INTERCROPPING FABA BEAN AT DIFFERENT PLANT DENSITIES WITH SUGAR BEET

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Abstract

Two field trials were carried out at the Agricultural Experimental Station, Faculty of Agriculture, Cairo University during 2000/2001 and 2001/2002 seasons to study the effect of intercropping faba bean at different plant densities with sugar beet on growth, yield and yield components of both crops. Sugar beet seeds were sown in hills spaced 20 cm apart on one side of the ridge whereas faba bean was seeded on the other side of the ridge in hills spaced 10, 20, 30 or 40 cm apart at one or two plants/hill. The results obtained indicated that growth yield and yield components of sugar beet were significantly decreased by faba bean intercropping compared with solid sugar beet in both seasons. Chemical traits of sugar beet and root/ratio were insignificantly affected by intercropping patterns in both seasons. Sugar beet yield and its attributes were significantly reduced with increasing plant density of the over story crop. The intercropping pattern including 100% sugar beet plus 12.5% faba bean recorded the highest sugar beet root yield, which were 95% and 93% of its pure stand in the first and second seasons, respectively. However, intercropping sugar beet with 100% faba bean density recorded the lowest values of sugar beet root yield and its attributes in both seasons. Estimated sugar yield showed the same trend. All faba bean traits except 100 seed weight were significantly affected by intercropping in both seasons. The highest faba bean yield was obtained from 100% sugar beet and 100% faba bean pattern, which were 70 and 74 % of the pure stand in both seasons, respectively. The lowest values were obtained from 100% sugar beet and 12.5% faba bean pattern (25% faba bean) in both seasons. The maximum values of Land Equivalent Ratio (LER), 1.36 and 1.38 in the first and second seasons were recorded when 100% sugar beet and 33% faba bean was applied. Intercropping 33 % of faba bean with 100% sugar beet recorded the highest values of Relative Crowding Coefficient (K) in the first and second seasons. Faba bean was the dominant partner in all-intercropping patterns, in both seasons. The highest values of total income were recorded from intercropping 100% sugar beet with 33 % faba bean in both seasons.

INTRODUCTION

Sugar beet is an important sugar crop in the world and ranks next to sugar cane as a source of sugar in Egypt. Faba bean is the most important food legume in Egypt. By means of intercropping, growing high yielding varieties of both sugar beet and faba bean at suitable plant densities, production of faba bean may be improved without significant reduction in beet yield. Some Egyptian farmers used to grow faba bean in sugar beet fields. Identifying the most suitable plant population of faba bean intercropped with sugar beet without appreciable reduction in beet yield was the target of this study. This would provide farmers with proper technology for achieving better land utilization and greater income.

Farrag (1990) stated that intercropping faba bean with sugar beet, at four weeks after planting, sugar beet did not significantly affect sugar beet, yield but the total income of both crops increased. El- Hawary *et al.* (1991) found that intercropping faba bean and onion decreased bean plant height while increased number of branches per plant, 100-seed weight and seed yield. El-Borai and Radi (1993) reported that decreasing faba bean ratio from 100 % to 50 % or 33.3 % when intercropped with sugar beet reduced LER; while sugar qualities as expressed in sucrose, TSS and purity percentages were not affected. Estimated sugar beet yield was not significantly reduced from faba bean intercropping. El-Douby (1996) found that increasing faba bean plant density by reducing plant spacing from 25 to 20 and 15 cm decreased bean yield components, but increased plant height and seed yield. Mansour *et al.* (1996) indicated that yield advantage from intercropping faba bean with sugar beet at 8 plants/m^2, grown on both sides of the ridge, was better than growing both crops on separate ridges. Amer *et al.* (1997) stated that intercropping sugar beet with faba bean did not significantly affect sucrose, TSS and purity percentage; but significantly reduced root and sugar yields. However, number of branches, pods and seeds/plant, as well as seed yield of faba been were significantly increased, but seed yield of solid faba bean surpassed the intercrop. Metwally *et al.* (1997) pointed out that intercropping is one of the most important practices as a pattern to increase productivity per unit of land. Mohamed (2000) mentioned that increasing plant population of faba bean increased plant height and seed yield. On the other hand, number of branches, pods and seeds/plant as well as 100-seed weight showed an opposite trend. Increasing faba bean density through close hills spacing and more plants/hill resulted in less number of pods, seeds and seed yield/plant. The highest

values of LER were obtained when 16 plants/m^2 of faba bean were intercropped to sugar beet, but the highest yield of sugar beet was obtained from intercropping five faba bean plants/m^2 (Abd El-All, 2002).

The present work aimed to study the effect of intercropping faba bean at different plant populations with sugar beet on yield and yield components of both crops as well as total income.

MATERIALS AND METHODS

Two field experiments were conducted at the Research Experimental Farm, Faculty of Agriculture, Cairo University, during the 2000/2001 and 2001/2002 seasons to study the effect of intercropping faba bean (*Vicia faba* L.) of Giza 843 at different population densities with sugar beet (*Beta vulgaris* L.). The soil texture of the experimental farm was clay loam with pH 7.9 and 2.35% organic matter content. The experiment included eight intercropping treatments and solid plantings of both crops.

Sugar beet, as the main crop, was seeded in hills spaced 20 cm on one side of ridges 60 cm apart both in intercropping and monoculture patterns to achieve full stand (a plant population of 35000 plants/fed). Three weeks after sowing sugar beet, germinated weeds were controlled and sugar beet was thinned to one seedling per hill. Faba bean seeds, as an intercrop, were sown on the other side of the ridge at all intercropping densities. Sowing of intercropping treatments was in a manner that each crop was sown on adjacent sides of successive ridges, i.e. two rows of faba bean alternating with two rows of sugar beet to increase light penetration for sugar beet. The ratios of intercropped faba bean differed according to number of plants/hill and hills spacing as follows:

T1: 100 % sugar beet + 100% faba bean (two plants per hill and 10 cm between hills).

T2: 100 % sugar beet +50 % faba bean (one plant per hill and 10 cm between hills).

T3: 100 % sugar beet +50 % faba bean (two plants per hill and 20 cm between hills).

T4: 100 % sugar beet +33 % faba bean (two plants per hill and 30 cm between hills).

T5: 100 % sugar beet +25 % faba bean (one plant per hill and 20 cm between hills).

T6: 100 % sugar beet + 25 % faba bean (two plants per hill and 40 cm between hills).

T7: 100 % sugar beet +16.5 % faba bean (one plant per hill and 30 cm between hills).

T8: 100 % sugar beet +12.5 % faba bean (one plant per hill and 40 cm between hills).

Faba bean as a sole crop was seeded in hills spaced 20 cm apart and two plants per hill on both sides of the ridge to achieve full stand of 33 plants/m^2 (140,000 plants/fed). Sugar beet was planted on October 12 and 16 in 2000 and 2001 seasons, respectively. In both seasons, the preceding crop was maize. Calcium super phosphate 15.5 % P_2O_5 was added at a rate of 150 kg/fed before planting sugar beet. Ammonium nitrate 33.5 % N was added to sugar beat plants at a rate of 60 kg N/fed in two equal doses at 21 and 60 days after sugar beet sowing. The experiment was designed as randomized complete blocks with four replications. Each plot consisted of six ridges 0.60 m apart and 3.5 m in long.

At 190 days after sowing, sugar beet plants grown on the four inner ridges (7.2 m^2) of each plot were pulled, topped, counted and fresh weight recorded. Root length and diameter were recorded on a random sample of roots. Total soluble sugar percentage (TSS %) was determined using hand refractometer. Sucrose percentage was polarimetrically determined on a lead acetate extract of fresh macerated root according to the method of Le-Docte (1927). Purity percentage was calculated by dividing sucrose percentage on TSS percentage. Sugar yield/fed was calculated by multiplying root yield/fed by root sucrose percentage

Faba bean was harvested 150 days after sowing (40 days before sugar beet harvest). Ten plants were randomly taken from each plot to determine plant height, number of branches, number of pods, weight of pods and seed yield. Seed yield/fed. and weight of 100 seeds were estimated from the central area (7.2 m^2) of each plot.

Competitive relationships

1- Land equivalent ratio (LER), calculated according to Andrews and Kassam (1976).

2- Relative crowding coefficient (K), calculated according to Dewit (1960).

3- Aggressivity (A), calculated according to Mc Gilchrist (1974).

Economic evaluation

The total income from each treatment was calculated at market price of LE 110 per ton of fresh sugar beet roots and, LE 230 per ardab of faba been. (One ardab = 155 kg & Feddan = 4200 m^2)

Data were statistically analyzed according to Roger (1985) and L.S.D. at 5% level was used to compare treatment means.

RESULTS AND DISCUSSION

1- Effect of intercropping on sugar beet traits

Results in Table 1 indicated that intercropping different populations of faba bean with sugar beet significantly decreased sugar beet root length, root diameter, root fresh weight and top fresh weight, compared with sugar beet grown in pure stand in both seasons. The gradual decrease in these traits was associated with increasing faba bean plant density. The highest values for these traits were recorded with 100% sugar beet and 12.5% faba bean population, whereas the lowest values were recorded from 100% sugar beet +100% faba bean in both seasons.

Such results are mainly due to the effect of both intra and inter crop competition among sugar beet and faba bean plants especially at higher faba bean densities. Sugar beet plants were shaded by faba bean especially at higher bean densities, which decreased beet growth compared with solid culture. (El-Borai and Radi, 1993 and Amer *et al.,* 1997) reported similar results.

Root and sugar yields/fed took similar trend. The highest root yields (95% and 93 % of sole sugar beet in both seasons) were obtained from of 100 % sugar beet with 12.5% faba bean population in both seasons. However, the lowest values were recorded when sugar beet and faba bean were intercropped at 100 % density for both crops (0.50 and 0.47 of sole sugar beet yield in two seasons). These results are in agreement with those of El-Kassaby *et al.* (1985), El-Hawary *et al.* (1991), El-Mihi *et al.* (1991), El-Nagar and El-Habbak (1992), Beshay *et al.* (2000), Rady *et al.* (2000) and Abd El-All (2002) .

Root/top ratio of sugar beet was insignificantly affected by faba bean intercropping in both seasons. Metwally *et al.* (1997) found similar results.

With respect to purity, sucrose and T.S.S. percentage, analysis of variance revealed that differences among treatments did not reach the level of significance. Similar results were recorded by El- Borai and Radi (1993) and Amer *et al.* (1997).

Table 1. Yields and sugar quality of sugar beet as affected by intercropping faba bean at different plant densities.

Treatment	Root			Top fresh weight (g)	Root/ top ratio	Yield of		Sugar quality		
	Length (cm)	Diameter (cm)	Fresh weight (g)			Roots / fed (ton)	Sugar /fed (ton)	sucrose %	TSS %	Purity %
2000/2001 season										
100% faba bean, two plants /hill spaced 10 cm apart	18.8	7.2	493	215.0	2.29	13.24	2.37	17.93	23.08	0.78
50% faba bean, one plant /hill spaced 10 cm part	20.0	8.9	615	278.0	2.21	17.27	2.99	17.34	23.12	0.75
50%faba bean, two plants /hill spaced 20 cm apart	20.3	9.1	633	277.5	2.28	17.93	3.09	17.22	23.05	0.75
33%, faba bean, two plants /hill spaced 30 cm apart	22.5	10.3	743	383.8	1.94	22.63	3.85	17.02	22.85	0.74
25% faba bean, one plant /hill spaced 20 cm apart	23.0	10.8	737	402.5	1.83	23.80	4.06	17.04	22.81	0.75
25% faba bean, two plants /hill spaced 40 cm apart	23.3	11.0	772	406.3	1.90	24.00	4.07	16.96	22.86	0.74
165% faba bean, one plant/hill spaced 30 cm apart	23.8	10.9	798	415.0	1.92	24.77	4.15	16.74	23.03	0.73
12.5% faba bean, one plant /hill spaced 40 cm apart	24.0	11.3	839	422.5	1.99	25.47	4.16	16.32	23.03	0.71
Sugar beet (Solid)	25.0	12.5	875	437.0	2.00	26.73	4.31	16.12	22.76	0.71
L.S.D at 5% level	1.49	1.91	128.80	62.16	Ns	1.88	0.59	Ns	Ns	Ns
2001/2002 season										
100% faba bean, two plants /hill spaced 10 cm apart	19.0	7.3	445	207.5	2.14	12.74	2.23	17.50	23.10	0.77
50% faba bean, one plant /hill spaced 10 cm part	20.5	9.5	642	279.5	2.30	18.07	3.13	17.31	23.11	0.75
50%faba bean, two plants /hill spaced 20 cm apart	21.0	9.7	685	290.0	2.36	19.27	3.33	17.27	22.90	0.75
33%, faba bean, two plants /hill spaced 30 cm apart	24.0	10.3	815	405.0	2.01	23.97	4.09	17.07	23.08	0.74
25% faba bean, one plant /hill spaced 20 cm apart	25.3	10.8	800	408.8	1.96	24.78	4.15	16.97	22.93	0.74
25% faba bean, two plants /hill spaced 40 cm apart	25.5	11.0	820	412.5	1.99	24.43	4.14	16.72	22.92	0.73
16.5% faba bean, one plant/hill spaced 30 cm apart	25.5	11.3	846	415.0	2.04	25.47	4.22	16.57	23.16	0.72
12.5% faba bean, one plant /hill spaced 40 cm apart	26.0	11.3	854	432.5	1.97	25.73	4.15	16.12	22.92	0.70
Sugar beet (Solid)	27.5	12.5	914	438.8	2.08	27.63	4.41	15.95	22.82	0.70
L.S.D. at 5% level	1.44	2.04	133.9	50.8	Ns	1.94	0.47	Ns	Ns	Ns

2- Effect of intercropping on faba bean traits

Results in Table 2 revealed that all faba bean characters, under study, were significantly affected by intercropping treatments in both seasons. Plant height significantly decreased under all intercropping densities except the 100 % sugar beet + 100 % faba bean pattern, compared with faba bean as sole crop in both seasons. Intercropping pattern of 100% sugar beet + 100% faba bean produced the tallest plants, while the shortest plants were produced by the 100% sugar beet + 12.5 % faba been pattern in both seasons. The increment in plant height of faba bean appears to be mainly due to the increase in intra specific competition for light at dense populations.

Yield attributes of faba bean, i.e. number of branches and pods/plant, weight of pods and seeds/plant were affected significantly with increasing intercropping density, compared with solid beans in both seasons. These traits increased gradually by increasing density of intercropped faba bean from 12.5 % up to 100% of its pure stand. Intercropping patterns in both seasons did not significantly influence seed index (100 seed weight). Faba bean seed yield (Table 2) was significantly reduced by intercropping compared with sole faba bean in both seasons. The intercropping pattern, 100 % sugar beet +100 % faba bean recorded the highest seed yield, being 70 % and 74 % of the pure stand in the first and second seasons, respectively. On the contrary, the lowest seed yield (25 % of the sole crop in both seasons) was that of 100 % sugar beet + 12.50 % faba bean pattern. The reduction in seed yield of faba bean was quite expected due to decreased stand of intercropped faba bean as reported by El Boria and Radi (1993), El-Douby (1996), Amer *et al.* (1997), Metwally *et al.* (1997), Mohamed (2000) and (Abd El-All, 2002).

Table 2. Yield and yield components of faba bean intercropped at different densities with sugar beet.

Treatment	Plant height (cm)	Branches/plant (n)	Pods/ plant (n)	Pods/ Plant (g)	Seeds/ plant (g)	100 seeds (g)	Seed yield/ fed, (ardab)
2000/2001 season							
100% faba bean, two plants /hill spaced 10 cm apart	140.00	2.30	12.50	33.90	12.21	75.81	8.54
50% faba bean, one plant /hill spaced 10 cm part	135.00	3.10	18.90	52.14	20.12	71.81	7.64
50%faba bean, two plants /hill spaced 20 cm apart	132.75	2.95	17.45	54.17	19.73	71.36	7.80
33%, faba bean, two plants /hill spaced 30 cm apart	131.00	3.20	21.05	60.45	21.90	73.00	6.17
25% faba bean, one plant /hill spaced 20 cm apart	130.25	3.45	20.90	62.47	25.37	69.07	4.66
25% faba bean, two plants /hill spaced 40 cm apart	123.50	3.60	24.25	63.32	24.10	73.27	4.87
16.5% faba bean, one plant/hill spaced 30 cm apart	126.00	3.75	26.95	79.61	27.59	74.83	3.56
12.5% faba bean, one plant /hill spaced 40 cm apart	132.75	4.05	27.70	89.61	29.26	73.28	3.10
Faba bean solid (33.3 plants/m2)	137.50	2.79	15.05	44.75	15.73	69.82	12.18
L.S.D. at 5% level	3.11	0.45	3.83	11.02	7.35	Ns	1.34
2001/2002 season							
100% faba bean, two plants /hill spaced 10 cm apart	142.75	2.05	12.35	38.41	12.43	78.25	8.76
50% faba bean, one plant /hill spaced 10 cm part	138.25	2.90	16.00	54.50	19.13	72.13	7.63
50%faba bean, two plants /hill spaced 20 cm apart	136.50	3.10	15.15	58.25	18.97	72.17	7.11
33%, faba bean, two plants /hill spaced 30 cm apart	136.50	3.40	19.20	62.75	21.41	72.26	6.06
25% faba bean, one plant /hill spaced 20 cm apart	133.75	3.60	20.95	65.75	22.94	74.51	4.28
25% faba bean, two plants /hill spaced 40 cm apart	132.00	3.93	22.20	68.71	22.08	77.17	4.09
16.5% faba bean, one plant/hill spaced 30 cm apart	134.25	3.95	24.10	77.79	25.62	70.17	3.48
12.5% faba bean, one plant /hill spaced 40 cm apart	133.00	4.10	28.85	82.00	26.95	69.02	2.97
Faba bean solid (33.3 plants/m2)	141.00	2.75	13.69	47.00	15.41	67.43	11.86
L.S.D. at 5% level	2.80	0.39	2.85	10.16	5.36	Ns	1.92

Table 3. Competitive relationships of faba bean intercropped at different densities with sugar beet.*

Treatment	Land equivalent ratio (LER)			Relative crowding coefficient (K)			Agressivity (A)	
	L_s	L_f	LER	K_s	K_F	K	A_s	A_f
2000/2001 season								
100% faba bean, two plants /hill spaced 10 cm apart	0.50	0.70	1.20	0.99	2.35	2.33	- 0.20	+ 0.20
50% faba bean, one plant /hill spaced 10 cm part	0.65	0.63	1.28	0.91	3.27	3.07	- 0.61	+ 0.61
50%faba bean, two plants /hill spaced 20 cm apart	0.67	0.64	1.31	1.02	3.56	3.63	- 0.62	+ 0.62
33%, faba bean, two plants /hill spaced 30 cm apart	0.88	0.51	1.36	1.82	3.11	5.66	- 0.68	+ 0.68
25% faba bean, one plant /hill spaced 20 cm apart	0.89	0.38	1.27	2.03	2.47	5.01	- 0.64	+ 0.64
25% faba bean, two plants /hill spaced 40 cm apart	0.90	0.40	1.30	2.20	2.66	5.85	- 0.70	+ 0.70
16.5% faba bean, one plant/hill spaced 30 cm apart	0.93	0.29	1.22	2.09	2.50	5.23	- 0.84	+ 0.84
12.5% faba bean, one plant /hill spaced 40 cm apart	0.95	0.25	1.20	2.05	2.72	5.58	- 1.09	+ 1.09
2001/2002 season								
100% faba bean, two plants /hill spaced 10 cm apart	0.47	0.74	1.21	0.86	2.83	2.43	- 0.27	+ 0.27
50% faba bean, one plant /hill spaced 10 cm part	0.70	0.64	1.34	0.95	3.60	3.42	- 0.59	+ 0.59
50%faba bean, two plants /hill spaced 20 cm apart	0.75	0.60	1.35	1.15	2.99	3.44	- 0.45	+ 0.45
33%, faba bean, two plants /hill spaced 30 cm apart	0.87	0.51	1.38	2.16	3.17	6.85	- 0.68	+ 0.68
25% faba bean, one plant /hill spaced 20 cm apart	0.90	0.36	1.26	1.91	2.25	4.30	- 0.54	+ 0.54
25% faba bean, two plants /hill spaced 40 cm apart	0.88	0.34	1.22	2.17	2.11	4.58	- 0.50	+ 0.50
16.5% faba bean, one plant/hill spaced 30 cm apart	0.92	0.29	1.21	1.95	2.52	4.91	- 0.86	+ 0.86
12.5% faba bean, one plant /hill spaced 40 cm apart	0.93	0.25	1.18	1.69	2.87	4.85	- 1.08	+ 1.08

* L_s, K_s and A_s = LER, K and A values of sugar beet.

L_f, K_f and A_f = LER, K and A values of faba bean.

3- Competitive relationships yield and yield advantage of intercropping

Land equivalent ratio (LER)

Results in Table 3 indicated that the intercropped yields of both sugar beet and faba bean were greater than their respective pure stand yields, and LER values were greater than one in all intercropping patterns. These yield advantages could be attributed to the relative higher sugar beet yield than that of faba bean under all tested intercropping patterns.

The increase in LER value above unity would indicate that the combined leaf canopy and root systems of the intercrops made better overall use of resources than crops grown separately. The highest land usage (1.36 and 1.38 in the first and second seasons, respectively), was recorded at 100% sugar beet + 33 % faba bean pattern. El-Borai and Radi (1993), Mansour *et al.* (1996), Amer *et al.* (1997) and Abd El-All (2002) recorded similar results.

Relative crowding coefficient (K): results in Table 3 indicated that intercropping faba bean with sugar beet was advantageous in the first and second seasons. Intercropping patterns including 100% sugar beet + 33 % faba bean recorded the highest K values of 6.55 and 6.85 in the first and second seasons, respectively

Aggressivity (A): results in Table 3 indicated that faba bean was the dominant crop component in all treatments.

4- Economic evaluation

Data in Table 4 show that the highest total income (LE/fed) was obtained from intercropping 100 % sugar beet + 33 % faba bean in both seasons. It could be concluded that the highest land usage ratio could be obtained from intercropping 33% faba bean with sugar beet at the regular density of the latter.

Table 4. Total income return values of intercropped faba bean with sugar beet in 2000/20001and 2001/2002 seasons.*

Treatment	2000/2001 season			2001/2002 season		
	Sugar beet price (LE) Ton/fed.	Faba bean price (LE) ardab/fed.	Total Income (LE)	Sugar beet price (LE) Ton/fed.	Faba bean price (LE) ardab/fed.	Total Income (LE)
100% faba bean, two plants /hill spaced 10 cm apart	1459.7	1946.2	3405.9	1401.4	2014.8	3416.2
50% faba bean, one plant /hill spaced 10 cm part	1899.7	1757.2	3656.9	1987.7	1754.9	3742.6
50%faba bean, two plants /hill spaced 20 cm apart	1972.3	1794.0	3766.3	2119.7	1635.3	3755.0
33%, faba bean, two plants /hill spaced 30 cm apart	2489.3	1419.1	3908.4	2636.7	1393.8	4030.5
25% faba bean, one plant /hill spaced 20 cm apart	2618.0	1071.8	3689.8	2687.3	984.4	3671.7
25% faba bean, two plants /hill spaced 40 cm apart	2640.0	1120.1	3760.1	2725.8	940.7	3666.5
16.5% faba bean, one plant/hill spaced 30 cm apart	2724.7	818.8	3543.5	2801.7	800.4	3602.1
12.5% faba bean, one plant /hill spaced 40 cm apart	2801.7	713.0	3514.7	2830.3	683.1	3510.1
Sugar beet (Solid)	2940.3	---	2940.3	3039.3	---	3039.3
Faba bean (Solid)	---	2801.4	2801.4	---	2727.8	2727.8

* LE 110 per ton of fresh sugar beet roots and LE 230 per ardab of faba bean.

(One ardab = 155 kg & Feddan = 4200 m^2)

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تحميل الفول بكثافات نباتية مختلفة مع بنجر السكر

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أجريت تجربتان حقليتان موسمي ٢٠٠٠/ ٢٠٠١ ، ٢٠٠١/٢٠٠٢ بمحطة التجارب والبحوث الزراعية – كلية الزراعة جامعة القاهرة – الجيزة لدراسة تأثير تحميل الفول البلدى مع بنجر السكر بكثافات نباتية مختلفة (تغيير المسافة بين الجور ١٠– ٢٠– ٣٠ و ٤٠ سم و نبات أو نباتين بالجورة) على النمو والمحصول لكلا المحصولين وعلى بعض الصفات الكيمائية لبنجر السكر. تم زراعة الفول البلدى والبنجر على جانبى الخط واشتملت كل تجربة ٨ معاملات بالإضافة الى كل من بنجر السكر والفول البلدى كمحاصيل فردية للمقارنة فى تصميم القطاعات الكاملة العشوائية فى أربع مكررات.

وكانت أهم النتائج كالتالي : –

بنجر السكر: تأثرت صفات البنجر تأثرا معنويا بالتحميل مع الفول البلدي ماعدا نسبة الجذر/المجموع الخضرى و نسبة كل من السكروز والمواد الصلبة الكلية والنقاوة فى كلا الموسمين كما نقص نمو ومكونات المحصول لبنجر السكر معنويا بالتحميل مقارنة بالزراعة المنفردة فى الموسمين.

أعطى نظام التحميل ١٠٠% بنجر السكر + ١٢,٥% فول بلدي أعلى قيمة في إنتاج المحصول النهائي من جذور بنجر السكر في الموسمين في حين أعطي نموذج التحميل ١٠٠% بنجر السكر + ١٠٠% فول بلدي أقل محصول ٥٠ ، ٤٧ % مقارنة بمحصول بنجر السكر المنفرد لموسمي الزراعة على التوالي . كذلك أوضحت النتائج أن محصول السكر/الفدان أخذ نفس اتجاه كمية المحصول من الجذور.

الفول البلدى : تأثر محصول الفول البلدى بالتحميل مع البنجر ما عدا وزن ال١٠٠% بذرة. فى كلا الموسمين. سجل نظام التحميل ١٠٠ % بنجر سكر +١٠٠ % فول بلدى أعلى إنتاجية من بذور الفول البلدى قدر بحوالى ٧٠ ، ٧٤ % من المحصول المفرد فى موسمي الزراعة على التوالى.

العلاقات التنافسية: – سجلت أعلى قيمة لمعدل استغلال الأرض LER وهو ١,٣٦،١,٣٨في موسمي الزراعة عند زراعة ١٠٠ % بنجر سكر + ٣٣ % فول بلدى. سجلت أعلى قيمة لمعامل الحشد النسبى K وهو ٥,٦٦ ،٦,٨٥ في موسمي الزراعة عند زراعة ١٠٠ % بنجر سكر + ٣٣ % فول بلدى. كان الفول البلدى هو السائد فى كل معاملات التحميل.

معـدل الدخـل : سـجلت نظم التحميل ١٠٠% فى بنجر السكر + ٣٣ % فول بلدى فى أول موسم أعلى معدل للدخل حيث كان الدخل المقرر ٣٩٠٨,٤، ٤٠٣٠,٥ جنيه مقارنة بمعدل ٢٩٤٠,٣ ، ٣٠٣٩,٢ جنيه للزراعة المنفردة .