varieties in the second seasons only. The onion bulbs which intercropped with chickpea variety Giza- 3 appeared the highest values of bulb diameter as compared to the other two varieties. While onion bulbs intercropped with chickpea variety Giza- 2 appeared the lowest values. Intercropping treatment affected significantly on bulb diameter in the two seasons. The effect of intercropping on onion bulb characters was reported with by Baniful and Mochiah (2012) who found that there was significant reduction in the bulb size of the intercropped onion with okra.

Bulbs diameter were insignificantly affected by the interaction between chickpea varieties and intercropping treatments, in the two seasons.

4- Total yield (ton/fed):

Data in Table (2) illustrated that intercropped chickpea varieties affected significantly on total yield/fed of onion in both seasons. Giza-3 variety achieved the highest values of total yield/fed (9.46 and 9.17 ton), while Giza-2 achieved the lowest values (8.20 and 7.54 ton), in the first and second seasons, respectively. These results may be explained in view of the less competition between chickpea variety Giza-3 and onion as compared to other two varieties. Intercropping treatments had significant effect on total yield/fed in the two seasons. Intercropping of chickpea with onion greatly decreased total yield/fed of onion, in both seasons, these results were in agreement with that recorded by Ghobashi and El-Aweel (1999) who found that intercropped onions or garlic with *faba bean* or chickpeas. They found that intercropping onions with chickpeas reduced onion yields by 29.0% in 1996/97, and by Mondal *et al* (2004) who cleared that monoculture produced the highest yields of individual crops. However (onion and groundnut). Among the intercropping treatments, intercropping onion with two rows of chickpea produced the highest values of total yield/fed (9.24 and 8.76 ton), while intercropping with five rows of chickpea produced the lowest values (7.97 and 7.58 ton), in the first and second seasons, respectively. These results may be attributed the less competition between chickpea and onion under low density of chickpea as compared to other densities. The effect of the interaction between chickpea varieties and intercropping treatments on total yield/fed of onion was insignificant.

5- Marketable yield/(ton/fed):

The results in Table (2) revealed that marketable yield/fed of onion was significantly affected by the different chickpea varieties in the second season only. Intercropping with chickpea variety Giza-3 appeared the highest values of marketable yield/fed, while Giza-2 variety appeared the lowest values, in both seasons, respectively. Intercropping treatments had significant effect on marketable yield/fed in both seasons. Intercropping onion with two rows of chickpea produced the greatest values of marketable yield/fed as compared to the other intercropping treatments, while intercropping with five rows of chickpea produced the smallest values, in both seasons. Planting onion in pure stand exceeded all intercropping treatments in respect to marketable yield/fed in the two seasons. Marketable yield/fed was insignificantly affected by the interaction between the two factors in both seasons.

6- Culls yield (ton/fed):

Results presented in Table (2) showed that culls yield/fed were significantly affected by different chickpea varieties in both seasons. The lowest values of culls yield/fed were obtained by planting chickpea variety Giza-2 or Giza-4 (with the some value) in the first seasons, while the lowest value in the second season was obtained by intercropping with chickpea variety Giza-2. The highest values were obtained by intercropping with chickpea variety Giza-3 in both seasons. Intercropping treatments affected significantly on culls yield/fed in both seasons. The lowest values of culls yield/fed were attained by intercropping onion with five or four rows of

chickpea, in the first and second seasons, respectively. While, the highest values of culls/fed were obtained by intercropping onion with two or three rows of chickpea, in the first and second seasons, respectively. The lowest values of culls yield under high system of intercropped chickpea is mainly due to the lowest total yield under high system as compared to low density. The interaction between chickpea variety and intercropping treatments had significant effect on culls yield/fed in the second season only, respectively. In the first season the lowest value were obtained by intercropping onion with chickpea variety Giza-4 under density of five rows of chickpea, while the highest value was obtained by intercropping onion with chickpea variety Giza-3 under density of two rows of chickpea. While in the second seasons, the lowest value was obtained by intercropping onion with chickpea variety Giza-2 under system of two or four rows of chickpea, or by intercropping with chickpea variety Giza-4 under system of four rows of chickpea.

Table (2): Effect of chickpea varieties and intercropping treatments on total yield (ton/fed) marketable yield (ton/fed) and culls yield (ton/fed) of onion during 2010/2011 and 2011/2012 seasons.

Chickpea varieties	Intercropping systems	2010/2011			2011/2012		
		Total yield (ton/fed)	Market. yield (ton/fed)	Culls yield (ton/fed)	Total yield (ton/fed)	Market. yield (ton/fed)	Culls yield (ton/fed)
Giza- 2	Onion+2rows chickpea	8.56	7.35	1.21	8.15	7.22	0.93
	Onion+3rows chickpea	8.72	7.50	1.22	7.66	6.12	1.54
	Onion+4rows chickpea	8.06	6.83	1.23	7.28	6.35	0.93
	Onion+5rows chickpea	7.45	6.25	1.20	7.07	6.10	0.97
Mean		8.20	6.98	1.22	7.54	6.45	1.09
Giza -3	Onion+2rows chickpea	9.93	7.74	2.19	9.78	7.97	1.82
	Onion+3rows chickpea	9.88	7.77	2.10	9.80	7.94	1.86
	Onion+4rows chickpea	9.24	7.16	2.07	8.39	6.64	1.75
	Onion+5rows chickpea	8.80	6.79	2.00	8.69	6.87	1.82
Mean		9.46	7.37	2.09	9.17	7.36	1.81
Giza- 4	Onion+2rows chickpea	9.24	7.92	1.32	8.34	7.28	1.06
	Onion+3rows chickpea	8.70	7.45	1.25	8.38	6.46	1.92
	Onion+4rows chickpea	8.68	7.49	1.19	7.17	6.23	0.93
	Onion+5rows chickpea	7.65	6.52	1.13	6.99	6.05	0.94
Mean		8.57	7.35	1.22	7.72	6.51	1.21
Intercrop. treatm. means	Onion+2rows chickpea	9.24	7.67	1.57	8.76	7.49	1.27
	Onion+3rows chickpea	9.10	7.57	1.53	8.61	6.84	1.77
	Onion+4rows chickpea	8.66	7.16	1.50	7.61	6.41	1.21
	Onion+5rows chickpea	7.97	6.52	1.45	7.58	6.34	1.24
Onion alone		12.48	8.68	3.80	13.18	9.24	3.94
L.S.D. 5%	Chickpea varieties (A)	0.36	N.S	0.04	0.54	0.45	0.20
	Intercrop. treatments(B)	0.33	0.31	0.08	0.82	0.83	0.14
	Interaction (A x B)	N.S	N.S	N.S	N.S	N.S	0.25

7- Double bulbs%:

Results showed in Table (3) cleared that double bulbs% of onion bulbs were significantly affected by chickpea varieties, in the first season only. Intercropping with Giza-4 variety of chickpea appeared the lowest values of double bulbs%, while intercropping with Giza-3 variety appeared the highest values, in the two seasons. Intercropping treatments had significant effect on double bulbs%, in both seasons. Double bulbs% were decreased by

increasing number of chickpea rows which intercropped with onion, in the two seasons. It is clear that the interaction effect of chickpea varieties and intercropping treatments were not great enough to reach the level of insignificance in both seasons.

8- Bolters%:

The available results in Table (3) indicated significant differences between the three chickpea varieties in respect to bolters% of onion bulbs, in the first season only. Intercropping with chickpea variety Giza-4 gave the lowest values of bolters, while intercropping Giza-3 gave the highest values, in both seasons. The differences among mean values of bolters% as affected by intercropping treatments were significant, in both seasons. Intercropping onion with five rows of chickpea appeared the lowest values of bolters%, while, intercropping onion with two rows of chickpea appeared the highest values, in the first and second seasons, respectively. Regarding the interaction effect on bolters%, it could be noticed that this character was insignificantly affected by the interaction between the two factors.

Table (3): Effect of chickpea varieties and intercropping treatments on double bulbs%, bolters% and TSS% of onion during 2010/2011 and 2011/2012 seasons.

Chickpea varieties	Intercropping systems	2010/2011			2011/2012		
		Double bulbs%	Bolters %	TSS%	Double bulbs%	Bolters %	TSS%
Giza- 2	Onion+2rows chickpea	3.71	3.46	13.93	1.79	4.15	13.67
	Onion+3rows chickpea	3.64	3.40	13.77	0.90	4.38	13.93
	Onion+4rows chickpea	3.86	3.27	15.03	1.46	3.01	14.00
	Onion+5rows chickpea	3.23	2.63	15.37	1.65	3.12	16.07
Mean		3.61	3.19	14.53	1.45	3.66	14.42
Giza- 3	Onion+2rows chickpea	4.31	3.98	14.77	2.15	4.85	13.00
	Onion + 3 rows chickpea	4.13	3.81	14.27	1.93	4.85	13.27
	Onion + 4 rows chickpea	3.94	3.61	14.53	1.20	3.54	15.00
	Onion + 5 rows chickpea	3.12	3.14	13.87	1.12	4.06	14.07
Mean		3.88	3.63	14.36	1.60	4.33	13.83
Giza- 4	Onion + 2 rows chickpea	3.71	3.45	13.50	2.44	4.55	13.70
	Onion + 3 rows chickpea	3.73	3.29	14.67	1.03	3.41	13.97
	Onion + 4 rows chickpea	2.98	3.07	15.27	0.94	3.70	15.70
	Onion + 5 rows chickpea	1.83	2.43	16.27	0.52	2.93	14.77
Mean		3.07	3.06	14.93	1.23	3.65	14.53
Intercrop. treatm. means	Onion + 2 rows chickpea	3.91	3.63	14.07	2.12	4.52	13.46
	Onion + 3 rows chickpea	3.84	3.50	14.23	1.29	4.21	13.72
	Onion + 4 rows chickpea	3.59	3.32	14.94	1.20	3.42	14.90
	Onion + 5 rows chickpea	2.73	2.73	15.17	1.10	3.37	14.97
Onion alone		3.82	3.82	14.67	3.84	4.17	14.67
L.S.D. 5%	Chickpea varieties (A)	0.44	0.26	0.38	N.S	N.S	0.19
	Intercrop. treatments(B)	0.52	0.53	0.58	0.69	0.68	0.67
	Interaction (A x B)	N.S	N.S	1.00	N.S	N.S	1.16

9- TSS%:

Results in Table (3) indicated significant differences among the studied chickpea varieties in both seasons. Intercropping onion with chickpea variety Giza-4 exhibited the highest values of TSS% of onion as compared to the other two varieties, while Giza-3 variety exhibited the lowest values, in the two seasons. Data also revealed that TSS% of onion bulbs was significantly affected by intercropping treatments, in both seasons. TSS% values were

increased by increasing the number of rows of chickpea which intercropped with onion from two to five rows, in both seasons. The interaction effect on TSS% was significant in both seasons. The highest combinations in respect to TSS% were obtained when intercropping onion with chickpea variety Giza 4 or Giza-2 under density of five rows of chickpea, in the first and second seasons, respectively. While the lowest combinations were obtained when intercropping onion with chickpea variety Giza-4 or Giza-3 under system of two rows, in the first and second seasons, respectively.

B- Effect of chickpea varieties and intercropping treatments on chickpea characteristics.

1- Plant height (cm):

The results in Table (4) reveal that chickpea cultivars differed significantly in respect to plant height, in both seasons. Giza-3 variety appeared the tallest plants, while variety Giza-2 appeared the shortest plants, in both seasons. The differences between studied chickpea genotypes in plant height may be due to the genetic variation between them. These results were in partial agreement with the findings of Kassab *et al* (2012). The results reveal a significant difference in plant height due to intercropping treatments in both seasons. Plant height of chickpea was increased by increasing the density of intercropped chickpea rows. The tallest plants were noticed by intercropping five rows with chickpea, while the shortest plants were noticed by intercropping two rows of chickpea in both seasons. These results may be due to that the increase in chickpea plants density resulted in more competition for light and consequently caused an increase in elongation of stem internodes. The results clear that the plant height was insignificantly affected by this interaction in both seasons.

2- No of branches/plant:

Results presented in Table (4) indicated that chickpea varieties differed significantly in No of branches/plant in both seasons. Giza 4 variety attained the highest values of No. of branches/plant, while Giza 2 attained the lowest values, in both seasons. The differences between chickpea genotypes in respect to No. of branches/plant were reported by Vaghar *et al* (2013) and Ahmed *et al* (2013). The effect of intercropping treatments was significant in both seasons. The highest values of No. of branches/plant were obtained by intercropping two rows of chickpea, in the first and second seasons, respectively. While the lowest values were obtained under pure stand or by intercropping five rows of chickpea with onion, in the first and second seasons, respectively. The highest values of No. of branches/plant for chickpea plants under low system (two rows) may be attributed to the low competition between chickpea plants under this system. These results were in accordance with that obtained by Shamsi (2010). No. of branches/plant were significantly affected by the interaction between the two studied factors in the first season only. The maximum values of No. of branches/plant were observed when chickpea variety Giza-4 was intercropped with onion at system of three rows or two rows, in the first and second seasons respectively. The minimum values were obtained by cultivating of chickpea variety Giza-2 in association with onion at density of five rows, or under pure stand condition, in first and second seasons, respectively.

Table (4): Effect of chickpea varieties and intercropping treatments on plant height (cm), No. of branches/plant and No. of pods/plant of chickpea plant during 2010/2011and 2011\2012 seasons.

Chickpea varieties	Intercropping systems	2010/2011			2011/2012		
		Plant height (cm)	No. of branches/ plant	No. of pods/ plant	Plant height (cm)	No. of branches/ plant	No.of pods/ plant
Giza- 2	Onion + 2 rows chickpea	79.87	5.33	180.67	80.67	6.27	183.73
	Onion + 3 rows chickpea	81.33	5.07	180.53	80.33	5.50	177.87
	Onion + 4 rows chickpea	81.33	4.73	181.47	81.40	4.93	173.80
	Onion + 5 rows chickpea	82.73	4.27	173.73	83.93	5.00	174.87
	Chickpea alone	80.13	4.67	174.27	82.67	4.87	175.40
Mean		81.08	4.81	178.13	81.80	5.31	177.13
Giza- 3	Onion + 2 rows chickpea	85.13	6.53	188.00	84.60	6.80	185.93
	Onion + 3 rows chickpea	85.87	6.27	181.27	86.07	6.43	181.13
	Onion + 4 rows chickpea	85.93	6.07	180.27	84.93	6.27	182.53
	Onion + 5 rows chickpea	87.53	5.40	179.93	86.40	6.07	180.13
	Chickpea alone	86.67	5.20	181.33	86.20	6.33	176.00
Mean		86.23	5.89	182.16	85.64	6.38	181.15
Giza- 4	Onion + 2 rows chickpea	82.53	7.00	187.73	83.20	7.40	187.40
	Onion + 3 rows chickpea	83.07	7.07	191.00	83.33	6.70	183.93
	Onion + 4 rows chickpea	84.33	6.80	184.87	83.73	6.73	180.87
	Onion + 5 rows chickpea	86.53	6.27	180.93	86.87	6.07	178.87
	Chickpea alone	81.27	5.93	182.53	85.33	6.47	185.20
Mean		83.55	6.61	185.41	84.49	6.67	183.25
Intercrop. treatm. means	Onion + 2 rows chickpea	82.51	6.29	185.47	82.82	6.82	185.69
	Onion + 3 rows chickpea	83.42	6.13	184.27	83.24	6.21	180.98
	Onion + 4 rows chickpea	83.87	5.87	182.20	83.36	5.98	179.07
	Onion + 5 rows chickpea	85.60	5.31	178.20	85.73	5.71	177.96
	Chickpea alone	82.69	5.27	179.38	84.73	5.89	178.87
L.S.D. 5%	Chickpea varieties (A)	2.88	0.33	3.30	1.63	0.29	3.98
	Intercrop. treatments(B)	1.30	0.21	4.69	1.42	0.32	4.24
	Interaction (A x B)	N.S	0.37	N.S	N.S	N.S	N.S

3- No. of pod/plant:

Results presented in Table (4) revealed that No. of pods/plant were significantly affected by the different chickpea varieties, in both seasons. Giza-4 variety exhibits the highest values of No. of pods/plant, while Giza-2 exhibit the lowest values in both seasons. The differences between chickpea varieties in respect to No. of pod/plant were recorded by Gollojeh and Ranjbar (2012), Kassab *et al* (2012) and Vaghar *et al.* (2013). Data also reveal to a significant difference in No. of pods/plant in response to intercropping treatments in both seasons. Intercropping two row of chickpea with onion gave the highest values of No. of pods/plant followed by intercropping with three rows of chickpea, while intercropping five rows gave the lowest values, in the two seasons. Similar results were obtained by Shamsi *et al.* (2011). No. of pods/plant were insignificantly affected by the interaction between the two factors in the two seasons.

4- No of seeds/pod:

Results in Table (5), it could be concluded that there a significant differences between the chickpea varieties in No. of seeds/pod in both

seasons. Giza-4 variety attained the greatest values of No. of pods/plant, while Giza-2 attained the smallest values in both seasons. The differences between chickpea genotypes in respect to No. of branches/plant were reported by Vaghar *et al.* (2013) and Thangwana and Ogola (2012). Intercropping treatments had significant effect on No. of seeds/pod in the two seasons. The highest means of No. of seeds/pod were obtained when intercropping onion with two rows of chickpea, followed by intercropping with three rows, while the lowest values were obtained when intercropping with five rows, in the two seasons. The results reveal that No. of seeds/pod were not significantly affected by the interaction between the studied factors in both seasons.

Table (5): Effect of chickpea varieties and intercropping treatments on No. of seeds/pod, 100-seeds weight (g)/plant and straw yield/fed of chickpea plant during 2010/2011and 2011\2012 seasons.

Chickpea varieties	Intercropping treatments	2010/2011			2010/2011		
		No. of seeds / pod	100-seed weight (g)	Straw yield (t/fed)	No. of seeds / pod	100-seed weight (g)	Straw yield (t/fed)
Giza- 2	Onion + 2 rows chickpea	1.63	23.00	0.713	1.77	20.27	0.853
	Onion + 3 rows chickpea	1.60	21.67	0.802	1.60	20.00	0.917
	Onion + 4 rows chickpea	1.53	18.63	0.844	1.57	20.00	0.985
	Onion + 5 rows chickpea	1.47	20.67	0.879	1.53	19.83	0.984
	Chickpea alone	1.40	20.00	1.352	1.47	18.60	1.483
Mean		1.53	20.79	0.918	1.59	19.74	1.044
Giza- 3	Onion + 2 rows chickpea	1.77	23.33	0.684	1.73	22.60	0.686
	Onion + 3 rows chickpea	1.70	22.67	0.760	1.60	21.00	0.699
	Onion + 4 rows chickpea	1.60	21.97	0.801	1.57	20.33	0.807
	Onion + 5 rows chickpea	1.57	21.33	0.850	1.60	19.83	0.813
	Chickpea alone	1.63	21.00	1.343	1.67	19.93	1.431
Mean		1.65	22.06	0.888	1.63	20.74	0.887
Giza- 4	Onion + 2 rows chickpea	1.87	25.00	0.714	1.87	24.93	0.881
	Onion + 3 rows chickpea	1.83	25.00	0.828	1.70	23.33	0.921
	Onion + 4 rows chickpea	1.70	24.97	0.853	1.73	23.00	0.934
	Onion + 5 rows chickpea	1.67	23.00	0.921	1.60	22.50	0.981
	Chickpea alone	1.70	23.67	1.420	1.67	23.27	1.577
Mean		1.75	24.33	0.947	1.71	23.41	1.059
Intercrop. treatm. means	Onion + 2 rows chickpea	1.76	23.78	0.704	1.79	22.60	0.806
	Onion + 3 rows chickpea	1.71	23.11	0.797	1.63	21.44	0.846
	Onion + 4 rows chickpea	1.61	21.86	0.833	1.62	21.11	0.909
	Onion + 5 rows chickpea	1.57	21.67	0.883	1.58	20.72	0.926
	Chickpea alone	1.58	21.56	1.372	1.60	20.60	1.497
L.S.D. 5%	Chickpea varieties (A)	0.06	1.41	0.028	0.09	1.60	0.029
	Intercrop. treatments(B)	0.10	1.08	0.034	0.09	1.36	0.210
	Interaction (A x B)	N.S	N.S	N.S	N.S	N.S	N.S

5- 100-seeds weight (g):

It is obvious from Table (5) that the differences between means of 100 seed weight of the three chickpea varieties were significant in both seasons. Giza-4 variety achieved the highest values of 100-seed weight, while Giza-2 variety achieved the lowest values, in both seasons. The differences between

studied chickpea varieties in 100- seeds weight may be due to the genetic variation between them. This results were in accordance with that found by El-Habbasha *et al.* (2012). The results show that 100-seed weight was significantly affected by the intercropping treatments in both seasons. Intercropped chickpea plants appeared an increase in 100-seed weight as compared to pure stand plants. This increase decreased by increasing the number of intercropped rows of chickpea. These results were true in both seasons. These results were in line with that obtained by Shamsi *et al.* (2011). 100-seed weight was insignificantly affected by the interaction between chickpea varieties and intercropping treatments in the two seasons.

6- Straw yield (ton/fed):

Results presented in Table (5) show that straw yield was significantly affected by different chickpea varieties in both seasons. The greatest values of straw yield/fed were obtained by cultivating chickpea variety Giza-4, while the smallest values were obtained by cultivating chickpea variety Giza-3 in the two seasons. Straw yield/fed, of chickpea was significantly affected by intercropping treatments in the two seasons. Cultivating chickpea on pure stand resulted in the highest values of straw yield/fed, while intercropping with two rows resulted in the lowest values, in both seasons. Straw yield/fed were insignificantly affected by the interaction between chickpea varieties and intercropping treatments in both seasons.

7- Seed yield (ton/fed):

Results presented in Table (6) show that seed yield/fed was significantly affected by different chickpea varieties in both seasons. Giza 4 variety appeared the maximum values of seed yield/fed, while Giza 2 variety appeared the lowest values, in both seasons. The differences between studied chickpea varieties in No. of branches/plant may be due to the genetic variation between them. The differences between chickpea genotypes in respect to seed yield/fed were reported by many investigators (Shamsi *et al.* 2011, Thangwana and Ogola 2012 and Vaghar *et al.* 2013). Seed yield/fed was significantly affected by intercropping treatments in the two seasons. Intercropping resulted in a decrease in seed yield/fed as compared to pure stand of chickpea. These decrements were 44.86 and 44.50% for intercropping two rows of chickpea, 37.06 and 36.68% for intercropping three rows, 30.50 and 29.98% for intercropping four rows and 32.98 and 31.39% for intercropping five rows, in the first and second seasons, respectively. These results revealed that the increase in No. of branches /plant, No. of pods/plant. No of seeds/pods and 100-seed weight of chickpea under low density could not compensate the effect of the reduction in number of plants/fed. in respect to root yield/fed. These results were in agreement with that reported by Kulmi and Chundawat (1997) and Shamsi (2010). Seed yield/fed was insignificantly affected by the interaction between the two factors in the two seasons.

8- Protein%:

Results in Table (6) revealed that protein % of chickpea seeds were significantly affected by the different chickpea varieties in the two seasons, Giza-3 variety appeared the highest values of protein%, while Giza-4 variety appeared the lowest values, in the two seasons. Protein% was significantly

affected by intercropping treatments, in both seasons. Cultivating chickpea in pure stand appeared the highest values of protein% as compared to intercropping treatments with onion under intercropping treatments, intercropping five rows of chickpea attained the highest values of protein%, while intercropping with two rows appeared the lowest values, in the two seasons. The interaction effect between the chickpea varieties and intercropping treatments were significant in both seasons. Cultivating chickpea variety Giza-3 and intercropping under system of four rows were the best combination in respect to protein%, while intercropping chickpea variety Giza-4 at density of four or three rows were the worst combinations, in the first and second seasons, respectively.

Table (6): Effect of chickpea varieties and intercropping systems on seed yield/fed, protein% and protein yield/fed of chickpea during 2010/2011 and 2011/2012 seasons.

Chickpea varieties	Intercropping systems	2010/2011			2011/2012		
		Seed yield (ardab /fed)	Protein %	Protein yield (kg/fed)	Seed yield (ardab /fed)	Protein %	Protein yield (kg/fed)
Giza- 2	Onion + 2 rows chickpea	3.02	19.85	90.04	3.01	19.40	87.54
	Onion + 3 rows chickpea	3.49	19.91	104.09	3.52	19.30	102.03
	Onion + 4 rows chickpea	3.78	20.72	117.43	3.83	20.30	116.71
	Onion + 5 rows chickpea	3.69	20.45	113.16	3.72	20.05	112.01
	Chickpea alone	5.33	21.18	169.34	5.50	20.75	171.16
Mean		3.86	20.42	118.81	3.92	19.96	117.89
Giza- 3	Onion + 2 rows chickpea	3.09	19.64	91.03	3.19	20.05	95.87
	Onion + 3 rows chickpea	3.54	20.74	110.19	3.50	21.24	111.39
	Onion + 4 rows chickpea	3.94	21.33	126.09	4.04	21.85	132.34
	Onion + 5 rows chickpea	3.80	21.33	121.47	3.94	21.81	128.89
	Chickpea alone	5.73	21.23	182.52	5.76	21.65	187.04
Mean		4.02	20.86	126.26	4.08	21.32	131.10
Giza- 4	Onion + 2 rows chickpea	3.22	18.77	90.59	3.19	19.22	91.92
	Onion + 3 rows chickpea	3.62	18.73	101.64	3.74	19.08	107.00
	Onion + 4 rows chickpea	4.03	18.63	112.56	4.05	19.20	116.77
	Onion + 5 rows chickpea	3.86	19.33	111.89	4.01	19.95	119.93
	Chickpea alone	5.86	19.82	174.05	5.74	20.36	175.28
Mean		4.12	19.06	118.15	4.15	19.56	122.18
Intercrop. treatm. means	Onion + 2 rows chickpea	3.11	19.42	90.56	3.13	19.56	91.78
	Onion + 3 rows chickpea	3.55	19.79	105.31	3.59	19.87	106.81
	Onion + 4 rows chickpea	3.92	20.23	118.69	3.97	20.45	121.94
	Onion + 5 rows chickpea	3.78	20.37	115.51	3.89	20.60	120.28
	Chickpea alone	5.64	20.74	175.30	5.67	20.92	177.83
L.S.D. 5%	Chickpea varieties (A)	0.08	0.09	3.02	0.15	0.20	5.61
	Intercrop. treatments(B)	0.12	0.20	3.92	0.13	0.18	4.03
	Interaction (A x B)	N.S	0.34	N.S	N.S	0.30	N.S

9- Protein yield/fed. (kg):

The results in Table (6) revealed that chickpea varieties affected significantly on protein yield/fed of chickpea, in both seasons. Chickpea variety Giza-3 gave the highest values of protein yield/fed as compared to the other two varieties, While Giza-4 and Giza-2 gave the lowest values, in the two seasons. Protein yield/fed was significantly affected by intercropping

treatments in both seasons. Planting chickpeas in pure stand produced the highest values of protein yield/fed; while the lowest values were produced by intercropping by two rows, in the two seasons. The effect of the interaction between chickpea varieties and intercropping treatments were insignificant in both seasons.

C- Land Equivalent Ratio (LER):

Land equivalent ratio (LER) values were greater than one by intercropping onion with different chickpea varieties at different densities. The highest LER values were observed under chickpea variety Giza-3, while the lowest values were obtained under chickpea variety Giza-2, these results were true in both seasons. The highest values of LER were observed when intercropping onion with four or three rows of chickpea, in the first and second seasons, respectively. The lowest values were observed when intercropping with two rows of chickpea in both seasons. These results were in accordance with that found by El-Kalla *et al* (1999) who reported that LER was greater than 1 in all intercropping systems and was highest (1.52) in the 2:4 faba bean : onion system.

The highest combination between the two factors in respect to LER was obtained under chickpea variety Giza-3 when intercropped with onion at density of three rows, in both seasons. The lowest one was obtained under chickpea variety Giza-2 when intercropped at density of two rows, in both seasons.

Table (7): Effect of chickpea varieties and intercropping systems on Land Equivalent Ratio (LER) during 2010/2011 and 2011/2012 seasons.

Chickpea varieties	Intercropping systems	2010/2011			2011/2012		
		RY onion	RY chickpea	L.E.R	RY onion	RY chickpea	L.E.R
Giza- 2	Onion + 2 rows chickpea	0.69	0.57	1.25	0.62	0.55	1.17
	Onion + 3 rows chickpea	0.70	0.65	1.35	0.58	0.64	1.22
	Onion + 4 rows chickpea	0.65	0.71	1.36	0.55	0.70	1.25
	Onion + 5 rows chickpea	0.60	0.69	1.29	0.54	0.68	1.21
Mean		0.66	0.66	1.31	0.57	0.64	1.21
Giza- 3	Onion + 2 rows chickpea	0.80	0.54	1.33	0.74	0.55	1.30
	Onion + 3 rows chickpea	0.79	0.62	1.41	0.74	0.61	1.35
	Onion + 4 rows chickpea	0.74	0.66	1.40	0.64	0.66	1.30
	Onion + 5 rows chickpea	0.71	0.64	1.35	0.66	0.65	1.31
Mean		0.76	0.62	1.37	0.70	0.62	1.31
Giza- 4	Onion + 2 rows chickpea	0.74	0.55	1.29	0.63	0.56	1.19
	Onion + 3 rows chickpea	0.70	0.62	1.31	0.64	0.65	1.29
	Onion + 4 rows chickpea	0.70	0.69	1.38	0.54	0.71	1.25
	Onion + 5 rows chickpea	0.61	0.66	1.27	0.53	0.70	1.23
Mean		0.69	0.63	1.31	0.59	0.65	1.24
Intercrop. treatm. means	Onion + 2 rows chickpea	0.74	0.55	1.29	0.66	0.55	1.22
	Onion + 3 rows chickpea	0.73	0.63	1.36	0.65	0.63	1.29
	Onion + 4 rows chickpea	0.69	0.69	1.38	0.58	0.69	1.27
	Onion + 5 rows chickpea	0.64	0.66	1.30	0.58	0.67	1.25

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تأثير تحميل بعض أصناف الحمص على البصل تحت ظروف مصر العليا

عبدالرحيم سيد ابو الحمد* ، مصطفى محمد إبراهيم* ، نبيل عبد الخالق عيد عزاز** ، رفعت علام مرعى * و أحمد هاشم أحمد إبراهيم*

* قسم المحاصيل- كلية الزراعة - جامعة الأزهر بأسيوط

** قسم الكيمياء الزراعية – كلية الزراعة – جامعة دمياط

أقيمت تجربتان حقليتان تحت ظروف محافظة سوهاج خلال موسمي ٢٠١٠/٢٠١١ و٢٠١١/٢٠١٢، لدراسة تأثير تحميل ثلاثة أصناف من الحمص مع البصل تحت أربع نظم تحميل للحمص وهي (بصل + ٢ خط حمص، بصل + ٣ خط حمص، بصل + ٤ خط حمص وحمص منفرد)، وأثر ذلك على المحصول ومكوناته لكلا المحصولين.

ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي:

١- تم الحصول على أطول النباتات وعدد الأوراق/ النبات من نباتات البصل عند التحميل بصنف الحمص جيزة- ٤، بينما تم الحصول على اقل القيم من خلال الصنف جيزة- ٣، وذلك في كلا الموسمين

٢- أوضحت النتائج أن معاملة تحميل البصل بخمسة خطوط من الحمص أعلى القيم من طول النبات وعدد الأوراق بالنبات، بينما أعطت معاملة التحميل بخطين من الحمص اقل القيم، وذلك في كلا الموسمين.

٣- أشارت النتائج أن تحميل البصل بصنف الحمص جيزة- ٣ إلى تحقيق أعلى القيم من المحصول الكلى للأبصال والمحصول التسويقي للأبصال، بينما أدى التحميل بصنف جيزة- ٢ إلى تحقيق اقل القيم، وذلك في كلا الموسمين.

٤- أظهرت النتائج ان معاملة تحميل البصل بخطين من الحمص إلى تحقيق أعلى القيم من المحصول الكلى للأبصال والمحصول التسويقي للأبصال، وذلك مقارنة بمعاملات التحميل الاخرى. بينما أعطت معاملة التحميل بخمسة خطوط من الحمص إلى تحقيق اقل القيم، وذلك في كلا الموسمين.

٥- اظهرت النتائج أن الصنف جيزة- ٤ أعلى القيم من عدد الأفرع بالنبات وعدد القرون بالنبات ومحصول البذور للفدان، بينما اظهر الصنف جيزة- ٢ اقل القيم، وذلك في كلا الموسمين.

٦-لقد تم الحصول على أعلى محصول من البذور للحمص عند زراعة الصنف جيزة- ٤ او جيزة- ٣ بصورة مفردة وذلك في الموسم الأول والثاني على التوالي.

٧-أظهرت النتائج أن أفضل توليفة لعاملي الدراسة بالنسبة لمعدل كفاءة استغلال الأرض (LER) هي زراعة صنف الحمص جيزة- ٣ مع نظام تحميل ثلاثة خطوط، وذلك في كلا الموسمين.

توصي الدراسة لتعظيم غنتاجية محصول الحمص بوحدة المساحة من خلال تحميل الصنف جيزة ٣ مع البصل بنظام ٣ سطور حمص وسطر بصل وذلك تحت الظروف البيئية لمحافظة سوهاج.