Impact of Planting Methods and Plant Density on Intercropped Wheat with Sugar Beet

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ABSTRACT: Two field experiments were carried out at Etay El-Baroud Research Station, El-Beheira Governorate, Agric. Res Center in 2016/2017 and 2017/2018 seasons to evaluate three planting methods and four intercropping densities of wheat with sugar beet and their interaction. The obtained results indicated that planting sugar beet on wide ridges (120 cm width) and wheat on the wide of the same ridges (M_1) significantly increased yield and its components. The intercropping densities of wheat had significant effect on most of studied traits for this crop. Decrease densities of wheat lead to the highest values of all sugar beet characters and spike length of wheat, while No. of spikes/m^2, grain weight/m^2 of wheat were increased by increasing intercropping densities of wheat. A monoculture crop gave the highest values of both crops. Significant interaction effect between planting methods and intercropping plant density was found on some studied characters of the two crops under testing. Planting method intercropping combination on wide sugar beet ridges 120 cm width (M_1) resulted in the greatest land eqvillant ratio (LER) and gross returns. The results showed that the productivity of land increased by intercropping 12.50 % of wheat seeding rate per feddan with sugar beet gave the highest LER and gross returns. The best productivity of land was achieved by planting wheat with sugar beet on sugar beet ridges 120 cm width (M_1) by using intercropping density 12.50 %.

key words: Intercropping, Sugar beet, Wheat, planting, density, intercroping

INTRODUCTION

Sugar is an essential commodity and an integral part of the 'food world and the cheapest source of energy. An overview of sugar beet (*Beta vulgaris* L.) indicates that it is an important commercial biennial root crop of the world, extensively grown for sugar and ethanol production. Sugar beet plant is one of the most efficient convertors of solar energy into stored energy and has great potential for augmenting sugar production at lower cost (Ahlawat *et al*., 2002. The cultivated area with sugar beet in Egypt was 559744 feddan yield about 11209160 ton). Wheat is one the main cereal crops, cultivated to meet the great demands of the population for bread flour in Egypt. The area of wheat in Egypt estimated about 3353151 feddan and production was 9342538 ton according to (FAO, 2017).

Intercropping wheat with sugar beet and planting methods are one of the recent agro techniques that can be employed to decrease the intercrop competition. The introduction of wide row spacing in intercropping dose not only minimal competition impacts, but also provide enough space for greater population of intercrops to achieve higher productivity. Thus, development of suitable intercropping system by evaluating the performance of wheat different row proportions with wider spacing of sugar beet (120 cm) is needed to increase the sugar production and net income. On the other hand, wheat was as an intercrop in sugar beet helps to augment ethanol requirement. The

intercropping will help to improve the income per unit area by increasing yield and its components of crop like sugar beet and reducing fertilizer requirements, which will ultimately enhance the economic status of growers and sugar productivity (Gao et al., 2014; Kumar *et al.,* 2014; Salama *et al.,* 2016; and Hamdany and El-Aassar, 2017). However, Egbe (2010) revealed that intercropping is important because it offers potential advantages for resource utilization, reduced inputs and enhanced sustainability in yield of crop. On the other hand, Farghaly *et al*. (2003) indicated that the highest Average values of land equivalent ratio were observed when sugar beet was intercropped with onion, while the least were found when sugar beet was intercropped with faba bean.

The objective of this investigating is to study the effect of different rows in planting methods; to study the different intercropping densities of wheat with sugar beet on growth, yield and quality of sugar beet in an intercropping system; and to study the economic benefits of such intercropping system.

MATERIL AND METHODS

Two field experiments were carried out at Etay El-Baroud Research Station El- Beheira Governorate, during 2016/2017 and 2017/2018 seasons to study the effect of three planting methods and four intercropping densities of wheat (*Triticum aestivum* L.) cv. Giza 94 variety with sugar beet (*Beta vulgaris* L.) cv. Halawa kws variety. Preceding crop was maize in both seasons. The soil texture of the experimental site was clay, having a physical composition as follows: 11.10% sand, 32.77% silt, 60.68% clay and 0.50% organic matter. The results of soil chemical analysis as follows: pH 7.75, available Ca=6.05meq/L, available Mg=3.49 meq/L, available Na=8.64 meq/L and available K= 2.30 meq/L. A split-plot design with four replications was used. The three planting methods were allocatted main plots and four different densities of wheat plants as well as sugar beet and wheat as a monoculture crop were distributed at random to sub-plots. Where, three planting methods i.e. (planting sugar beet on wide ridges 120 cm width on both sides and planting wheat on the width of the ridges (M_1), planting sugar beet on ridges (60 cm narrow) on one side, planting wheat on one sugar beet ridge alternating with one solid sugar beet ridge the (M_2) and planting sugar beet on ridges (60 cm narrow) on one side and planting wheat on the ridges (M_3) and four intercropping densities of wheat with sugar beet i.e. 6.25% of wheat density with sugar beet (D_1), 12.5% of wheat density with sugar beet (D_2), 25% of wheat density with sugar beet (D_3) and 50% of wheat density with sugar beet (D_4) and cultivation of wheat alone and sugar beet alone. In all intercropping systems and pure stand sugar beet was planted in 100% (35000 plant/fed) density.

The number of rows in sub- plot were 4 ridges (120 cm width) or 8 ridges 60 cm narrow, the length of ridge was 3.5 m (plot area was 16.8 m^2 = 1/250 of feddan).All the other culture treatments were done according to the recommendation of the ministry of Agriculture and land reclamation.

Sugar beet was planted in 30th of October and wheat in 26th of November in the first and second seasons, respectively. Harvesting date was 10th and 5th May for sugar beet and 15th and 10th May for wheat in the first and second seasons, respectively.

Table (1). Meteorological records of Central Laboratory for Agriculture Climate (Source: Etay El-Baroud Research Station, during 2016/2017 and 2017/2018 seasons)

Meteorological Records	Air temperature (C^o)						Air Relative humidity (%)	
Season	2016/17			2017/18			2016/17	2017/18
Month	Aver	Min	Max	aver	Min	Max	aver	Aver
January	14.45	6.50	22.40	15.05	6.0	24.10	71	78
February	16.55	7.0	26.10	17.85	6.1	28.60	79	75
March	20.75	9.10	32.40	21.55	9.0	34.10	71	64
April	22.70	9.30	36.10	24.10	11.0	37.20	67	64
May	23.78	10.06	37.67	25.64	11.9	39.38	68	64

Studied characters:

1-Sugar beet attributes were root length (cm), root diameter (cm), root weight (g), root yield (ton)/fed and top yield (ton/fed). Fresh sugar beet samples taking for sucrose% using sacharemeter according to Le-Docte (1927), and sugar yield (tons/fed) was determined according to the method of Delta Sugar Company in Kafrel-Sheikh where approximately 3.07 % of the sucrose percentage is considered as a loss during industrial practices.

2-Wheat attributes were; plant height (cm), spike length (cm), number of spikes/m^2, grain weight/m^2, grain yield in ardabs (one ardab = 150 kg/fed), straw yield (tons/fed) and 1000- grain weight (g).

Evaluation of intercropping characters:

1-Land equivalent ratio (LER).

LER is considered as the sum of fractions of the intercropped yield related to their sole crop yields. It is usually assumed that the same level of management ratio must be the same for intercropping as for solid cropping. This was determined according to Willey and Soiree (1972).

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

Where: Y_{ab}= yield of crop (a) intercropped with crop (b), Y_{ba}= yield of crop (b) intercropped with crop (a), Y_{aa}= yield of crop (a) as a monoculture crop, and Y_{bb}= yield of crop (b) as a monoculture crop.

2- Economic attributes:

An economic analysis for the results of the experiments were done to investigate the variances between the different levels of studied factors to get the highest profitability of intercropping patterns compared with a monoculture crop.

Gross income = total from selling sugar beet production {(Root yield (ton) + top yield (ton)} and wheat production {(grains at (ardab) + straw yield (tan)}. It was worked out on the basis of local market price prevailing the harvest time of the produce were used {the price of sugar beet was 570 and 700 L.E/ton of root, 100 and 150 L.E/ton of top. 540 and 570 L.E/ardab of grain and 1000 and 1400 L.E/ton of straw of wheat} in both seasons, respectively. The statistical analysis was carried out according to Snedecor and Cochron (1967). Treatment Averages were compared by L.S.D at 0.05 level of probability. The analysis of variance (ANOVA) was computed using CoStat V 6.4 (2005) program.

RESULTES AND DISCUION

A. Sugar beet.

The results in (Table 2) indicated that studied characters were significantly affected by planting methods in both seasons, top yield (ton per fed) and sucrose% were significantly affected by planting methods in 2017/2018 season only. The planting method (M_1) had the highest values, while (M_3) planting method recorded the lowest values for these traits. Root length, root diameter, root weight, root yield per fed, sugar yield per fed were significantly affected by planting methods in both seasons. Planting method (M_1) had the highest values for these traits, but planting method (M_3) recorded the lowest values. These data are in agreement with those reported by (Zahoor *et al*., 2010).

Results in Table (2) revealed that intercropping densities of wheat plants with sugar beet had significant effect on all studied characters in both seasons except root length in the first season. Planting sugar beet in pure stand gave the tallest root length (26.56cm), followed by growing sugar beet under intercropping density (D_1). Root diameter, root weight, root yield per fed, top yield per fed, sucrose% and sugar yield per fed were significantly affected by intercropping densities of wheat with sugar beet in both seasons. The monoculture crop had the highest values for root diameter (9.67 and 9.96cm), root yield (672.96 and 670.51g), root yield/fed (23.567 and 23.347 t/fed), top yield (10.281 and 9.898 t/fed), sucrose% (17.36 and 20.22%) and sugar yield/fed (4.006 and 4.753t/fed), followed by planting sugar beet under intercropping density (D_1) for these characters root diameter (7.95 & 8.43cm), root weight (533.03 & 521.54g), root yield per fed (18.223 & 17.891t/fed), top yield per fed (8.380 & 8.239t/fed), sucrose% (18.32 & 19.78%) and sugar yield per fed (3.318 & 4.583t/fed), in the two seasons, respectively. While the lowest values were obtained when planting sugar beet under density (D_4) for the pervious mentioned characters in the first and second seasons, respectively. These results are in harmony with those reported by Salama *et al*. (2016) who intercropped sugar beet with wheat, barley and faba bean and found that root yield (ton ha^{-1}), harvest index and sugar yield (ton ha^{-1}) of sugar beet, pure stands of sugar beet were superior for these characters followed by sugar beet intercropped with the lowest companion crops percentage.

Table (2). Sugar beet attributes as affected by planting methods and intercropping densities of wheat in 2016/2017 and 2017/2018 seasons

Treatments	Root length (cm)		Root diameter (cm)		Root weight (g)		Root yield (ton/fed)		Top yield (ton/fed)		Sucrose(%)		Sugar yield (ton/fed)	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
Planting methods														
M_1	27.00	29.40	8.93	9.26	600.67	595.48	20.832	20.602	7.830	8.261	17.12	20.80	3.583	4.301
M_2	22.88	22.20	7.36	7.56	546.47	553.63	18.550	18.715	8.068	8.137	17.10	19.40	3.120	3.261
M_3	25.09	24.62	5.95	6.21	317.32	342.50	12.726	12.080	5.607	5.547	17.17	17.93	2.259	2.194
Average	24.99	25.11	7.41	7.68	488.15	497.20	17.369	17.132	7.168	7.315	17.13	19.38	2.987	3.252
L.S.D.at5%	0.43	1.94	1.05	0.70	87.85	45.48	2.066	1.574	NS	0.954	NS	1.32	0.393	0.046
Intercropping densities														
D_1	26.84	26.56	7.95	8.43	533.03	521.54	18.223	17.891	8.380	8.239	18.32	19.78	3.318	4.583
D_2	25.22	26.26	7.27	7.50	525.13	505.65	17.683	17.115	6.522	7.256	17.42	19.67	3.039	3.406
D_3	23.33	24.34	6.67	6.68	433.65	427.78	15.011	14.737	5.770	6.152	16.00	19.11	2.423	2.841
D_4	23.12	23.00	5.52	5.80	358.11	360.56	12.531	12.571	4.936	4.979	16.56	18.11	2.067	2.342
Pure stand	26.44	26.88	9.67	9.96	672.96	670.51	23.567	23.347	10.281	9.898	17.36	20.22	4.006	4.753
Average	24.99	25.41	7.42	7.67	504.58	497.21	17.403	17.132	7.178	7.305	17.13	19.38	2.971	3.585
L.S.D.at5%	NS	1.93	1.11	0.86	61.61	28.20	2.055	1.674	1.134	0.987	1.10	1.44	0.411	0.430
Interaction	NS	NS	NS	NS	NS	*	NS	*	*	*	NS	NS	NS	NS

- Planting wheat on the wide of the all ridges (M_1), planting sugar beet on ridges (60cm narrow) on the first side, planting wheat on one sugar beet ridge alternating with one solid sugar beet ridge (M_2) and planting sugar beet on rides (60cm narrow) on first side and planting wheat on all ridges (M_3).
- 6.25% of wheat density with sugar beet (D_1), 12.5% of wheat density with sugar beet (D_2), 25% of wheat density with sugar beet (D_3) and 50% of wheat density with sugar beet (D_4) and alone to planting sugar beet and wheat (pure stand).

Results in Table (3) revealed that root weight and root yield per fed in the first season and top yield per fed in both seasons were significantly affected by interaction. The highest values (731.33g) and (25.667t/fed) were recorded in a monoculture crop with planting method on narrow ridges {60cm (M_2)}, followed by planting sugar beet under intercropping density of wheat (D_1) on wide ridges {120cm width (M_1)}. Regarding to interaction in both seasons, where the highest top yield (11.611 & 11.701 ton/fed) were resulted from pure stand of sugar beet planted in 60 cm ridge (M_2).

Table (3). Effect of interaction between planting methods and density on root weight, root yield/fed and top yield/fed in both seasons.

Treatments		Root weight (g)	Root yield (ton/fed)	Top yield (ton/fed)	
P. methods	**I. densities**	**2017/18**	**2017/18**	**2016/17**	**2017/18**
M_1	D_1	629.45	21.708	9.333	9.800
	D_2	608.89	21.002	8.133	8.050
	D_3	550.96	18.933	6.800	7.933
	D_4	463.87	16.242	4.550	5.360
	Pure stand	724.22	25.124	10.333	10.160
	Average	595.48	20.602	7.830	8.261
M_2	D_1	599.08	20.222	9.816	9.310
	D_2	590.33	18.676	7.001	8.973
	D_3	467.48	15.943	6.233	5.833
	D_4	380.02	13.067	5.678	4.900
	Pure stand	731.33	25.667	11.611	11.701
	Average	553.65	18.715	8.068	8.143
M_3	D_1	336.09	11.744	5.991	5.761
	D_2	317.73	11.667	4.433	4.776
	D_3	264.89	9.334	4.278	4.689
	D_4	237.80	8.403	4.583	4.676
	Pure stand	555.99	19.251	8.750	7.834
	Average	342.50	12.080	5.607	5.547
LSD at 5%		48.85	2.081	1.964	1.709

- Planting wheat on the wide of the all ridges (M_1), planting sugar beet on ridges (60cm narrow) on the first side, planting wheat on one sugar beet ridge alternating with one solid sugar beet ridge (M_2) and planting sugar beet on rides (60cm narrow) on first side and planting wheat on all ridges (M_3).
- 6.25% of wheat density with sugar beet (D_1), 12.5% of wheat density with sugar beet (D_2), 25% of wheat density with sugar beet (D_3) and 50% of wheat density with sugar beet (D_4) and alone to planting sugar beet and wheat (pure stand).

B. Wheat attributes:

Results in Table (4) indicated that, plant height, spike length, 1000-grain weight and straw yield per fed were significantly affected by planting methods in 2017/2018 season only. The tallest plants were obtained when wheat was sown on narrow ridges (M_2) method, while the highest straw yield per fed was recorded when wheat was sown by (M_3) method. Planting wheat on wide ridges {120cm (M_1)} gave the highest values for spike length and 1000-gain weight. Number of spike/m^2, grain weight/m^2 and grain yield/fed (ardab) on the other hand, the highest number of spike /m^2 (184.44 & 190.38spike), grain weight /m^2 (423.06 & 415.38g) and grain yield / fed (11.96 & 11.75ardab) for these characters resulted by planting wheat on all sugar beet ridges (M_3) method, in both seasons respectively. Hassan et al. (2005) suggested that, methods of sowing were statistically significant for plant height, No. of grains/spike, 1000-grain weight and biological yield.

The results in the same Table reviled that, intercropping densities of wheat plants with sugar beet had significant effect in all studied treats of wheat except plant height in first season and spike length in the second season and 1000-grain weight in both seasons. The tallest plants were observed when wheat was grown under intercropping density (D_4), the tallest spike length was observed when was grown wheat under intercropping density (D_1). Number of spikes/m^2, grain weight/m^2, grain yield/fed and straw yield/fed were significantly affected by intercropping densities in 2016/2017 and 2017/2018 seasons. Planting wheat alone had the highest values in these treats, (152.63 and 159.15spike), (374.74 & 364.78g), 10.59 & 10.29 ardab) and (2.393 & 2.831ton) followed by planting wheat under intercropping density (D4), which were in the first and second seasons, respectively. Similar results were reported by Salama *et al*. (2016).

Table (4). Yield, yield components of wheat as affected by planting methods and intercropping densities during 2016/2017 and 2017/2018 seasons

Treatments	Plant height (cm)		Spike length(cm)		No of spikes/m^2		Grain weight/m^2 (g)		1000-grain weight (g)		Grain yield (ardab/fed)		Straw yield (ton/fed)	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
Planting. Methods														
M_1	98.49	94.12	13.92	17.68	136.40	140.80	355.36	345.00	53.36	52..46	9.93	9.78	2.861	2.765
M_2	97.25	94.53	14.47	16.03	137.17	141.25	314.25	311.87	50..16	48.66	8.84	8.78	2.643	2.635
M_3	98.58	89.28	13.67	15.39	184.44	190.38	423.06	415.38	50.89	49.91	11.96	11.75	3.179	3.147
Average	98.11	92.64	14.02	16.37	152.67	157.48	364.22	357.42	51.47	50.34	10.24	10.10	2.894	2.849
LSD at 5%	NS	2.14	NS	1.36	24.33	12.24	37.68	32.91	NS	3.02	0.78	0.56	NS	0.279
Intercropping. Densities														
D_1	102.40	89.67	15.86	16.91	102.06	108.28	240.76	237.50	53.70	52.32	6.87	6.94	2.197	2.142
D_2	99.86	92.67	14.22	16.33	114.15	119.84	277.28	272.13	51.44	50.59	7.89	7.71	2.415	2.408
D_3	98.69	92.75	14.28	16.75	131.52	134.37	326.05	319.90	51.16	49.54	9.17	9.02	2.570	2.625
D_4	96.93	94.20	13.04	15.91	152.63	159.15	374.74	364.78	49.82	48.47	10.59	10.29	2.893	2.831
Pure stand	92.67	93.93	12.73	15.92	263.01	268.52	602.27	592.75	51.28	50.81	16.70	17.02	4.397	4.238
Average	98.11	92.64	14.03	16.36	152.67	158.03	364.22	357.41	51.48	50.35	10.24	10.20	2.894	2.849
LSD at 5%	NS	2.73	1.16	NS	54.17	23.54	36.12	33.42	NS	NS	2.83	1.32	0.408	0.230
Interaction	NS	NS	*	NS	NS	40.77	NS	*	NS	NS	NS	*	Ns	NS

- Planting wheat on the wide of the all ridges (M_1), planting sugar beet on ridges (60cm narrow) on the first side, planting wheat on one sugar beet ridge alternating with one solid sugar beet ridge (M_2) and planting sugar beet on rides (60cm narrow) on first side and planting wheat on all ridges (M_3).
- 6.25% of wheat density with sugar beet (D_1), 12.5% of wheat density with sugar beet (D_2), 25% of wheat density with sugar beet (D_3) and 50% of wheat density with sugar beet (D_4) and alone to planting sugar beet and wheat (pure stand).

The interaction between the studied factors had no significant interaction between the two factors for most of studied characters except of spike length, number of spikes/m^2, grain weight/m^2 and grain yield per fed. The tallest spikes length obtained under the lowest intercropping density (D_1) with planting method (M_3) in 2017/2018 season. Number of spikes/m^2, grain weight/m^2, and grain yield per fed recorded the highest value when planting wheat in solid with planting method (M3), followed by the highest intercropping density of wheat (D_4) with the same planting method (M_3).

Table (5). Effect of interaction between planting methods and intercropping density on yield of wheat in both seasons

Treatments		Spike length (cm)	No of spikes/m^2	Grain weight (g/m^2)	Grain yield (ardab/fed)
Planting methods	**Intercropping densities**	**2016/17**	**2017/18**	**2017/18**	**2017/18**
M_1	D_1	15.87	97.00	235.00	6.69
	D_2	13.33	118.00	260.00	7.21
	D_3	13.53	135.00	320.00	9.02
	D_4	13.73	154.00	340.00	9.91
	Pure stand	13.13	200.00	570.00	16.08
	Average	13.92	140.80	345.00	9.78
M_2	D_1	15.33	79.50	185.83	5.22
	D_2	14.93	93.18	220.84	6.32
	D_3	14.94	107.00	256.67	7.41
	D_4	13.27	129.89	296.11	8.34
	Pure stand	14.20	296.67	599.90	16.63
	Average	14.47	141.25	311.87	8.78
M_3	D_1	16.87	140.00	291.67	8.90
	D_2	14.40	148.34	335.56	9.60
	D_3	14.67	161.12	383.00	10.62
	D_4	12.13	193.56	458.33	12.61
	Pure stand	10.87	308.89	608.34	17.02
	Average	13.67	190.38	415.38	11.75
L. S. D. at 5%		2.01	40.77	57.88	2.19

- Planting wheat on the wide of the all ridges (M_1), planting sugar beet on ridges (60cm narrow) on the first side, planting wheat on one sugar beet ridge alternating with one solid sugar beet ridge (M_2) and planting sugar beet on rides (60cm narrow) on first side and planting wheat on all ridges (M_3).
- 6.25% of wheat density with sugar beet (D_1), 12.5% of wheat density with sugar beet (D_2), 25% of wheat density with sugar beet (D_3) and 50% of wheat density with sugar beet (D_4) and alone to planting sugar beet and wheat (pure stand).

C. Yield advantages:

C.1. Land equivalent ratio (LER):

Results in Table (6) revealed that the highest values of LER (1.244 and 1.285) were recorded by planting on ridges {120cm (M_1)}, while the lowest values of LER (1.120 and 1.073) were recorded by planting on ridges {60cm (M_2)} in the two seasons, respectively.

Generally, results show that, land equivalent ratio (LER) exceeded unite in all intercropping combinations between sugar beet and wheat during the two seasons. Intercropping 12.50% of wheat density with sugar beet (D_2) had the highest values (1.210 and 1.187) in the first and second seasons, respectively. (Salama *et al*., 2016) reported values of LER were greater than 1.00 in any intercropping system of sugar beet with wheat, barley, and faba bean, indicating an advantage of the intercropping patterns for land usage and yield gain.

C.2. Gross returns (L.E. /fed):

Data in Table (6) showed that sowing on sugar beet on ridges {120cm width (M_1)} achieved the higher gross return (18167.11 and 21038.95 LE) in the first and second seasons. Generally all intercropping systems recorded gross return higher than monoculture crops in both crops in the first and second seasons. The highest gross return (18061.94 and 20953.63 LE) was achieved when sowing 12.50% wheat density with sugar beet (D_2) in the first and second seasons respectively. The best gross return of land, as indicated by results was obtained by sowing wheat density of 12.50% with sugar beet planted on wide {120cm width (M1)} in the first and second seasons. These results are confirmed with those recorded by Abd El-Zaher and Gendy (2014) who found that, the total income of sugar beet in all intercropping treatments was evidently higher than that of the solid plantings.

Table (6). Interaction effect of planting methods and wheat intercropping densities on land equivalent ratio (LER) and gross returns (L.E. /fed) in both seasons

Planting methods (M)	Plant density of wheat (D)													
	D_1		D_2		D_3		D_4		Sole s. beet		Sole wheat		Average	
	LER	G. ret.	LER	G. ret.	LER	G. ret.	LER	G. ret.	LER	G. ret.	LER	G. ret.	LER	G. ret.
2016/2017														
M_1	1.218	19735.44	1.271	19489.11	1.256	19565.17	1.232	19201.64	1.000	16093.68	1.000	14917.60	1.244	18167.11
M_2	1.149	17869.23	1.180	18121.62	1.101	16802.25	1.047	16232.15	1.000	14788.26	1.000	15052.80	1.120	16477.72
M_3	1.154	16182.18	1.181	16575.09	1.180	16517.55	1.192	16628.24	1.000	12180.09	1.000	15549.60	1.177	15605.46
Average	1.174	17928.95	1.210	18061.94	1.179	17628.32	1.157	17354.01	1.000	14354.01	1.000	15173.33	1.180	16750.09
2017/2018														
M_1	1.280	23041.70	1.284	23348.90	1.315	23307.80	1.262	22163.70	1.000	18602.80	1.000	15768.80	1.285	21038.95
M_2	1.102	21245.80	1.108	20942.70	1.067	19779.90	1.011	18491.50	1.000	19137.00	1.000	16087.10	1.073	19280.67
M_3	1.133	17913.10	1.170	18569.30	1.109	17723.30	1.177	18417.40	1.000	14259.40	1.000	16832.60	1.147	17285.80
Average	1.172	20733.53	1.187	20953.63	1.164	20270.33	1.150	19690.87	1.000	17352.97	1.000	16229.50	1.168	19201.80

- Planting wheat on the wide of the all ridges (M_1), planting sugar beet on ridges (60cm narrow) on the first side, planting wheat on one sugar beet ridge alternating with one solid sugar beet ridge (M_2) and planting sugar beet on rides (60cm narrow) on first side and planting wheat on all ridges (M_3).
- 6.25% of wheat density with sugar beet (D_1), 12.5% of wheat density with sugar beet (D_2), 25% of wheat density with sugar beet (D_3) and 50% of wheat density with sugar beet (D_4) and alone to planting sugar beet and wheat (pure stand).

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الملخص العربي

تأثير طرق الزراعة والكثافة النباتية للقمح المحمل على بنجر السكر

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تم إجراء تجربتين حقليتين خلال موسمي ٢٠١٦/٢٠١٧ و٢٠١٧/٢٠١٨ بمحطة البحوث الزراعية بإبتاي البارود – محافظة البحيرة لتقييم تأثير ثلاثة نظم زراعة (زراعة بنجر السكر على خطوط (١٢٠سم) وزراعة القمح على ظهر الخط(M1), زراعة بنجر السكر على خطوط (٦٠ سم) وزراعة القمح على على خط للبنجر وترك الأخر(M2) وزراعة بنجر السكر على خطوط (٦٠سم) وزراعة القمح على كل خطوط البنجر (M3). وأربع كثافات لتحميل القمح مع بنجر السكر (٦.٢٥% من تقاوى الفدان للقمح مع بنجر السكر (D1) و ١٢.٥٠% من تقاوى الفدان للقمح مع بنجر السكر (D2) و 25% من تقاوى الفدان للقمح مع بنجر السكر (D3) و٥٠% من تقاوى الفدان للقمح مع بنجر السكر (D4) بالإضافة إلي زراعة بنجر السكر منفردا وزراعة القمح منفردا. وكانت زراعة بنجر السكر ١٠٠% في كل المعاملات.

وكانت أهم النتائج ما يلي:

- زراعة بنجر السكر على خطوط ١٢٠ (M1) أدى إلي زيادة معنوية في كل صفات بنجر السكر والقمح.
- أثرت كثافات القمح مع بنجر السكر: معنويا على كل الصفات في المحصولين ماعدا وزن الألف حبة في القمح. بينما أدت كثافة القمح إلي زيادة معنوية في صفات بنجر السكر بينما عدد السنابل ووزن الحبوب/م٢ ومحصول حبوب وقش الفدان من القمح زاد بزيادة كثافة القمح. الزراعة المنفردة أعطت أعلى القيم في كلا المحصولين.
- تأثرت معنويا بالتفاعل بين عاملي الدراسة على بعض الصفات المدروسة لكلا المحصولين.
- طريقة الزراعة (M1) ١٢٠سم وكثافة القمح ١٢.٥٠% (D2) أعطت أعلى قيم (LER) وإجمالي الدخل. أعطى أعلي قيم (LER) وإجمالي الدخل.
- يمكن الحصول على أعلى إنتاجية وأعلى مكافئ أرضى وأعلى عائد بزراعة بنجر السكر على خطوط ١٢٠سم باستخدام كثافة القمح ١٢.٥٠%.