Egypt. J. Agron. **Vol.38**, No.3, pp. 489-507(2016)

Effect of Faba Bean Sowing Distance and Some Combinations of Mineral Nitrogen Levels With Bio Fertilizers on Sugar Beet and Faba Bean Productivity Under Intercropping System

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A FIELD experiment was conducted at Sakha Agric. Res. Station, Kafer EL-Sheikh Governorate, Egypt during 2013/2014 and 2014/2015 seasons to study the relative advantage of intercropping faba bean (variety Giza 643) with sugar beet (variety Geloria) and its impact on yield and quality attributes of both crops. A split plot design with three replications was used. The treatments of faba bean sowing distance (10, 20 and 30 cm) allocated in the main plots, while, the ten combination of nitrogen levels with bio fertilizers (90, 72, 54, 36 kg N/fad, 72, 54, 36 kg N/fad + Cerealine, 72, 54, 36 kg N/fad + Rizobacterine) were arranged in sub plots, the obtained results showed that:

The planting space of 30 cm gave the greatest values of number of branches/ plant, number of pods /plant, number of seeds/plant, weight of 100 seeds, straw yield/fad, seeds yield/fad, protein percent, root diameter (cm), fresh leaves weight/plant, fresh root weight/plant, dry leaves weight /plant, dry root weight /plant and root yield/fad (ton fad^{-1}) in both seasons and at number of leaves /plant in the first seasons only, while the planting space of 10 cm recorded the lowest values in all previous characters. The treatment of 36 kg N level showed the lowest values at plant height (cm), number of pods/plant, number of seeds/plant, weight of 100 seeds (gm), seeds yield (ton fad^{-1}), protein percent of faba bean, number of leaves /plant, root length (cm), root diameter (cm), fresh leaves weight/plant, fresh root weight/plant, dry leaves weight /plant, dry root weight /plant, root yield/fad(ton fad^{-1}), sugars percent (%), purity percent and TSS (%) of sugar beet in the two growing seasons, while the treatments both of 90 and 72 kg mineral nitrogen as individual or 72 kg mineral nitrogen in combination with Cerealine or Rizobacterien recorded the highest significant values at all mentioned previous characters in both seasons. The interaction between 30 cm sowing distance of faba bean with both of 90 and 72 kg mineral nitrogen as individual or 72 kg mineral nitrogen in combination with Cerealine or Rizobacterien in both growing seasons recorded the highest values of the all studied characters while, the lowest values of those characters were recorded at the interaction between 10 cm faba bean sowing distance 36 kg mineral nitrogen as individual in both growing seasons. The highest values of Relative yield (RY), LER and net income of faba bean and

sugars beet were obtained from the interaction between 30 cm sowing distance of faba bean with both 90 and 72 kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien in both seasons.

It could be concluded that the highest productivity and best total net income of faba bean and sugars beet resulted from planting of faba bean at distance 30 cm under intercropping system with sugar beet with application of 72 kg mineral nitrogen in combination with bio fertilizers (Cerealine or Rizobacterien).

Keywords: Nitrogen and Bio fertilizer, Faba bean, Intercropping, Sowing distance, Sugar beet.

Sugar beet (*Beta vulgaris* L.) is the principle main source of sugar outside of the tropical areas of world, and it is the second crop for sugar production in Egypt after sugar cane; the importance of sugar beet crop to agriculture is not confined only to sugar production, but also it is adapted to saline, sodic and calcareous soils. Sugar beet is specialized as a short duration crop, where its growth period is about half that of sugar cane, furthermore, sugar beet requires less water. The aim of all investigators was to decrease the gap between production and consumption by increasing sugar production. Mahmoud *et al.* (2014) reported that application of 100 kg mineral N/fad produced the highest growth trait followed by Azot. + Azosp. with 80 kg N/fad. The highest values of TSS%, sucrose%, and recoverable sugar resulted from either Azoto. or Azosp.+ 60kg N/fad increasing N rates from 60 to 80 kg/fad in combination with N fixing bacteria depressed beet quality and increased impurities in beet roots. The highest root and top yields resulted from 100 kg N/fad, while sugar yield was highest with the combination of Azto. + Azosp. with 60 or 80 kg N /fad followed by 100 kg N/fad

Faba beans (*Vicia faba* L.), one of the leguminous crops cultivated in Egypt and in the world and it can be used as human food in developing countries as green vegetable or dried, fresh, it is a source of several foods that in turn contain high proportion of protein (21 to 34%), amino acids, fat and sugar (Aljubouri, 2006 and Hansen, 1972). Egypt is ranked the third in faba bean production (262 thousand tons year) and consumption after China and Ethiopia (9%) and then Egypt 262 thousand tons /year. Kakahy *et al.* (2012) investigated the effect of planting distance on yield of faba beans (*Vicia faba* L.). The yield of three different varieties of beans (Spanish, Turkish and Local) at three different planting distances, including 10, 25 and 30 cm was studied. The results indicates that both, the interactions between plant distance and different varieties of faba bean did not significantly differed at 95% level of significance.

Intercropping faba bean with other crops has particular importance to replenish faba bean gap. Since 2001 the cultivated area has decreased from 333 thousands fad to less than 222 thousand fad in 2009 (due to the severe competition with wheat, berseem in winter season). Hussein & EL-Deeb (2012) found that the highest seed yield was obtained when faba bean was intercropped

with sugar beet at density of six or eight plants /m^2. Intercropping faba bean at four plants m^{-2} with sugar beet increased profitability by 12.5% over solid sugar beet. Mohammed *et al.* (2005) found that maximum values of land equivalent ratio 1.36 and 1.38 were obtained from intercropping 100% sugar beet with 33% faba bean in the first and second seasons, respectively along with the highest values of total income.

Bio-fertilizers are reasonably safer to the environment than chemical fertilizers and play an important role in decreasing the use of chemical fertilizers. Consequently, it causes a reduction environmental pollution. Soil inoculation with microorganisms may lead to increase soil available nitrogen and consequently increase formation of metabolites which encourage the plant vegetative growth and enhance the meristematic activity of tissues to produce more branches. The role of bio-fertilizers containing symbiotic or non-symbiotic nitrogen-fixing bacteria is improved the vegetative growth characters, yield and yield components.

Therefore, this study aimed to evaluate the yield and quality of both faba bean and sugar beet under intercropping system as affected by faba bean sowing distance and the combination between mineral nitrogen levels with bio fertilizers sources (Cerealine and Rizobacterine).

Materials and Methods

The field experiment was conducted at Sakha Agriculture Research Station, Kafer EL-Sheikh Governorate, (310 07¯ N Latitude and 300 57¯ E longitude with an elevation of about 6 meters above mean sea level) during 2013/2014 and 2014/2015 seasons to study the effect of the combination between mineral nitrogen levels with bio fertilizers sources and plant density on both faba bean (*Vicia faba* L.) and sugar beet (*Beta vulgaris* var. saccharifera, L.) production and quality attributes of both crops. Split plot design in three replications was used in this study. The present investigation included three treatments of faba bean distance 10, 20 and 30 cm (Equal plant density 70,000 - 35,000 - 17,500 plants / fad , respectively) which were occupied in the main plot, while the ten combinations between mineral nitrogen levels with bio fertilizers sources {Control treatment (equal recommended rate of 90 kg / fad), 40% of control treatment, 60 % of control treatment, 80 % of control treatment (equivalent to 36, 54 and 72 kg / fad , respectively), 40 % of control treatment + Cerealine, 60 % of control treatment + Cerealine, 80 % of control treatment + Cerealine, 40 % of control treatment + Rizobacterine , 60 % of control treatment + Rizobacterine, 80 % of control treatment + Rizobacterine} were arranged in a sub plot. The sub plot area was 28.80 m^2 including 6 ridges of 4-m in length and 120 cm in width. The phosphorus fertilizer was applied in the form of calcium super phosphate (15 % P2O5) at the rate of 200 kg/fad at seed bed preparation. Nitrogen fertilizer was applied for sugar beet as ammonium nitrate at rate of 90 kg N/fad, Potassium fertilizer was added in the form of potassium sulphate (48% K_2O) at the rate of 48 kg/fad before

canopy closer. Sowing of sugar beet variety "Geloria" during the 12th of October and faba bean variety "Giza 843" was cultivated in 15th November in both seasons. The cultivation of sugar beet on both sides of the bed with a single plant/hill, the plant density 35,000 plants/fad and planting faba bean on the back of the bed in two lines with two plants / hill. Harvesting of sugar beet was done after 210 days, while faba bean was harvested after 190 days in both seasons. Whereas, the biofertilizers Cerealine and Rhizobecterien were obtained from General Organization for Agricultural Equalization Fund (GOAEF), Agricultural Research Center, Giza, Egypt. Cerealine is the commercial name of nitrogen fixing bacteria containing *Azotobcter chroococcum* sp. And Azospirillum baseline while, Rhizobecterien is the commercial name of nitrogen fixing bacteria containing *Bacillus polymyxa*, Both biofertilizers were added at the rate of 10 gm /kg of faba bean and sugar beet seeds.

Air and soil temperatures were recorded during the two growing seasons as presented in Table 1. Some soil physical properties were analyzed using the procedure described by Black *et al.* (1965). Soil chemical analysis was determined according to the method of Jackson (1973). Physical and chemical analyses of the soil (the upper 30 cm) of the experimental site are given in Table 2.

TABLE 1. Means of some agro meteorological data for Kafer EL-Sheikh area during the two growing seasons.

Month	T (C0)			RH (%)			Ws m/sec	Pan Evap.	Rain mm
	Max.	Min.	Mean	Max.	Min.	Mean			
2013/2014 season									
Nov.	25.39	15.14	20.27	87.00	64.43	75.72	0.80	2.28	-------
Dec.	19.64	8.51	14.06	92.07	67.61	79.84	0.61	4.15	81.9
Jan.	20.34	7.55	13.95	93.69	70.55	80.55	0.54	1.60	20.7
Feb.	20.64	8.19	14.42	91.90	67.15	79.53	0.79	2.52	16.5
Mar.	22.94	11.71	17.33	86.10	56.80	71.45	0.96	3.14	26.2
April.	27.50	15.53	21.52	81.80	49.80	65.8	1.07	4.91	20.2
May	30.47	19.57	25.02	77.20	48.60	62.90	1.14	5.87	-----
2014/2015 season.									
Nov.	24.30	13.79	19.05	87.80	60.50	74.15	0.78	2.77	24.6
Dec.	22.27	9.72	16.00	88.60	63.50	76.05	0.53	1.72	5.70
Jan.	18.79	6.46	12.63	88.10	61.10	74.60	0.82	2.70	52.55
Feb.	19.01	7.65	13.33	86.80	62.70	74.75	0.84	2.90	38.8
Mar.	22.69	11.69	17.19	82.36	58.82	70.59	1.01	3.23	15.25
April.	25.64	13.70	19.67	78.30	48.50	63.40	1.11	6.07	35.85
May	30.19	18.79	24.49	77.3	46.1	61.7	1.33	7.15	0.00

T= Air temperature, RH= Relative humidity, Ws = Wind speed and Pan Evap. = pan evaporation
Source: Meteorological Station at Sakha Agricultural Research Station 31°-07N latitude, 30°-57E longitude with an elevation of about 6 meters a above mean sea level.

TABLE 2. Physical and chemical soil characteristics at the experimental sites during 2013-2014 and 2014-2015 seasons.

Soil property	2013/2014	2014/2015	Soil property	2013/2014	2014/2015
Particle size distribution			**Available nutrients**		
Coarse sand %	1.45	1.55	Organic Matter %	3.40	3.41
Fine sand %	16.05	14.50	Available Nitrogen mg/kg soil	45.0	40.90
Silt	25.80	24.60	Available P_2O_5 mg/kg	6.21	5.91
Clay	57.42	59.35	Available K_2O mg/kg soil	334	338
Texture class	Clay	Clay	pH at (1:2.5) soil : water	7.54	7.9
$CaCo_3$	1.60	1.75	EC dS/m^{-1}	1.92	1.95
Soluble cations meq/L-			**Soluble Anions meq/L-**		
K+	1.50	1.14	SO4=	1.39	0.89
Na+	0.80	0.76	Cl-	2.1	1.80
Mg++	1.20	0.90	HCO3-	0.90	0.86
Ca++	0.89	0.75	CO3=	-	-

The recorded data

Sugar beet characters

Vegetative characters: Number of leaf/plant, fresh leaf weight/plant, root length(cm), diameter (cm), Root fresh weight (g/plant), leaf dry weight/plant, root dry weight/plant and total dry weight /plant.

Yield characters : At harvest, guarded plants of six ridges were uprooted, topped and weighted to determine the following parameters: root yield (ton fad^{-1}) and sugar yield (ton fad^{-1}).

Quality and chemical constituents: Sucrose percentage was estimated in fresh samples of sugar beet roots, using Saccharometer according to the method described in A.O.A.C. (1990), Total soluble solids (TSS %) was determined by using the hand refractometer. Sodium, potassium and Purity percent: The purity of a sugar solution may be defined as the percentage of total solids (dry substance) of all solution which is sugar.

Faba bean characters

Plant height (cm), number of branches/plant, number of pods/plant, number of seeds/plant, 100-seed weight (g), seed yield/plant, straw yield (ton fad^{-1}) and seed yield/fad (ton fad^{-1}).

The Data obtained were statistically analyzed according to the method described by Gomez & Gomez (1984). Means of the treatments were compared by the least significant difference (LSD) at 5 % level of significance which

developed by Waller & Duncan (1969). All statistical analysis was performmed using analysis of variance technique of (MSTATC) computer software package.

Land equivalent ratio (LER)

LER was described by Willey & Osiru (1972). Land equivalent ration LER was determined according to the following formula:

$$\text{LER} = \frac{Yab}{Yaa} + \frac{Yba}{Ybb}$$

where: Yaa and Ybb were pure stand of crop a and b respectively, Yab is yield of the intetcropped a crop (ton /fad), Yba is yield of the intercropped b crop (ton /fad).

Total return of intercropping cultures (Net income/fad)

It was calculated for each treatment in price of faba bean yield by Egyptian pounds + price of sugar beet yield by Egyptian pounds, using the average farm gate price for two seasons .The market price for faba bean seeds and sugar beet was LE 900 / ardab and LE 375 /ton, respectively.

Results and Discussion

Faba bean characters

Plant height, number of branches/ plant, number of pods /plant, number of seeds/plant, weight of 100 seeds, straw yield fad^{-1}, seeds yield fad^{-1}, and protein content of faba bean as affected by sowing distance and the combination between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) in 2013/2014 and 2014/2015 seasons are presented in Tables 3 and 4.

The data in both seasons showed that increasing faba bean sowing distance from 10 to 30 cm resulted in a significant increase at all previous mentioned agronomic traits except the plant height and straw yield/fad traits in both seasons which recorded decreasing with increasing the bean sowing distance. A significant increase in these traits was accompanied with each increment of plant density. The data revealed that the planting space of 30 cm gave the greatest values at all previous mentioned growth traits in both seasons except the plant height and straw yield/fad characters which recorded the lowest values, while the planting space of 10 cm recorded the lowest values in all previous characters except the plant height and straw yield/fad which showed the highest values. Such effect of faba bean sowing distance could be attributed mainly to its role in the growth stages and the competition between all plants on nutrition and light and the effect of various physiological process including cell division and cell elongation of internodes resulting in more tillers formation, leaf numbers and photosynthetic area (leaf area), which resulted in more photosynthetic production. These results are in harmony with those obtained by Hussein & EL-Deeb (1999) and Mohammed *et al.* (2005).

TABLE 3. Plant height (cm), number of branches/plant ,number of pods/plant and number of seeds/plant of faba bean (*Vicia faba L.*) as affected by bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) and their interaction during 2013/2014 and 2014/2015seasons .

Factors	Plant height (cm)		No. of branch/plant		No. of pods/plant		No. of seeds/plant	
Bean sowing distance	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**
10 cm	119.84	120.19	2.33	2.17	13.41	13.26	40.09	39.92
20 cm	115.79	115.15	2.92	2.77	14.52	14.36	41.84	41.63
30 cm	110.40	109.77	3.85	3.74	15.25	15.10	43.27	43.14
LSD	**3.95**	**3.92**	**0.34**	**0.36**	**0.79**	**0.74**	**0.83**	**0.91**
Fertilizer treat. (kg/fad)								
90 kg N/fad (Control)	116.18	115.03	3.02	2.92	14.39	14.23	41.96	41.78
36 kg N/fad	112.72	110.10	2.9 5	2.82	14.18	14.02	41.01	41.15
36 kg N/fad + C	113.50	112.82	2.98	2.85	14.20	14.05	41.20	41.16
36 kg N/fad + R	113.51	112.83	3.00	2.86	14.26	14.10	41.16	41.18
54 kg N/fad	115.05	114.45	3.01	2.87	14.48	14.32	41.72	41.56
54 kg N/fad + C	116.17	115.25	3.04	2.89	14.42	14.26	41.78	41.64
54 kg N/fad + R	115.34	115.25	3.04	2.89	14.39	14.24	41.64	41.494
72 kg N/fad	117.00	116.35	3.06	2.92	14.50	14.35	41.97	41.80
72 kg N/fad + C	118.13	117.16	3.07	2.95	14.52	14.37	42.09	41.94
72 kg N/fad + R	118.14	117.16	3.10	2.98	14.58	14.43	42.28	42.08
LSD	**1.40**	**1.10**	**N.S**	**0.095**	**0.151**	**0.141**	**0.229**	**0.196**
Interaction	**N.S**	**N.S**	**0.686**	**N.S**	**0.258**	**N.S**	**N.S**	**N.S**

N= nitrogen, C = Cerealine, R= Rizobacterin, LSD = least significant difference and Ns indicate p <0.05 and not significant, respectively.

TABLE 4. Weight of 100 seeds (gm), Straw yield (ton /fad), seeds yield (ton fad^{-1}) and protein percent of faba bean (*Vicia faba L.*) as affected by faba bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) and their interaction during 2013/2014 and 2014/2015 seasons .

Factors	Weight of 100 seed(gm)		Straw yield/fad (ton fad^{-1})		Seeds yield/fad (ton fad^{-1})		Protein percent	
Bean sowing	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**
10 cm	53.910	53.77	1.322	1.179	0.929	0.76	20.112	19.918
20 cm	56.547	56.220	1.220	1.064	1.022	0.84	20.941	20.667
30 cm	59.364	58.743	1.063	0.953	1.072	0.88	21.721	21.571
LSD	**2.052**	**1.470**	**1.174**	**0.049**	**0.072**	**0.117**	**0.279**	**0.0866**
Fertilizer treatment								
90 kg N fad^{-1} (Control)	65.600	56.240	1.211	1.060	1.12	0.93	20.920	20.710
72 kg N fad^{-1}	55.788	55.334	1.197	1.111	0.85	0.68	20.245	19.867
54 kg N fad^{-1}	55.921	55.376	1.193	1.098	0.88	0.71	20.572	20.221
36 kg N fad^{-1}	56.047	55.552	1.194	1.082	0.89	0.73	20.688	20.354
72 kg N fad^{-1} + C	56.574	55.695	1.185	1.065	0.98	0.83	20.772	20.491
54 kg N fad^{-1} + C	56.710	56.535	1.184	1.060	1.03	0.84	20.921	20.596
36 kg N fad^{-1} + C	56.876	56.685	1.195	1.054	1.06	0.86	21.401	20.788
72 kg N fad^{-1} + R	56.900	56.866	1.193	1.048	1.04	0.86	21.276	21.240
54 kg N fad^{-1} +R	57.035	57.011	1.186	1.037	1.10	0.92	21.336	21.288
36 kg N fad^{-1} +R	57.566	57.201	1.174	1.032	1.12	0.93	21.401	21.625
LSD	**0.155**	**1.355**	**N.S**	**N.S**	**0.053**	**0.061**	**0.303**	**0.122**
Interaction	**0.276**	**N.S**	**N.S**	**N.S**	**0.466**	**0.495**	**N.S**	**0.789**

N= nitrogen, C = Cerealine, R= Rizobacterin, LSD = least significant difference and
Ns indicate p <0.05 and not significant, respectively.

The application of combination between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) resulted in a significant effects in plant height, number of pods /plant, number of seeds/plant, weight of 100 seeds, seeds yield/fad and protein

content in both seasons and number of branches/ plant in the second season only, however the straw yield/fad did not significantly differed in both seasons. The treatment of 36 kg mineral nitrogen level showed the lowest values at plant height (cm), number of pods/plant, number of seeds/plant, weight of 100 seeds (gm), seeds yield (ton fad^{-1}) and protein percent of faba bean in the two growing seasons and number of branches/plant in the second season, while the treatments of 90 kg mineral nitrogen as individual and 72 kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien recorded the highest significant values compared with the other combinations at plant height (cm), number of pods /plant, number of seeds/plant, weight of 100 seeds, seeds yield/fad and protein content in both seasons and number of branches/ plant in the second season, on the other hand the treatment of 54 kg mineral nitrogen as individual and in combination with Cerealine or Rizobacterien showed relative increasing at all previous significantly traits compared with the level of 36 kg mineral nitrogen which recorded the lowest values. Such effect of fertilizers might have been resulted from the role of Nitrogen fertilizers in enhancing the soil biological activity which improved nutrient mobilization from organic to chemical fertilizers which is closely related to the amount of absorbed nitrogen and then improve translocation of assimilates and thus improve the growth characters.

With regard to the interaction faba bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin), the data in Tables 3 and 4 show that there is a significant effect on number of branch/ plant, number of pods /plant, weight of 100 seeds in the first season and protein content in the second season while the seed yield/fad had a significant effect in both. Similar results were obtained by Mahmoud *et al.* (2014).

Sugar beet crop characters

Results in Tables 5 ,6 ,7 and 8 show that faba bean sowing distance and the combination between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) and its interaction had a significant effect on the number of leaves / plant, root length (cm), root diameter (cm), fresh leaves weight/plant, fresh root weight/plant, dry leaves weight /plant, dry root weight /plant, root yield/fad (ton fad^{-1}), sugars percent (%), purity percent and TSS (%) of sugar beet in 2013/2014 and 2014/2015 seasons.

There are significant differences in number of leaves /plant, root length (cm), root diameter (cm), fresh leaves weight/plant, fresh root weight/plant, dry leaves weight / plant, dry root weight /plant, root yield/fad(ton fad^{-1}), sugars percent (%), purity percent and TSS (%) due to the application of combination between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) in both seasons. The treatments of 90 kg mineral nitrogen as individual and 72 kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien showed the highest significant values compared with the other combinations for the previous traits, followed by the treatments of 54 kg mineral nitrogen as

individual and in combination with Cerealine or Rizobacterien. However, the lowest values were obtained from the application of 36 kg Nfad^{-1} as individual or in combination with Cerealine or Rizobacterien. Such effect of fertilizers might have been resulted from the role of fertilizers in enhancing the soil biological activity which improved nutrient mobilization from organic and chemical fertilizers which is closely related to the amount of absorbed nitrogen and then improve translocation of assimilates and thus improve the growth characters. These results are in harmony with those obtained by Abdel Motagally *et al.* (2014).

TABLE 5. Number of leaves /plant, root length and root diameter of sugar beet (*Beta vulgaris*) as affected by bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) and their interaction during 2013/2014 and 2014/2015 seasons .

Factors	**No. of leaves/plant**		**Root length (cm)**		**Root diameter (cm)**	
Bean sowing distance	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**
10 cm	23.37	24.11	23.53	23.54	13.37	13.12
20 cm	24.23	25.70	22.30	22.26	14.06	13.63
30 cm	25.92	25.93	21.29	21.00	14.57	14.43
LSD	**0.979**	**N.S**	**0.709**	**0.363**	**0.651**	**0.522**
Fertilizer treatment						
90 kg N fad^{-1} (Control)	29.51	28.24	22.37	22.27	13.82	13.72
72 kg N fad^{-1}	24.75	25.96	22.06	21.42	13.08	13.50
54 kg N fad^{-1}	24.86	26.97	22.06	21.67	13.11	13.52
36 kg N fad^{-1}	24.78	26.01	22.02	22.24	13.17	13.60
72 kg N fad^{-1} + C	24.83	27.74	22.10	22.23	13.97	13.70
54 kg N fad^{-1} + C	26.87	28.79	22.46	22.08	13.96	13.72
36 kg N fad^{-1} + C	25.81	28.35	22.79	22.42	14.04	13.78
72 kg N fad^{-1} + R	28.88	29.90	22.62	22.90	14.99	13.87
54 kg N fad^{-1} +R	30.99	28.87	22.65	22.94	14.93	13.89
36 kg N fad^{-1} +R	27.90	28.96	22.58	22.49	14.94	13.90
LSD	**0.349**	**1.371**	**0.415**	**0.288**	**0.219**	**0.126**
Interaction	**0.172**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**

N= nitrogen, C = Cerealine, R= Rizobacterin, LSD = least significant difference and Ns indicate p <0.05, and not significant, respectively.

TABLE 6. Fresh leaves weight (gm)/plant, fresh root weight/plant , dry leaves weight / plant and dry root weight / plant of sugar beet (*Beta vulgaris*) as affected by bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) and their interaction during 2013/2014 and 2014/2015 seasons .

Factors	Fresh leaves weight (gm) / plant		Fresh root weight (gm)/ plant		Dry leaves weight (gm)/ plant		Dry root weight (gm) / plant	
Bean sowing distance	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**
10 cm	492.32	571.70	647.79	647.75	151.64	150.78	399.46	396.06
20 cm	516.00	575.17	742.00	741.84	155.61	155.22	408.65	407.10
30 cm	597.79	579.70	766.32	765.93	158.35	158.91	414.29	413.54
LSD	**27.49**	**47.84**	**27.49**	**27.60**	**1.17**	**2.16**	**6.61**	**4.78**
Fertilizer								
90 kg N fad^{-1} (Control)	535.37	595.51	718.70	718.50	155.20	155.00	409.47	407.56
72 kg N fad^{-1}	484.79	561.70	700.57	700.57	153.3	153.55	394.47	394.01
54 kg N fad^{-1}	490.31	567.41	707.17	707.17	154.2	154.89	397.14	395.11
36 kg N fad^{-1}	490.64	568.54	713.55	713.55	154.0	154.80	401.18	395.36
72 kg N fad^{-1} + C	497.71	573.21	714.18	713.67	155.4	154.54	405.59	406.82
54 kg N fad^{-1} + C	503.95	574.64	720.63	720.62	155.5	155.12	407.81	405.94
36 kg N fad^{-1} + C	504.49	577.11	721.30	721.16	155.6	155.80	412.90	408.20
72 kg N fad^{-1} + R	517.12	572.10	727.46	727.46	156.2	156.22	414.57	413.37
54 kg N fad^{-1} +R	511.79	575.80	728.08	728.06	156.0	156.56	415.67	414.51
36 kg N fad^{-1} +R	517.52	589.16	734.37	734.31	156.8	156.24	415.88	414.76
LSD	**10.60**	**18.24**	**10.602**	**10.578**	**0.84**	**1.35**	**3.73**	**1.77**
Interaction	**14.60**	**N.S**	**16.945**	**N.S**	**N.S**	**N.S**	**1.27**	**N.S**

N= nitrogen, C = Cerealine, R= Rizobacterin, LSD = least significant difference and Ns indicate $p < 0.05$ and not significant, respectively.

TABLE 7. Root yield ton fad^{-1}, sugar percent %, purity % and TSS % of sugar beet as affected by bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) and their interaction during 2013/2014 and 2014/2015 seasons .

Factors	Root yield ton fad^{-1}		Sugar percent%		Purity%		TSS %	
Bean sowing distance	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**	**2013/14**	**2014/15**
10 cm	14.45	13.76	15.18	15.08	81.0	81.1	18.39	18.31
20 cm	19.41	18.84	14.50	14.29	79.9	80.0	17.47	17.25
30 cm	20.54	20.05	13.04	12.96	79.3	79.1	16.60	16.30
LSD	**4.893**	**5.0301**	**0.427**	**0.237**	**0.64**	**0.37**	**0.542**	**0.115**
Fertilizer treatment (kg/fad)								
90 kg N fad^{-1} (Control)	21.83	21.34	14.24	14.41	80.1	80.0	17.68	17.59
72 kg N fad^{-1}	13.96	13.29	13.76	13.86	78.6	78.4	16.96	17.21
54 kg N fad^{-1}	13.72	12.68	13.85	13.96	78.4	78.7	17.42	17.22
36 kg N fad^{-1}	13.96	13.29	13.95	13.91	78.7	78.2	17.42	17.22
72 kg N fad^{-1} + C	15.71	15.31	14.13	14.18	80.7	80.5	17.43	17.29
54 kg N fad^{-1} + C	19.95	19.49	14.19	14.16	80.5	80.5	17.65	17.46
36 kg N fad^{-1} + C	13.72	12.68	14.28	14.11	80.5	80.5	17.67	17.33
72 kg N fad^{-1} + R	19.89	19.63	14.49	14.37	81.2	81.3	17.68	17.69
54 kg N fad^{-1} +R	21.36	20.87	14.47	14.45	81.1	81.2	17.76	16.94
36 kg N fad^{-1} +R	21.66	21.18	14.33	14.50	81.0	81.1	17. 62	16.92
LSD	**0.380**	**0.396**	**0.177**	**0.127**	**0.995**	**0.985**	**0.354**	**0.242**
Interaction	**0.682**	**0.572**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**0.572**

N= nitrogen, C = Cerealine, R= Rizobacterin, LSD = least significant difference and Ns indicate p <0.05 and not significant, respectively.

TABLE 8. Roots yield fad^{-1} of sugar beet (*Beta vulgaris*) and seed yield fad^{-1}of faba bean (*Vicia faba* L.) as affected by the interaction between faba bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) during 2013/2014 and 2014/2015 seasons.

Combinations of mineral N and bio fertilizers		Root yield ton fad^{-1}		Faba bean Seed yield ton fad^{-1}	
		2013/2014	2014/2015	2013/2014	2014/2015
90 kg N fad^{-1}(Control)	10 cm	15.78	15.37	1.00	0.84
72 kg N fad^{-1}		15.45	14.94	0.98	0.82
54 kg N fad^{-1}		15.04	14.5	0.93	0.79
36 kg N fad^{-1}		11.69	10.02	0.81	0.62
72 kg N fad^{-1}+ C		15.58	15.09	0.99	0.82
54 kg N fad^{-1}+ C		15.38	14.62	0.96	0.80
36 kg N fad^{-1}+ C		12.00	11.40	0.82	0.64
72 kg N fad^{-1}+ R		15.74	15.29	0.99	0.84
54 kg N fad^{-1}+R		15.43	14.64	0.97	0.81
36 kg N fad^{-1} +R		12.37	11.70	0.84	0.64
90 kg N fad^{-1}(Control)	20 cm	24.36	23.81	1.16	0.97
72 kg N fad^{-1}		21.00	21.16	1.01	0.85
54 kg N fad^{-1}		15.85	15.53	1.00	0.84
36 kg N fad^{-1}		12.88	12.06	0.84	0.65
72 kg N fad^{-1}+ C		23.39	22.91	1.14	0.96
54 kg N fad^{-1}+ C		21.87	21.59	1.02	0.86
36 kg N fad^{-1}+ C		14.24	12.44	0.90	0.72
72 kg N fad^{-1}+ R		23.63	23.14	1.15	0.96
54 kg N fad^{-1}+R		22.29	21.90	1.09	0.86
36 kg N fad^{-1} +R		14.59	13.88	0.91	0.76
90 kg N fad^{-1}(Control)	30 cm	25.35	24.85	1.20	0.98
72 kg N fad^{-1}		23.21	22.80	1.14	0.91
54 kg N fad^{-1}		16.25	15.90	1.01	0.85
36 kg N fad^{-1}		14.63	14.19	0.91	0.78
72 kg N fad^{-1}+ C		25.10	24.60	1.17	0.97
54 kg N fad^{-1}+ C		22.61	22.26	1.12	0.87
36 kg N fad^{-1}+ C		14.91	14.20	0.92	0.78
72 kg N fad^{-1}+ R		25.61	25.10	1.21	0.98
54 kg N fad^{-1}+R		22.75	22.35	1.12	0.90
36 kg N fad^{-1} +R		14.93	14.28	0.92	0.79
L. S .D		**0.513**	**2.572**	**0.466**	**0.495**

N= nitrogen, C = Cerealine, R= Rizobacterin, LSD = least significant difference.

The data in both seasons showed that increasing faba bean sowing distance from 10 to 30 cm resulted in a significant increase at root diameter (cm), fresh leaves weight/plant, fresh root weight/plant, dry leaves weight /plant, dry root weight /plant and root yield/fad (ton fad^{-1}) while number of leaves /plant showed increasing in the first seasons only where the 30 cm sowing distance gave the greatest values at all previous mentioned traits while the sowing distance of 10 cm recorded the lowest values in all previous mentioned characters. The same treatments showed that decreasing at root length (cm), sugars percent (%), purity percent and TSS (%) of sugar beet in 2013/2014 and 2014/2015 seasons. The data revealed that sowing distance of 10 cm recorded the highest values in all previous mentioned traits but the 30 cm sowing distance gave the lowest values at the same mentioned characters. Such favorable effect of bean sowing distance on growth characters might have been resulted from the increase the volume of plant roots, which increased vegetative growth, photosynthetic area, which resulted in more assimilates products and consequently increased dry matter accumulation and translocation of more photosynthesis to seeds. These results are in agreement with those obtained by Mohammed *et al.* (2005), Abo-Elela (2012), Abdel Motagally *et al.* (2014) and El-Shamy *et al.* (2015).

The interaction between the faba bean sowing distance and the combination between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin), had a significant effect on number of leaves /plant, Fresh leaves weight (gm) / plant, fresh root weight (gm) /plant, and dry root weight/plant in first season and TSS % of sugar beet in the second season, There are significant differences in the root yield $tonfad^{-1}$ in both seasons.

Data in Table 8 showed that the effect of interaction between faba bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers (Cerealine and Rizobacterin) on root yield fad^{-1} and seed yield fad^{-1} of faba bean in both seasons. The interactions between 10 cm sowing distance of faba bean and 36 kg showed the lowest values of sugar beet root yield $tonfad^{-1}$ and faba bean seeds yield $tonfad^{-1}$without a significantly differences compared with other interactions, the interaction between 30 cm sowing distance of faba bean with 90 kg mineral nitrogen as individual or 72 kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien gave the highest significant values of sugar beet root yield $tonfad^{-1}$and faba bean seeds yield $tonfad^{-1}$ without a significantly differences compared with the other interactions, followed by the interaction between 20 cm sowing distance of faba bean with 90 kg mineral nitrogen as individual or 72 kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien in both traits. These results may be due to the effect of nitrogen levels and biofertilizer on soil activity and characters, added to that the effect of sowing distance on optimum plant distribution in the field, all that improve nutrient mobilization from organic and chemical fertilizers which is closely related to the amount of absorbed nitrogen and then improve translocation of assimilates and thus improve the growth and yield characters. Similar results were obtained by Abdel Motagally *et al.* (2014).

The data in Tables 9 and 10 revealed that the highest values of relative yield (RY), LER and net income of faba bean and sugars beet were obtained from the interaction between 30 cm sowing distance of faba bean with 90 kg mineral nitrogen as individual or **72** kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien in both growing seasons followed by the combinations between 30 cm faba bean sowing distance and 54 kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien but the lowest values of those characters were recorded at the interaction between 10 cm faba bean sowing distance 36 kg mineral nitrogen as individual or in combination with Cerealine or Rizobacterien in both growing seasons. Such favorable effect of faba bean sowing distance on those characters might have been resulted from improve in faba bean and sugar beet productivity which reverse on relative yield (RY), net income for faba bean and sugar beet and land equivalent ratio (LER). These results are in accordance with those obtained by Mohammed *et al.* (2005), Abo-Elela (2012), Abdel Motagally *et al.* (2014) and El-Shamy *et al.* (2015).

TABLE 9. Relative yield (RY), LER and net income of faba bean and sugar beet (*Beta vulgaris*) and as affected by faba bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers sources (Cerealine or Rizobacterien) and their interaction during 2013/2014 seasons.

Combinations of mineral N and bio fertilizers		Relative yield (RY)		LER	Net income for		Total net income
		Faba bean	Sugar beet		Faba bean	Sugar beet	
90 kg N fad^{-1}(Control)	10 cm	0.112	0.649	0.760	6666.00	5917.50	12583.5
72 kg N fad^{-1}		0.110	0.635	0.745	6532.68	5793.75	12326.43
54 kg N fad^{-1}		0.104	0.618	0.722	6199.38	5640.00	11839.38
36 kg N fad^{-1}		0.091	0.485	0.571	5399.46	4383.75	9783.2
72 kg N fad^{-1}+ C		0.111	0.640	0.751	6599.34	5842.50	12441.84
54 kg N fad^{-1}+ C		0.107	0.632	0.740	6399.36	5767.50	12166.86
36 kg N fad^{-1}+ C		0.092	0.493	0.585	5466.12	4500.00	9966.1
72 kg N fad^{-1}+ R		0.111	0.647	0.758	6599.34	5902.50	12501.84
54 kg N fad^{-1}+R		0.109	0.634	0.743	6466.02	5786.25	12252.27
36 kg N fad^{-1} +R		0.094	0.508	0.603	5599.44	4638.75	10238.19
90 kg N fad^{-1}(Control)	20 cm	0.130	1.001	1.131	7732.56	9135.00	16867.56
72 kg N fad^{-1}		0.113	0.863	0.976	6732.66	7875.00	14607.66
54 kg N fad^{-1}		0.112	0.652	0.763	6666.00	5943.75	12609.75
36 kg N fad^{-1}		0.094	0.529	0.623	5599.44	4830.00	10429.44
72 kg N fad^{-1}+ C		0.128	0.961	1.089	7599.24	8771.25	16370.49
54 kg N fad^{-1}+ C		0.115	0.899	1.013	6799.32	8201.25	15000.57
36 kg N fad^{-1}+ C		0.101	0.585	0.689	5999.40	5340.00	11339.4
72 kg N fad^{-1}+ R		0.129	0.971	1.010	7665.90	8861.25	16527.15
54 kg N fad^{-1}+R		0.122	0.916	1.038	7265.94	8358.75	15624.69
36 kg N fad^{-1} +R		0.102	0.599	0.702	6066.06	5471.25	11537.31
90 kg N fad^{-1}(Control)	30 cm	0.134	1.042	1.176	7999.20	9506.25	17505.45
72 kg N fad^{-1}		0.128	0.954	1.082	7599.24	8703.75	16302.99
54 kg N fad^{-1}		0.113	0.668	0.781	6732.66	6093.75	12826.41
36 kg N fad^{-1}		0.102	0.601	0.703	6066.06	5486.25	11552.31
72 kg N fad^{-1}+ C		0.133	1.032	1.163	7799.22	9412.50	17211.72
54 kg N fad^{-1}+ C		0.125	0.929	1.055	7465.92	8478.75	15944.67
36 kg N fad^{-1}+ C		0.103	0.613	0.716	6132.72	5591.25	11723.97
72 kg N fad^{-1}+ R		0.135	1.053	1.188	8065.86	9603.75	17669.61
54 kg N fad^{-1}+R		0.125	0.935	1.060	7465.92	8531.25	15997.17
36 kg N fad^{-1} +R		0.103	0.614	0.717	6132.72	5598.75	11731.47

N= nitrogen, C = Cerealine and R= Rizobacterin, total income for solid crops sugar beet: LE 2685.75, Faba bean: LE 4408, Solid sugar beet root yield: 24.33 ton fad^{-1}

TABLE 10. Relative yield (RY), LER and net income of faba bean and sugar beet (*Beta vulgaris*) and as affected by faba bean sowing distance and combinations between mineral nitrogen levels and bio fertilizers sources (Cerealine or Rizobacterien) and their interaction during 2014/2015 seasons.

Combinations of mineral N and bio fertilizers		Relative yield (RY)		LER	Net income for		Total net income
		Faba bean	Sugar beet		faba bean	sugar beet	
90 kg N fad^{-1}(Control)	**10 cm**	0.093	0.650	0.743	5599.44	5763.75	11363.2
72 kg N fad^{-1}		0.091	0.632	0.723	5466.12	5602.50	11068.6
54 kg N fad^{-1}		0.088	0.613	0.701	5266.14	5437.50	10703.6
36 kg N fad^{-1}		0.069	0.424	0.492	4132.92	3757.50	7890.4
72 kg N fad^{-1}+ C		0.091	0.638	0.729	5466.12	5658.75	11124.9
54 kg N fad^{-1}+ C		0.089	0.618	0.707	5332.80	5482.50	10815.3
36 kg N fad^{-1}+ C		0.071	0.482	0.553	4266.24	4275.00	8541.2
72 kg N fad^{-1}+ R		0.093	0.647	0.740	5599.44	5733.75	11333.2
54 kg N fad^{-1}+R		0.090	0.619	0.709	5399.46	5490.00	10889.5
36 kg N fad^{-1} +R		0.071	0.495	0.566	4266.24	4387.50	8653.7
90 kg N fad^{-1}(Control)	**20 cm**	0.108	1.007	1.114	6466.02	8928.75	15394.9
72 kg N fad^{-1}		0.094	0.895	0.989	5666.10	7935.00	13601.1
54 kg N fad^{-1}		0.093	0.657	0.750	5599.44	5823.75	11423.2
36 kg N fad^{-1}		0.072	0.510	0.582	4332.90	4522.50	8855.4
72 kg N fad^{-1}+ C		0.106	0.969	1.075	6399.36	8591.25	14990.6
54 kg N fad^{-1}+ C		0.095	0.913	1.008	5732.76	8096.25	13829.0
36 kg N fad^{-1}+ C		0.080	0.526	0.606	4799.52	4665,00	9464.5
72 kg N fad^{-1}+ R		0.106	0.978	1.085	6399.36	8677.50	15076.9
54 kg N fad^{-1}+R		0.095	0.926	1.021	5732.76	8212.50	13945.3
36 kg N fad^{-1} +R		0.084	0.589	0.671	5066.16	5205.00	10271.2
90 kg N fad^{-1}(Control)	**30 cm**	0.109	1.051	1.159	6532.68	9318.75	15851.4
72 kg N fad^{-1}		0.101	0.964	1.065	6066.06	8550.00	14616.1
54 kg N fad^{-1}		0.094	0.672	0.767	5666.10	5962.50	11628.6
36 kg N fad^{-1}		0.087	0.600	0.687	5199.48	5321.25	10520.7
72 kg N fad^{-1}+ C		0.108	1.040	1.148	6466.02	9225.00	15691.0
54 kg N fad^{-1}+ C		0.097	0.941	1.038	5799.42	8347.50	14146.9
36 kg N fad^{-1}+ C		0.087	0.600	0.687	5199.48	5325.00	10524.5
72 kg N fad^{-1}+ R		0.109	1.061	1.170	6532.68	9412.50	15945.2
54 kg N fad^{-1}+R		0.10	0.945	1.045	5999.40	8381.25	14380.7
36 kg N fad^{-1} +R		0.088	0.604	0.692	5266.14	5355.00	10621.1

N= nitrogen, C = Cerealine and R= Rizobacterin, total income for solid crops sugar beet: LE 2685.75, Faba bean: LE 4408, Solid sugar beet root yield: 24.33 ton fad^{-1}

Conclusion

From the results and under the conditions of this study, It could be concluded that he highest productivity and best total net income of faba bean and sugars beet resulted from planting of faba bean at distance 30 cm under intercropping system with sugar beet with application of 72 kg mineral nitrogen in combination with bio fertilizers (Cerealine or Rizobacterien).

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(*Received 17/10/2016;*
accepted 29/1/2017)

تأثير مسافات زراعة الفول البلدى وبعض التوافيق بين مستويات النيتروجين المعدنى والاسمدة الحيوية على انتاجية بنجر السكر و الفول البلدى المحملين

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قسم بحوث التكثيف – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – القاهره و* قسم االمحاصيل - كلية الزراعة - جامعة كفر الشيخ- كفر الشيخ - مصر.

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بسخا بمحافظة كفر الشيخ - مصر خلال موسمى ٢٠١٣/ ٢٠١٤ و ٢٠١٤/ ٢٠١٥ لدراسة تأثير الميزة النسبية من تحميل نباتات الفول البلدى مع بنجر السكر وتاثير ذلك على محصول وجودة كلا المحصولين. وقد استخدم تصميم القطع المنشقة فى ثلاث مكررات حيث تضمنت الدراسة ثلاث مسافات لزراعة الفول البلدى (١٠ ، ٢٠ ، ٣٠ سم) وزعت فى القطع الرئيسية بينما اشتملت القطع الشقية على تسع معاملات من مستويات النيتروجين المنفرد وتواليفه المختلفة مع مصدرى الاسمدة الحيوية (ريزوباكترين وسيريالين) وكانت كما يلى ٩٠، ٧٢ ، ٥٤ و ٣٦ كجم أزوت/فدان ، ٧٢ + سيريالين ، ٥٤ + سيريالين ، ٣٦ + سيريالين ، ٧٢+ ريزوباكترين ، ٥٤ + ريزوباكترين ، ٣٦ + ريزوباكترين و قد اظهرت النتائج المتحصل عليها ما يلى :-

ان الزراعة على مسافة ٣٠ سم اعطت القيم العظمى فى صفات الفول البلدى التالية عدد الفروع \نبات ، عدد القرون\نبات ، عدد البذور\نبات ،وزن ١٠٠ بذرة ، محصول البذور\فدان ، محصول القش\ فدان ، ومحتوى البروتين ، قطر الجذر ، وزن الاواق الطازج\ نبات ، وزن الجذر الطازج\ نبات ، وزن الاوراق الجاف \ نبات ، وزن الجذر الجاف \ نبات ، محصول الجذور\فدان ، فى حين سجلت مسافة الزراعة كل ١٠ سم القيم الاقل فى الصفات السابقة بينما اظهرت صفة عدد الفروع\ نبات زيادة فى الموسم الاول .

وقد اظهرت معاملة ٣٦ كجم نيتروجين القيم الاقل فى ارتفاع النبات،عددالقرون\ نبات ، وعدد البذور \ نبات ، وزن ١٠٠ بذرة ، محصول البذور\فدان،نسبةالبروتين فى الفول البلدى فى كلا الموسمين وعدد الفروع \نبات فى الموسم الثانى بينما معاملة ٩٠ كجم\فدان منفردا و٧٢ كجم نيتروجين \فدان منفردا او فى تواليف مع السيريالين اوالريزوبكترين سجلت القيم الاعلى معنوية بالمقارنة بالتواليف الاخرى فى ارتفاع النبات وعدد القرون \نبات وعدد البذور \نبات ووزن ١٠٠ بذرة ومحصول البذور \فدان ونسبة البروتين فى كلا الموسمين وعددالفروع\نبات فى الموسم الثانى.

اظهرت زراعة الفول البلدى على مسافة ٣٠ سم مع اضافة السماد النيتروجينى بمعدل ٩٠ كجم ن\ فدان منفردا و٧٢ كجم نيتروجين \فدان منفردا او فى تواليف مع السيريالين اوالريزوبكترين فى كلا موسمى الزراعة فى حين سجل التفاعل بين زراعة الفول البلدى على مسافة ١٠ سم واضافة النيتروجين بمعدل ٣٦ كجم ن\فدان فى تواليف مع السيريالين او الريزوبكتيرين القيم الاقل فى كلا الموسمين .

المكافىء الارضى وصافى العائد من الفول البلدى وبنجر السكر نتجت من زراعة الفول البلدى على مسافة ٣٠ سم مع اضافة معدل ٩٠ كجم ن\فدان منفردا و٧٢ كجم ن \فدان منفردا او فى تواليف مع السيريالين او الريزوباكترين فى كلا الموسمين .

من النتائج السابقة يمكن التوصية بان زراعة الفول البلدى محملا على بنجر السكر على مسافة ٣٠ سم مع اضافة ٧٢ كجم ن\فدان منفردا او فى تواليف مع السيريالين او الريزوباكترين سجلت اعلى انتاجية من بنجرالسكروالفول البلدى مع تحقيق افضل عائد من الفول البلدى وبنجر السكر فى كلا الموسمين .