

MAXIMIZING PRODUCTIVITY BY INTERCROPPING SOME WINTER CROPS ON SUGER BEET

Gadallah , R.E; A.M, Abdel-Galil and F. R. Nawar .

Crop Intensification Res. Section, Field Crops Research Institute, Agric, Rs, Cent., Giza, Egypt

ABSTRACT

Two field experiments were conducted at Mallawi Experimental Station (Middle Egypt) during 2002/2003 and 2003/2004 seasons to study the effect of intercropping sugar beet with onion , faba bean or wheat on yield and yield components of sugar beet . The experimental design was randomized complete block design with three replications . The important results could be summarized as follows :

1. Yield of sugar beet was significantly reduced by intercropping and the reduction was more evident wheat as compared with pure stand in both seasons Yield and yield components under bed system (120 cm) were higher than that grown on ridges (60 cm) .
2. Chemical characters of sugar beet i-e T.S.S % , sucrose % and sugar yield / fad were significantly reduced by intercropping and the reduction was in highest value when intercropped with wheat comparing with pure stand in both seasons .
3. Intercropping onion with sugar beet on bed system gave higher yield than on ridges. Bulb weight under bed system was heavier than under pure stand . However intercropped bulb yield / fad was reduced as compared to pure stand .
4. Faba bean and wheat yield were significantly decreased by intercropping comparing with pure stand . The yield of faba bean and wheat grown with sugar beet on bed system were higher than under ridges .
5. The highest values of LER and gross return were observed when sugar beet intercropping with onion on bed system .

This study showed that grown sugar beet with onion on bed system gave the highest economic return for the farmers .

INTRODUCTION

Agricultural intensification is considered to be one of the important ways of solving or decreasing the gap between production and consumption of food products . Application of intercropping some field crops with other crops such as sugar beet , sugar cane, cotton, would decrease the food gap especially for strategic food crops .

Some farmers started to plant faba bean in an irregular arrangement in sugar beet fields . Sugar beet yield was not significantly reduced by intercropping with faba bean and it raised the total income Nour and Farag (1984), Farag (1990) and EL-Borai and Radi (1993). Whereas, Abou -Kerasha *et al.*(1991) , Amer *et al.*(1997), Metwally *et al.*(1997), Abd El-All, (2002) and Farghaly *et al.*(2003), indicated that monoculture planting gave the highest values of yield and its components of sugar beet as compared to the intercropping systems . Abdel - Aal *et al.* (1989) they concluded that the intercropping faba bean at different densities on sugar beet decreased root length and diameter

and yield of top and root per plant and per faddan of beet as compared to sole planting. Abou- Keriasha *et al.*(1991). showed that seed yield / plant , seed index and seed yield / fad of faba bean were statically influenced by intercropping . Monoculture faba bean , chick pea and lentil produced the highest means of plant higher and seed yield / faddan than the other intercropping systems Amer *et al.*(1997) , Metwally *et al.*(1997) , Hussein and El-Deeb , (1999) and Farghaly *et al.*(2003) showed that yield of sugar beet intercropped with onion , faba bean and chickpea were reduced by intercropping .The highest values for LER were observed when intercropping sugar beet with onion, while the lowest values were done when intercropping sugar beet with faba been. Besheit *et al.*(2002) found that the highest sugar beet quality and productivity were obtained from beet planted on ridge (100 cm) width and intercropped with two onion rows, while intercropping onion on the other side of sugar beet ridge (50 cm) width was higher and negativity affected sugar beet quality and productivity . Marey, (2003) recorded that the intercropping resulted in a significant decrease in number of leaves / plant , top weight / plant , root length , root diameter, root weight and yield of top or root / fad . Hussein and El-Deeb (1999) found that intercropping faba been at a density of 4 plants / m² with sugar beet increased profitability by L.E 12.5 % than solid sugar beet. Toaima *et al.*(2001) found that higher yield was obtained with the intercropping system when it was 120 cm width ridges higher LER were (1.56,1.51) for onion, (1.53, 1.52) for garlic and total income (3174, 3154 L.E) for onion and (4103 , 4120 L.E) for garlic in both seasons respectively .

MATERIAL AND METHODS

Two field trials were carried out at Mallawi Agriculture Research Station in Minia governorate (Middle Egypt) during 2002 / 2003 , and 2003 / 2004 seasons to investigate the effect of intercropping sugar beet (cv. Gloria) with onion (Giza 6), faba bean (Giza 674) and wheat (Giza 168) on yield and its components of sugar beet .The experimental design was randomized complete block system with three replication . The plot area was 10.8 m² containing of 3 beds or 6 ridges, 6 m long . The treatments were :-

1. Sugar beet was planted on one side of ridges (60 cm),at a distance of 20 cm apart (35.000 plants / fad) and onion was transplanted on the other side of ridge 10 cm apart (70.000 plants / fad) .
2. Sugar beet was planted on one side of ridges (60 cm), 20 cm. apart (35.000 plants / fad) and faba bean planted in one row on the other side 10 cm . apart two plants / hill (70.000 planted / fad) .
3. Sugar beet was planted on one side of ridges (60 cm) , at a distance 20 cm apart (35.000 plants / fad) and wheat was planted in one row on the other side, 10 cm apart between hills .
4. Sugar beet was planted on both sides of the bed system (120 cm), at a distance of 20 cm. apart between hills (35.000 plants / fad) and onion was transplanted as two rows on the top of the ridges, at a distance of

- 20 cm. apart between rows and 10 cm. between hills (70.000 plants / fad).
- Sugar beet was planted on both sides of the bed system and faba bean was planted as two rows on the top bed at a distance of 20 cm. between rows and 10 cm. between hills and thinned to two plants / hill (140.000 plants / fad).
 - Sugar beet was planted on both sides of the bed system and wheat was sown on two rows on the top of the bed , at a distance of 20 cm between rows and hills .

The solid crops of onion and faba bean were planted on both sides of ridges (60 cm.), at a distance of 10 cm between hills (70.000 plants for onion and 140.000 plants for faba bean / fad), while solid sugar beet was planted on one side of ridges at a distance of 20 cm between hills (35.000 plants / fad .) and wheat was seeded in rows (20 cm between rows). The preceding crop was maize in the two seasons.

Data of sowing and harvesting dates for the four crops recorded in Table 1 .

Table 1 : Sowing and harvesting dates of sugar beet, onion, faba bean and wheat in both seasons .

Season	Sowing date				Harvesting date			
	S.beet	onion	F. bean	wheat	S.beet	onion	F.bean	Wheat
002/ 2003	Oct.28 th	Nov.18 th	Oct.28 th	Nov.11 st	May.15 th	Apr.22 nd	Apr.23 rd	May.11 st
003/ 2004	Nov.3 rd	Nov.23 rd	Oct.23 rd	Nov.8 th	May.23 rd	Apr.18 th	May.3 rd	May.8 th

Normal cultural practices were done for crops under study ,either in pure stand or intercropped as recommended . Calcium super phosphate (15 kg P₂ O₅ / fad) was added during soil preparation .Potassium fertilizer was applied as potassium sulphate (48 K₂O) at the rate of 24 kg K₂O / fad with the first N-dose . Nitrogen fertilizer for sugar beet (90 kg N / fad) was added after thinning and after 75 days from sowing. While nitrogen fertilizer for onion (60 kg N / fad) in three doses , the first dose was applied during transplanting , the second dose after one month and the third one after two months from transplanting . For wheat nitrogen (60 Kg N / fad) was applied in three equal doses before first, second and third irrigations.

Ten plants from each treatment were chosen randomly to determine yield parameters. While the yield / fad . was determined from the whole plot . The traits under study were ;

1-Sugar beet .

Number of roots / m² (at harvesting) , root length (cm) ,root diameter (cm) , root fresh weight / plant (gm) , root yield (ton / fad) , top fresh weight / plant (kg) , top length (cm) and top yield (ton / fad .) .Quality attributes : A fresh sample was taken from fresh roots of sugar beet plants representing each treatment to determine : total soluble solids percentage (T.S.S%) was measured by using hand refractometer according to A.O.A.C. (1984). Sucrose % by saccharemeter according to Le-Docte (1927) , purity % was calculated as (sucrose % by T.S.S%) x 100 and sugar yield = root yield (ton/fad) x sucrose % .

2-Onion

Number of bulbs / m², bulb diameter (cm), bulb weight (g) and bulb yield (ton / fad).

3-Faba bean

Number of branches / plant , number of pods / plant , number of seeds / plant , seed yield / plant (g), seed yield (ardab / fad) and straw yield (ton / fad).

4-Wheat

Number of grains / spike , spike length (cm), weight of grains/ spike, 1000 grain weight (g), grain yield (ardab / fad.) and straw yield (ton/ fad).

Competitive relationships

1-Land equivalent ratio (LER) : According to Willy (1979) the following formula was used :

$$LER = \frac{yab}{yaa} + \frac{yba}{ybb}$$

where : yaa = pure stand yield of species a

ybb = pure stand yield of species b

yab = Mixture yield of a (when combined with b)

yba = Mixture yield of b (when combined with a)

2-Relative crowding coefficient (Rcc)

According to Dewit (1960) K for crop a, (K) for crop b and (Rcc) for the two crops were calculated as follows :-

$$K_{ab} = \frac{yab \times zba}{(yaa - yab) \times zab}, K_{ba} = \frac{yba \times zab}{(ybb - yba) \times zba}$$

where = zab = sown proportion of crop a (in a mixture with b) .

zba = sown proportion of crop b (in a mixture with a) .

if ever $k > 1$ there is a yield advantage, if $k = 1$ there is no difference and there is yield disadvantage if $k < 1$.

3-Aggressivity (Agg)

This was proposed by Mc-Gilchrist (1960) and was determined according to the following formula .

$$A_{ab} = \frac{yab}{yaa \times zab} - \frac{yba}{ybb \times zba}$$

An aggressivity value of zero indicates that the component crops are equally competitive . For any other situation both crops will have the same numerical value , but , the sign of the dominante crop will be positive and the dominated negative. The greater the numerical value of (Agg) , the bigger the difference in competitive abilities and the bigger the difference between actual and expected yields .

4-Gross profit :

Gross profit was calculated in Egyptian pound (L.E / ton) for sugar beet and onion (L.E.100 / ton) for sugar beet and (L.E 216.5 / ton for onion).

Prices of faba bean and wheat seeds were L.E 195 / arḍab for faba bean L.E 175 / arḍab for wheat , according to Ministry of Agriculture and land Reclamation, Economic Affairs Sector Agricultural Statistics, volume 2 , March 2002 pp:113 ,114 .

Data of the two seasons were Statically analyzed according to Snedecor and Cochran (1988) using MSTAT computer V + (1986) and L.S.D test at 5 % level was used to compare between treatment .

RESULTS AND DISCUSSION

I. Sugar beet

Data presented in Tables (2 and 3) showed that yield , yield components and chemical characters of sugar beet were significantly affected by intercropped crops in both seasons except in cases of T.S.S.% in the first season and purity % in both seasons .Number of roots /m², top root and chemical characters were less affected when intercropped with onion whereas root fresh weight under bed system were increased . While these characters were more affected when intercropped with wheat . The highest values were observed when intercropping sugar beet with onion under bed system (120 cm.) , followed by onion under ridges (60 cm) . While the lowest values were observed when wheat was on ridges. The reduction in the characters when intercropped with onion on bed system were 9.03 and 11.65% for number of roots / m² , 17.17 and 23.48 % for top length , 17.43 and 33.33 % for top fresh weight 13.44 and 3.94 % for root length and 16.44 and 20.18 % for root diameter as compared to solid in the first and second seasons respectively. Sugar beet and onion grown on ridges , the reduction was 10.40 and 12.39 % for number of beets / m², 20.9 and 29.56 % for top length , 20.02 and 42.11 % for top fresh weight , 13.44 and 13.71% for root length, 29.08 and 24.4 % for root diameter and 0.06 and 0.04 % for root fresh weight as compared to solid in the first and second seasons respectively .

The intercropping of sugar beet and wheat on ridges the resulted in reduction by 38.57 and 34.80% for number of roots / m², 52.25 and 41.74 % for top length , 57.80 and 38.60 % for top fresh weight , 34.62 and 33.35 % for root length , 50.23 and 51.77 % for root diameter and 53.64 and 60.98 % for root fresh weight as compared to solid in the first and second seasons respectively.

Top and root yield of sugar beet per faddan were reduced when intercropping with onion , faba bean or wheat compared with pure stand . Top and root yield / fad were more affected when intercropped with wheat than with onion. Root yield of intercropped sugar beet with onion, faba bean or wheat were 14.59 and 11.89% with onion 38.23 and 38.11% with faba bean and 55.40 and 63.63 % with wheat under bed system in the first and second seasons respectively .While root yield under ridges were 29.63 and 27.65% of onion, 42.66 and 44.51% of faba bean and 66.70 and 63.63% of wheat in the first and second seasons respectively.

Table 2: Effect of intercropping some winter crops on yield and its components and chemical analysis of sugar beet (2002 / 2003 season)

Characters Treatments	No of roots at harvesting /m ²	Top fresh length (cm)	Top fresh weight (kg)	Top yield ton/ fad	Root length (cm)	Root diameter (cm)	Root fresh weight / plant(kg)	Root yield ton/ fad	T.S.S %	Sucrose %	Purity %	Sugar yield ton/fad
Solid sugar beet	7.31	44.67	1.09	12.26	17.33	8.70	1.10	34.53	16.5	13.00	78.70	4.49
S.beet with onion on bed system	6.65	37.00	0.90	11.27	15.00	7.27	1.20	29.45	16.0	12.67	79.17	3.73
S. beet with onion on ridges	6.55	35.33	0.85	10.28	15.00	6.17	1.03	24.30	15.67	12.00	76.72	2.92
S. beet with F.bean on bed system	6.06	35.67	0.81	8.61	13.33	5.90	0.89	21.33	15.33	12.3	80.26	2.62
S. beet with F.bean on ridges	5.60	34.33	0.79	8.63	10.30	4.43	0.79	19.80	15.10	12.17	79.46	2.41
S. beet with wheat on bed system	4.91	25.70	0.52	6.36	13.01	4.60	0.57	15.40	15.25	12.23	80.2	1.88
S. beet with wheat on ridges	4.49	21.33	0.46	5.50	11.33	4.33	0.51	11.50	15.20	12.00	79.03	1.38
L.S.D 5%	0.66	5.56	0.094	1.03	1.37	0.85	0.13	2.39	NS	1.14	NS	0.38

Table 3 : Effect of intercropping some winter crops on yield and its components and chemical analysis of sugar beet (2003 / 2004 season)

Characters Treatments	No of roots at harvesting /m ²	Top length (cm)	Top fresh weight (kg)	Top yield ton/ fad	Root length (cm)	Root diameter (cm)	Root fresh weight / plant (kg)	Root yield ton/ fad	T.S.S %	Sucrose %	Purity %	Sugar yield ton/fad
Solid sugar beet	7.04	38.33	0.57	11.50	17.00	8.77	1.23	32.80	16.43	12.9	78.51	4.23
S.beet with onion on bed system	6.22	29.33	0.38	11.31	16.33	7.00	1.30	28.90	16.20	12.83	79.29	3.71
S. beet with onion on ridges	6.17	27.00	0.33	10.54	14.67	6.63	1.17	23.73	16.0	12.63	78.9	3.00
S.beet with F.bean on bed system	5.90	35.67	0.38	8.11	15.33	5.67	0.97	20.30	15.50	12.53	80.89	2.54
S. beet with F.bean on ridges	5.41	34.00	0.33	8.32	14.67	4.30	0.89	18.20	15.30	12.17	79.55	2.21
S.beet with wheat on bed system	5.22	22.33	0.37	5.87	12.33	4.33	0.61	13.50	15.30	12.53	81.9	1.69
S. beet with wheat on ridges	4.59	22.33	0.35	5.34	11.33	4.23	0.48	11.93	15.00	12.00	80.02	1.43
L.S.D 5%	0.52	8.78	0.22	0.39	3.04	1.69	0.13	1.79	0.85	0.43	NS	0.21

Regarding to chemical characters of sugar beet (T.S.S., sucrose, purity and sugar yield) in Tables (2 and 3) showed that T.S.S.% in the first season and sucrose % and sugar yield / fad in the two seasons only were significantly affected by intercropped crops (onion, faba bean and wheat). Intercropping onion , faba bean and wheat significantly decreased T.S.S% sucrose % and sugar yield / fad compared with pure stand sugar beet in the two seasons. This results are in agreement with these obtained by Amer *et al.*(1997) , Toaima *et al.*(2001) and Farghaly *et al.*(2003) .

It is clear that yield and yield components of sugar beet were less affected by intercropping with onion than intercropping with faba bean or wheat .This results are mainly large due to the lower below and above ground competition fore nutrients, water and light when intercropped sugar beet with onion as compared to the other intercropped crops. This findings are in agreement with those obtained by Amer *et al.*(1997), Toaime *et al.*(2001), Abd-El-Ail (2002) and Farghaly *et al.*(2003) .

The results also showed that the highest sugar beet quality and productivity were obtained from , planted sugar beet on both sides of bed system (120 cm), and intercropped with two onion rows on the top ridge, while the intercropped crops (onion, faba bean or wheat) planted on the other side of sugar beet of ridges (60cm) was highest negatively affected sugar beet quality and productively . Similar results were obtained by Beshit *et al.*(2002).

II . Intercropped crops

1.onion :

Data in Table 4 showed intercropping of sugar beet with onion on yield and yield components of onion, number of bulbs /m², bulb diameter, and bulb yield /fad. were decreased by intercropping while bulb weight under bed system was increased compared with pure stand.

The reduction under ridges was higher than under bed system . The reductions in the characters under bed system were 41.23 and 33.28 % for number of bulbs /m², 9.52 and 3.47 % for bulb diameter and 30.54 and 34.0 % for bulb yield / fad . Whereas under ridges were 73.98 and 70.88 % for number bulbs / m², 22.70 and 22.62 % for bulb diameter and 50.33 and 55.69 % for bulb yield / fad in first and second seasons respectively .

Bulb weight of onion on bed system was heavier (1.15 and 1.13% in both seasons) than pure stand. However, the intercropped bulb yield / fad was lesser than yield of pure stand. The current data indicated that the increase in bulb weight under bed system could not compensate the reduction in number of plants / fad actual stand to bulb yield / fad. The reduction in yield bulb under ridges due to bulb weight and number of bulb / m² were lesser than when planted under pure stand .These results may be attribute to the fact that increasing number of bulbs per unit area under ridge means high competition between plants for nutrients carbon dioxide , moisture , light etc . Similar results were obtained by Toaima *et al.*(2001) and Beshit *et al.*(2002).

Table 4: Effect of intercropping sugar beet with onion on yield and yield components of onion (2002 / 2003 and 2003 / 2004 seasons).

Characters	season 1					season 2				
	No. of bulbs at harvesting /m ²	Bulb diameter (cm)	Bulb weight (g)	Bulb yield ton/ fad	No. of bulbs at harvesting /m ²	Bulb diameter (cm)	Bulb weight (g)	Bulb yield ton/ fad		
Solid onion	31.82	6.30	130.00	7.63	28.61	6.63	146.70	6.50		
Onion with S. beet on bed system	18.70	5.70	150.00	5.30	19.09	6.40	166.40	4.29		
Onion with S. beet on ridges	8.28	4.87	96.70	3.79	8.33	5.13	106.80	2.88		
L.S.D 5%	0.45	1.13	31.61	0.88	1.18	1.04	13.09	0.60		

Table 5: Effect of intercropping sugar beet with faba bean on yield and yield components of faba bean (2002 / 2003 and 2003 / 2004 seasons).

Characters	season 1					season 2				
	No. of branches / plant	No. of pods / plant	No. of seeds / plant	Seed yield/ plant (g)	Seed yield / ardab / fad	No. of branches / plant	No. of pods / plant	No. of seeds / plant	Seed yield / ardab / fad	Straw yield ton / fad
Solid faba bean	3.07	20.67	2.87	24.30	6.87	3.27	21.30	3.07	24.79	4.44
Faba bean with S.beet on bed system	3.00	12.47	2.67	18.93	3.51	3.20	18.80	3.07	24.31	2.84
Faba bean with S.beet on ridges	2.60	11.13	2.47	16.43	2.59	2.87	14.47	2.80	10.14	2.42
L.S.D 5%	0.32	1.74	NS	5.37	0.95	0.11	1.08	NS	2.69	1.25

Faba bean :

Data in Table (5) show that all characters studied of faba bean were significantly affected by intercropping except no. of seeds / pod in both seasons, however no. of branches / plant, no. of pods / plant, no. of seeds / pod, seed yield / plant, seed yield / fad. and straw yield / fad. were decreased compared with pure stand in both seasons. Characters values of intercropped faba bean on sugar beet under bed system (120 cm) were higher than grow on ridges (60 cm). The reduction in characters under ridges were 15.31 and 12.23 % for number of branches / plant, 46.15 and 32.07 % for no. of pods / plant, 13.94 and 8.79 % for no. of seeds / pod and 32.39 and 26.83 % for seed yield / plant in the first and second seasons respectively. Seed yield of intercropping faba bean decreased on bed system and ridges were 48.98 and 62.30 % of pure stand in the first season 48.31 and 65.46 % of pure stand in the second season, respectively. The reduction in seed yield of intercropped faba bean due to that yield components character and number of plants per unit area (faddan) were decreased as compared to pure stand. These results were in harmony with those obtained by Abou -Kerasha et al (1991), Amer et al (1997) and Farghaly et al (2003).

2.Wheat_:

Data in Table (6) show that no. of grains / spike, grain yield and straw yield / fad were significantly affected by intercropping systems in both seasons. The highest values of spike length, no. of grains / spike, weight of grains spike and 1000 grain weight were observed when wheat grown with sugar beet on bed system, whereas, the lowest values were observed under ridges in both seasons. Grain and straw yield / fad of intercropped wheat were more decreased as compared to pure stand. Grain yield / fad under bed system were 68.37 and 71.26 % of pure stand, while, under ridges were 80.09 and 81.43 % of pure stand in the first and second seasons, respectively. The current data indicated that increase in spike length, no. of grains / spike weight of grains spike and 1000 grain weight under bed system could not compensate the reduction in number of plants / fad in the respect yield / fad.

III . Competitive relationships and advantage :

1.Land Equivalent Ratio (LER) :

Data presented in Tables (7 and 8) showed the effect of intercropping sugar beet with other winter crops (onion, faba bean or wheat) on land equivalent ratio (LER). Land equivalent ratio (LER) values was greater than one by intercropping sugar beet with onion on both bed system and ridges and with faba bean on bed system only in both seasons. This clarify that the actual productivity was higher than the expected productivity when sugar beet was intercropped with onion bed system or ridges and with faba bean on bed system. Sugar beet relative yield (RYS) was large when intercropping with onion under bed and ridges and with faba bean under bed system and it decreased when intercropping with wheat under both bed and ridges and with faba bean under ridges.

Table 6: Effect of intercropping sugar beet with wheat on yield and yield components of wheat (2002 / 2003 and 2003 / 2004 seasons).

Characters	season 1					season 2						
	Spike length (cm)	No. of grains / spike	Weight of grains / spike (g)	1000 grain weight (g)	Grain yield / ardab / fad	Straw yield / ton / fad	Spike length (cm)	No. of grains / spike	Weight of grains / spike (g)	1000 grain weight (g)	Grain yield / ardab / fad	Straw yield / ton / fad
Treatments												
Solid wheat	7.63	38.00	2.35	58.50	18.43	5.33	7.93	38.93	2.26	57.50	20.63	4.68
wheat with S.beet on bed system	8.07	41.00	2.41	58.70	5.83	2.52	8.70	41.13	2.68	58.00	5.93	2.45
wheat with S.beet on ridges	6.80	37.00	2.13	56.70	3.67	2.48	7.87	36.47	2.09	54.40	3.83	2.28
L.S.D 5%	NS	2.61	NS	NS	4.40	0.60	NS	0.93	NS	NS	2.70	.60

Table 7: Land Equivalent Ratio (LER), Relative crowding coefficient (Rcc) , Aggressivity (Agg) and total income on (2002 / 2003 season).

Characters	Land Equivalent Ratio		Relative Crowding Coefficient		Aggressivity	Total Income
	Ry S.beet	LER crop	K S.beet	Rcc crop		
Treatments						
S. beet with onion on bed system	0.85	0.69	1.54	13.17	+0.32	4092.5
S. beet with onion on ridges	0.70	0.50	1.20	2.35	+0.40	3034.04
S. beet with F. bean on bed system	0.62	0.51	1.13	1.68	+0.22	2817.45
S. beet with F. bean on ridges	0.57	0.38	0.95	0.82	+0.40	2485.05
S. beet with wheat on bed system	0.45	0.32	0.77	0.38	+0.19	2569.00
S. beet with wheat on ridges	0.33	0.20	0.53	0.13	+0.27	1792.25
Pure stand S. beet						3453.0
Pure stand onion						1651.9
Pure stand F. bean						1339.7
Pure stand wheat						3225.3

Relative yield of onion and faba bean only was over half when intercropping with sugar beet under bed system. The highest LER values (1.54 and 1.60) was observed when intercropping sugar beet with onion on bed system in the first and second seasons , respectively . On the other hand of these values it could be concluded that planting sugar beet with onion under bed system may produce the best yield advantage and the highest land usage . This results was confirmed by Toaime et al (2001) and Farghaly et al.(2003).

2. Relative crowding coefficient (RCC) (k):

If a species has a relative crowding coefficient (K) less than, equal to or greater than one this means that it produced less yield , the same yield or more yield than expected, respectively .

Data in Tables (7 and 8) show that relative crowding coefficient (K) for both sugar beet and intercropped crops was large when intercropping with onion and decreased under ridges . The highest values of K was observed by when intercropping sugar beet with onion under bed system (13.17 and 17.86) in the first and second seasons, respectively. While the lowest values was observed when intercropping sugar beet with wheat under ridges (0.13 and 0.13) in the two seasons, respectively .

3. Aggressivity (Agg) :

Data in Tables (7 and 8) showed that intercropping sugar beet with onion under ridge gave the highest values of (Agg) 0.40 and 0.56 in the first and second seasons , respectively . The lowest values (0.19 and 0.21) in the first and second seasons, were observed when intercropping sugar beet with wheat and with faba bean under bed system. Sugar beet was the dominant (positive values) , whereas the intercropped crops (onion , faba bean or wheat) were the dominated crops (negative values) . This results is in disagreement with that found by Farghaly et al.(2003) .

4. Gross returns / fad

Data presented in Tables (7 and 8) showed that intercropping the other crops (onion, faba bean or wheat) on sugar beet had effect on gross returns / fad , where the highest gross returns / fad (4092.45 and 4005.39) was obtained when intercropping sugar beet with onion under bed system (realized more than pure stand of sugar beet) in the first and second seasons, respectively. Whereas, when sugar beet intercropped with onion under ridges was the second rank, but less than pure stand of sugar beet .The lowest gross returns was observed when sugar beet cropped with wheat under ridges system in both seasons.

In conclusion , this study showed that the best treatment was growing sugar beet with onion under bed system (120 cm) which gave the highest economic return for the farmers Similar results were recorded by Toaime et al.(2001) and Farghaly et al.(2003) .

Acknowledgment

The authors wishes to express deep gratitude to Prof .Dr Abou - Keriasha .M.A. Intensification Res . sec . ARC for his kind guidance in statistical analysis and writing this paper.

Table 8 : land Equivalent Ratio (LER), Relative crowding coefficient (Rcc) , Aggressivity (Agg) and total income (2003 / 2004 season).

Characters	Land Equivalent Ratio		Relative Crowding Coefficient		Aggressivity		Total Income
	Ry	Ry S.beet	K	K S.beet	Agg S.beet	Agg crop	
Treatments							
S. beet with onion on bed system	0.88	0.72	7.41	2.41	+0.40	- 0.40	4005.39
S. beet with onion on ridges	0.72	0.44	2.62	0.82	+0.56	-0.56	2996.52
S. beet with F. bean on bed system	0.62	0.51	1.62	1.07	+0.21	-0.21	2952.35
S. beet with F. bean on ridges	0.55	0.34	1.25	0.53	+0.41	-0.41	2358.20
S. beet with wheat on bed system	0.41	0.29	0.70	0.40	+0.25	-0.25	2387.75
S. beet with wheat on ridges	0.36	0.19	0.57	0.23	+0.36	-0.36	1863.25
Pure stand S. beet							3280.0
Pure stand onion							1407.25
Pure stand F. bean							1558.1
Pure stand wheat							3610.3

REFERENCES

- Abdel-Aal, S.M.;H.A. Dawwan and F .A.Honawy (1989).Studies on intercropping of faba bean with some fodder beet varieties . Minufiya.J . Agric. Res.,14(1) : 85 - 98 .
- Abd-El-All.A.M.(2002) : Weed control treatments for different intercropping systems of sugar beet and faba bean .J. Agric. sci . Mansoura Univ.27(12):8081-8092
- Abou-Keriasha , M.A. ; M.M. Mihi ; K.E.EL-Habbak ; M.A,EL-Masry and A.S. KameI (1991): Varietal response of fodder beet intercropping with faba bean to different patterns of intercropping. Egypt .J. Appl . Sci.,6 (8):225-232.
- Amer , M.I.,M.M. Radi , K.A.Ali and S.S.Zalat (1997).Intercropping faba bean with sugar beet under different plant densities . Egypt .J. Appl .Sci., 12(1):155-161.
- A.O.A.C. (1984) . Official Methods of Analysis 14th Ed. Association of official Analytical Chemist , Alington, Virginia , USA .
- Besheit , S.Y.;A.M. Abo Elwafa ; A.S. Abo El- Hamd and M. A. Bekheet (2002) : Quality and productivity of sugar beet as affected by intercropping onion in various densities. AL- Azhar . J. Agric . Rec. , 36:87-101 .
- Dewit.C.T.(1960).On competition. Its importance and research needs. Part I. Competition and yield advantages . Veriag landbov Wkundige Onder zoek No . 66 ; 1-82 (C.F . Field Crop Abst . , 32:1-10).
- EL-Borai.M. A.and M.M . Radi (1993).Effect of intercropping faba bean with sugar beet in Kafr El-Sheikh governorate . Report of fifth Ann . Meeting Cairo, 12-16 September . Nile valley Regional program on cool season food legumes . ARC. Egypt .
- Farghaly , B.S.; A.A. Zohry and S.A.A. Bssal (2003). Crop management for intercropping sugar beet with some essential crops to maximize area unit productivity J . Agric. Sci. Mansoura Univ.,28(7):5183.5199.
- Farag , H . A (1990) . Effect of intercropping faba bean on sugar beet . M.Sc thesis, Fac. of Agric . AL-Azhar, Univ. Egypt .
- Hussein, A.H.A and M.A.EL-Deeb (1999) . Evaluation of intercropping faba bean, chickpea and lentil with sugar beet in Middle Egypt . Arab Univ .J . Agric .Sci. Ain-Shams , Univ., Cairo.7(2) : 475 – 482 .
- Le-Docte , A .(1927) . Commercial determination of sugar beet root using sachs. Le-Docte Process Int . Sug . J . 29 : 488-492. (C.F. Sugar beet Nutrition ,1972 Appl . Scr , Pub. London , A.P, Drycott) .
- Marey . R. A . (2003) : Effect of intercropping of faba bean of chickpea on sugar beet. Ph.D.Thesis, Fac . Agric . Assiut . Univ .
- Mc-Gilchrist, C.A (1960) . Analysis of competition experiments Biometrics . 21: 975 - 985 .
- Metwally , I.O.E .; S.A.A. Bassal ; E. M. A. Gabr and Abd EL-All (1997) : Effect of potassium fertilizer levels on intercropped fodder beet and faba bean . J. Agric. Sci ., Mansoura Univ., 22 (1) : 23-31 .

- MSTAT (1986) . A micro computer program of the Design Management and Analysis of Agronomic Research Experiments . Michigan state Univ .U.S.A.
- Nour , A.H. and H.A. Farag (1984): Intercropping of broad bean (vicia faba) with sugar beet (Beta vulgaris) . Proc. of the 2nd conf., ARC. Giza, 9-11 April XI 10 , 1984 .
- Snedecor . G.W. and W. G. Cochran (1988) . Statistical method 7th Ed . Iowa State Univ . Press. Ames Iowa, U.S.A.
- Toaima , S. E. A . ; K. A . EL- Douby and A. I. Nafe (2001) : Effect of different intercropping systems of onion and garlic on sugar beet yield, yield components and chemical analysis Egypt . J . Agric . Res . 79 (3) : 983 -1003.
- Willy , R.W. (1979) : Intercropping its importance and research needs . part 1: competition and yield advantages (C.F. Field Crop Abst , 32 : 1 -10) .

تعزيز إنتاجية وحدة المساحة بتجميل بعض المحاصيل الشتوية علي بنجر السكر
رأفت عايد جاد الله ، عبد الجليل محمد عبد الجليل و فتحى رجب نوار
قسم التكايف المحصولي- معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية - الجيزة -
مصر

- أجريت تجربتان حقليتان في محطة البحوث الزراعية بملاوي محافظة المنيا (مصر الوسطي)
خلال موسمي الزراعة ٢٠٠٢ / ٢٠٠٣ و ٢٠٠٣ / ٢٠٠٤ لدراسة تأثير تحميل بنجر السكر
مع البصل والفول البلدي والقمح علي المحصول ومكوناته .
وتم استخدام تصميمات القطاعات الكاملة العشوائية في ثلاث مكررات ويمكن تلخيص النتائج فيما يلي :
١. محصول بنجر السكر انخفض مع التحميل وكان الانخفاض كبير عند التحميل مع القمح مقارنة
بالزراعة المنفردة .
المحصول ومكوناته لبنجر السكر المنزرع علي المصاطب (١٢٠ سم) كان اكبر من المنزرع علي
الخطوط (٦٠ سم) .
٢. صفات الجودة لبنجر السكر معبرا عنها كنسبة مئوية لكل من المواد الصلبة الذائبة الكلية والسكريز
ومحصول
السكر بالطن أظهرت تأثيرات معنوية بالتحميل وكان الانخفاض كبيرا عند التحميل مع القمح .
٣. البصل المحمل مع البنجر علي المصاطب (١٢٠ سم) أعطي قيما اعلي من التي حملت علي
الخطوط (٦٠ سم) -
متوسط وزن البصلة عند الزراعة علي المصاطب كان اكبر من التي حملت علي الخطوط وعن
الزراعة المنفردة
ومع ذلك قد أعطت محصولا منخفضا عن الزراعة المنفردة .
٤. محصول الفول البلدي والقمح كان منخفضا تحت ظروف التحميل ، الفول البلدي والقمح المحمل
علي المصاطب
أعطت قيما اعلي من المحملة علي الخطوط .
٥. سجل اعلي معدل لاستغلال الأرض وأكبر عائد اقتصادي عند تحميل البصل مع بنجر السكر علي
المصاطب .
لهذا ينصح بتحميل البصل مع بنجر السكر علي المصاطب حيث أعطي اعلي عائد اقتصادي
للمزارع .