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WEED CONTROL TREATMENTS FOR DIFFRENT INTERCROPPED SYSTEMS OF SUGAR BEET AND FABA BEAN

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ABSTRACT

Two field experiments were carried out at El-Serw Agric. Res. Station, Domiatta Governorate, during 1998/1999 and 1999/2000 seasons, to study the effect of intercropping systems and different weed control treatments on growth, yield and yield components of faba bean (cv. Giza 3) and sugar beet (cv. Ceres poly) and faba bean. A split plot design with four replications was adopted.

It was evident that (a_4) a_1 + faba bean on 60 cm between hill intercropping significantly increased No. of pods/plant, No. of branched/plant and 100-seed weight than other two intercropping systems (on 20 and 40 cm between hills) and decreased in seed yield ardab/fad. While monoculture of faba bean produced the highest means of all characters study than the other three intercropping system (i.e. a_2, a_3 and a_4). On the other hand, (a_4) a_1 + faba bean on 60 cm between hill significantly increased all characters study except fresh top yield ton/fad in the second season only than the other two systems (a_2 and a_3).

Whereas, monoculture gave the highest values of yield and its components of sugar beet as compared to the intercropping systems. The highest seed yield of faba bean was obtained with the intercropping systems of (a_2): a_1 + faba bean on 20 cm between hill, compared with the other intercropping systems.

The obtained results show that yields and its components of both crops were increased proportioned with using weed control of hand weeding. The highest value of LER was obtained with intercropping faba bean and sugar beet at (a_2) a_1 + faba bean on 20 cm between hills, but for sugar beet the highest value was obtained at (a_4): a_1 + faba bean on 60 cm in both seasons.

INTRODUCTION

Sugar beet plays a prominent role for sugar production. About 45 % of sugar in the world is normally produced from sugar beet. It is a new cultivated crop in Egypt (started in 1982 at Kafr El-Sheikh Governorate). Recently, this crop has attracted the attention in Egypt for sugar production and explanding its cultivation in the newly reclaimed soil such as some areas at Dakahlia, Nubaria and other districts. The government encourage beet growers to increase the cultivated area as well as to raise its productivity. In this respect, several factors are believed to affect sugar yield such as plant spacing and weed control treatments.

Egyptian Government imports large amounts of sugar every year to face the rapid increase of population. Increasing sugar yield per unit area had national interest and it can be achieved by adopting suitable cultural practices such as solid and intercropping.

Intercropping is one of the most important practice as away to increase the productivity per unit land area, El-Kassaby and Leilah (1991), Metwally *et al.* (1997) and Rady *et al.* (2000).

Plant density plays a major in role yield improvement of faba bean, in this concentration, increasing plant density significantly reduced number of branches, pods, as well as increased seed yield, El-Deib (1982), Ali (1993) and Ali and Abdel-Mottaleb (1997).

In Egypt, leaving weeds without removal from sugar beet caused losses in yield by about 50 % (El-Hattab and Shaban, 1982). Both chemical and mechanical methods of control are used alone or together. Farag *et al.* (1987) found that application of Eptam (2.5 L/fad) and pyramin (2.5 kg/fad)significantly increased root yields/fad.

The main objective of this study is to evaluate the efficiency of intercropping systems and weed control treatments on growth, yield and yield components of faba bean and sugar beet under North Delta conditions at El-Serw.

MATERIALS AND METHODS

The present investigation was performed at El-Serw Agricultural Research Station Farm, Domiatta Governorate, during the two winter growing seasons of 1998/99 and 1999/2000 to study the effects of intercropping patterns and weed control treatments on yield and yield components of sugar beet and faba bean.

Each plot included 3 raised beds (120 cm apart and 2.90 m length), with an area of 10.5 m^2 (1/400 fad).

Calcium super phosphate (15.5 % P_2O_5) at a rate of 100 kg/fad was applied during tillage operations.

Seed balls of sugar beet (cv. Ceres ploy) were hand sown as the usual dry method of planting on two sides of raised beds at 20 cm between hills on the first of October in both seasons. Sugar beet plants were thinned to one plant per hill after 30 days from planting.

Potassium sulphate (48 % K_2O) at a rate of 48 kg K_2O/fad was added in two equal portions, before the first and second irrigations. Nitrogen in the form of ammonium sulphate (20.6 % N) at a rate of 90 kg/fad was added at three equal portions, with sowing, the second and third irrigations. Other normal cultural practices for growing sugar beet were followed.

Sowing date of faba bean (cv. Giza 3) was the first of November in both seasons. Solid planting was done on both sides of raised bed at 20 cm between hills. Faba bean seeds were soaked in water for 24 hours before planting to promote seed germination. Then after plots were immediately irrigated.

In case of intercropping faba bean with sugar beet, seeds of faba bean were sown on hills 20, 40 and 60 cm between two rows/raised beds (120 cm). Thinning was done at 30 days from sowing to leave healthy two plants/hill. A split plot design with four replicates was laid out. The main plots were devoted to the following intercropping patterns:

- Solid planting of faba bean (70000 plants/fad).

a_1: Solid planting of sugar beet (35000 plants/fad).

a_2: a_1 + faba bean on 20 cm between hills (70000 plants/fad).

a_3: a_1 + faba bean on 40 cm between hills (35000 plants/fad).

a_4: a_1 + faba bean on 60 cm between hills (23333 plants/fad).

The sub plots were devoted to the following weed control methods:

b_1- Without weeding (control).

b_2- Hand weeding, three hand hoeing i.e. before the first, second and third irrigation.

b_3- Pyrazon (peramen) [5-amino-4-chloro 2-phenyl-3- (2/H)-pyridazinone]. It was applied pre-emergence at a rate of 2.0 kg/fad.

b_4- Eptam (5 Ethyl dipropyl thiocarbamate) which was applied pre-emergance at 2.5 L/fad.

The preceding summer crop was rice in both seasons.

Studied characters:-

- Faba bean measuraments:

At harvest, data recorded on faba bean plants included: plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pod and 100-seed weight (g). These characters were determined from 10-plant-sample taken at random from each plot.

Seed yield ardab/fad was recorded on whole plot basis.

- Sugar beet measurements:

At maturity (190 days after sowing), random sample of ten guarded plants of sugar beet were taken from each plot and the following characteristics were recorded:

- Root length (cm).
- Root diameter (cm).
- Top fresh weight/plant (g).
- Root fresh weight/plant (g).
- Top fresh yield ton/fad.
- Top dry yield ton/fad.
- Root fresh yield ton/fad.
- Root dry yield ton/fad.

Root and top yields of sugar beet plants in the one central raised bed of each plot were estimated in kilograms/m^2 and converted to record root and top yields in ton/fad. Also, root and top dry weight ton/fad were estimated then it were dried at 70 °C in an oven, with five of plants carried out at random from each plot.

- Competitive relationships and yield advantage:

1- Land Equivalent Ratio (LER), as described by Willey (1979).

2- Relative Crowding Coefficient (RCC), as mentioned by Dewit (1960).

3- Aggressivity (A), as mentioned by Mc-Gilchrit (1965).

Data obtained were subjected to statistical analysis by the technique of analysis of variance for the split plot design. The treatment means were compared using the Least Significant Differences (LSD) method mentioned by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Faba bean:

Results in Table (1) show that monoculture faba bean produced taller plants as compared to the intercropping systems. It was evident that, closer spacing (i.e. 20 cm between hills) recorded the tallest plants as compared with the wider spacing (40 and 60 cm between hills) in both seasons. This result may be attributed to competition between plants to get up light. Abu-Kresha *et al.* (1991), El-Mihi *et al.* (1991), El-Naggar and El-Habbak (1992) and Metwally *et al.* (1997).

Number of branches/plant, number of pods/plant, number of seeds/pod, 100-seed weight (gm) and seed yield (ardab/fad) were significantly increased with the pure stand of faba bean in the two growing seasons.

Increased plant spacing between hill (60 cm between hills) gave higher number of branches/plant, number of pods/plant, number of seeds/pod and 100-seed weight (gm) as compared to the other spacing (20 and 40 cm between hills). This may be attributed to less competition between plants above and under ground in case of wider spacing as recorded by Salem (1982), Glelah and Saffan (1987), Ali (1993) and Ali and Abdel-Mottaleb (1997). The increase in seed yield by decreasing hill spacing may be due to the extra number of plants per unit area in dense planting.

Concerning faba bean, weed control had significant effect on all studied traits in the two seasons Table (1). Hand weeding treatments significantly increased plant height, number of branches/plant, number of pods/plant, number of seeds/pod, 100-seed weight (gm) and seed yield (ardab/fad) as compared to without weeding and weed control (Pyrazon 2.0 kg/fad and Eptam 2.5 L/fad). The highest values of all studied traits in the two seasons were recorded with the treatment of hand weeding, whereas the low values were observed under the treatment of without weeding. These results are in harmony with those obtained by Elain *et al.* (1980), Khalil *et al.* (1989) and Salama (1996).

2. Sugar beet:

Data presented in Table (2) show that pure stand of sugar beet produced the higher yield and its components. Wider spacing (60 cm between hills) gave highest yield and increased each of root length (cm), root diameter (cm), root fresh weight (gm) and top fresh weight (gm). But the narrowest spacing (20 cm between hills) recorded the lower yield and its components, in both seasons. Similar results were reported by El-Naggar and El-Habbak (1992), El-Mihi *et al.* (1992) and Rady *et al.* (2000).

In both seasons, using hand weeding significantly increased root length (cm), root diameter (cm), fresh top weight/plant (gm), fresh root weight/plant (gm), fresh top yield ton/fad, dry top yield ton/fad, fresh root yield ton/fad and dry root yield ton/fad as compared with the other weed control treatment (Table 2). In both seasons, the greatest values of yield and its component were recorded under hand weeding, whereas, the lowest values were obtained under without weeding, in both seasons.

All herbicidal treatments enhanced growth of sugar beet plants, consequently weed competition was inhibited and more nutrients were available to promote growth of sugar beet plants. These results are supported by those of Badawi (1989) and Salama (1996).

3. Interaction Effects:

Regarding to faba bean, the interaction between intercropping patterns and weed control methods had significant effects on seed yield (ardab/fad) in both seasons, 100-seed weight (gm) in the first season and number of pods/plant in the second season. The highest seed yield (ardab/fad) (13.47 and 13.23 ardab/fad) in both seasons, 100-seed weight (gm) (74.47 gm) in the first season and number of pods/plant (24.10) in the second season were obtained with the solid and hand weeding. The lowest seed yield (2.70 and 2.80 ardab/fad) in both seasons, 100-seed weight (gm) (66.83) in the first season and number of pods/plant (22.10) in the second season were recorded under wide spacing (60 cm between hills, i.e. a_4) and without weeding see in Table (3).

The interaction between intercropping patterns and weed control had a significant effect on sugar beet fresh top yield ton/fad in the second season, dry top yield (ton/fad) in the both seasons, fresh top yield (gm/plant) in the first season, root length (cm) in the second season and root diameter (cm) in the first season as shown in Table (4). The highest fresh top yield (gm/plant), root length (cm) and root diameter (cm) was obtained from the treatment of solid sugar beet and hand weeding.

4. Competitive relationships and yield advantages

a) Land Equivalent Ratio (LER):

Data presented in Table (5) indicated clearly that LER showed considerable yield advantage with intercropping faba bean and sugar beet in the successive seasons. The highest LER value (1.32) in both seasons was obsreved with plant spacing of 20 cm between hills. Similar observation was obtained by Machado *et al.* (1984).

b) Relative Crowding Coefficient (RCC):

Values of K Table (5) indicated that intercropping faba bean with sugar beet produced a yield advantage in both seasons. The greatest K values (10.8 and 7.10) were found when faba bean was intercropped with sugar beet with the spacing (60 cm between hill on faba bean with sugar beet was sown two sided raised beds 20 cm between hills).

C) Aggressivity (Agg):

Data in Table (5) show that Aggressivity values of faba bean were negative, while, these values of sugar beet were positive. This means that sugar beet was the dominant intercrop and faba bean was the dominated one. El-Naggar and El-Habbak (1992) and Abu-Kersha *et al.* (1991) came to similar results.

5. Final economical evaluation:

Data in Table (6) show final economical evaluation of intercropping of faba bean with sugar beet and order of yield and income return. Results revealed that the hand weeding was the best treatments which gave preferable economic income. Although the highest income return obtained from planting two crop in same of unit area. But the solids crop decrease affected because it reduced yields.

Table (5): Competitive relationships and quality advantages as affected by intercropping faba bean with sugar beet in both seasons.

	First season			Second season		
	20	40	60	20	40	60
	Land Equivalent Ratio (LER)					
L-Faba bean	0.41	0.28	0.25	0.42	0.29	0.26
L-Sugar beet	0.91	0.94	0.97	0.90	0.92	0.93
LER Faba –Sugar	1.32	1.22	1.22	1.32	1.21	1.21
	Relative Crowding Coefficient (K)					
K-Faba bean	0.71	0.76	1.0	0.72	0.80	1.1
K-Sugar beet	10.01	7.55	10.8	8.53	5.79	6.45
K Faba –Sugar	7.11	5.06	10.8	6.14	4.63	7.10
	Aggressivity					
A-Faba bean	-0.50	-0.68	-0.72	-0.48	-0.63	-0.69
A-Sugar beet	+0.50	+0.68	+0.72	+0.48	+0.63	+0.69

Table (6): Final economical evaluation of weed control on intercropping of sugar beet and faba bean and order of yield and income return (average of the two seasons).

	Sugar beet					Faba bean			Final Evaluation	
	Fresh root yield (ton/ fad)	Order for yield	Weed control price L.E/ fad	Income return L.E/ fad	Order for net income	Yield ardab /fad	Order for yield	Income return L.E/ fad	Total income return L.E	Order for net income
Solid sugar beet	25.44		200	2344					2344	
Solid faba bean						12.42		24.84	2484	
Without weeding control	22.7	4	75	2195	4	5.23	4	10.46	3241	4
Hand weeding	25.54	1	100	2454	1	6.51	1	1302	3756	1
Pyrazon 2.0 kg/fad	24.55	2	130	2325	2	6.1	2	1220	3545	2
Eptam 2.5 kg/fad	23.95	3	150	2245	3	5.86	3	1172	3417	3

Generally, the intercropping can be stated that the highest income return from yield of faba bean intercropped.

Finally, it can be concluded that intercropping faba bean and sugar beet in a system of sugar beret + faba bean on 20 cm between hills (70000 plants/fad) and hand weeding (3 hoeing) seems a recommended treatment for raising faba bean and sugar beet productivity under the same conditions of this study.

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تأثير معاملات مقاومة الحشائش على انتاجية الفول البلدى وبنجر السكر تحت نظم تحميل مختلفة

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أجريت هذه الدراسة بمحطة البحوث الزراعية بالسرو ـ محافظة دمياط خلال موسمى ١٩٩٩/٩٨ ، ٢٠٠٠/٩٩ لدراسة نظم التحميل الفول البلدى و بنجر السكر وكانت النظم كالتالى:

ـ فول منفرد ٧٠٠٠٠ نبات/فدان.
أ١ ـ بنجر منفرد ٣٥٠٠٠ نبات/ف.
أ٢ ـ أ١ + فول بلدى محمل على مسافة ٢٠ سم (٧٠٠٠٠ نبات /ف)
أ٣ ـ أ١ + فول بلدى محمل على مسافة ٤٠ سم (٣٥٠٠٠ نبات /ف)
أ٢ ـ أ١ + فول بلدى محمل على مسافة ٦٠ سم (٢٣٣٣٣ نبات /ف)

وكذلك طرق مقاومة الحشائش (بدون مقاومة ـ عزيق ثلاث مرات ـ بيرازون بمعدل ٢كجم /فدان ـ إبتام بمعدل ٢,٥ لتر/ فدان) على نمو المحصول ومكوناته للفول البلدى صنف جيزة ٣ وبنجر السكر صنف سريس بولى والتصميم فى قطع منشقة مرة واحدة باستخدام أربع مكررات.

وتتلخص نتائج الدراسة فى الآتى:ـ

عند زراعة الفول البلدى منفردا ازداد طول النبات ، عدد الأفرع للنبات ، عدد قرون للنبات ، عدد الحبوب /القرن ، وزن المائة حبة ومحصول الحبوب للفدان. كما أدت الزراعة الكثيفة ٢٠ سم بين الجور إلى زيادة واضحة فى طول النبات بالمقارنة بالزراعة الخفيفة (٦٠ سم بين الجور) ولكن أدت الزراعة الخفيفة ٤٠ ، ٦٠ سم) إلى زيادة واضحة فى كل من عدد الأفرع للنبات ، عدد قرون للنبات ، عدد الحبوب /القرن ، وزن المائة حبة فى حين انخفض محصول الحبوب للفدان.

كما أدت زراعة بنجر السكر منفردا إلى زيادة واضحة فى وزن وطول وقطر الجذر ومحصول الجذور للفدان فى حين أن الزراعة الخفيفة بين الجور كانت مصحوبة بزيادة وزن وطول وقطر الجذر لكن مع انخفاض محصول الجذور للفدان وذلك مع استعمال العزيق اليدوى ثلاث مرات لمقاومة الحشائش.

أوضحت النتائج أن معدل استغلال الأرض قد زاد إلى أقصى حد عند زراعة بنجر السكر على جانبى المصطبة مع زراعة الفول البلدى على مسافة ٢٠ سم بين الجور.

وعلى ذلك يمكن استنتاج أن تحميل الفول البدى وبنجر السكر على مصاطب ١٢٠ سم مع زراعة الفول البلدى على مسافة ٢٠ سم بين الجور وقد أدى إلى الحصول على زيادة معنوية فى إنتاجية كلا المحصولين كما أشارت النتائج إلى زيادة استغلال الأرض إلى أقصى حد باتباع نظام التحميل السابق.

Table (1): Averages of plant height, number of branches/plant, number of pods/plant, number of seeds /pods, 100-seed weight and seed yield of faba bean as affected by intercropping patterns and weed control in both seasons.

Characters / Treatments	Plant height (cm)		No. of branches/plant		No. of pods / plant		No. of seeds / pods		100-seed weight (g)		Seed yield (ardab/fad)	
	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000
A- Intercropping patterns:												
a_1. Solid faba bean (70000 plants/fad)	116.83	116.19	4.02	4.26	22.78	23.09	4.29	4.43	70.33	71.13	12.35	12.48
a_2. a_1 + faba bean on 20 cm (70000 plants/fad)	113.68	113.12	3.04	3.18	20.67	21.11	3.07	3.26	64.71	65.25	5.11	5.23
a_3. a_1+ faba bean on 40 cm (35000 plants/fad)	108.97	105.84	3.59	3.70	21.66	22.36	3.59	4.07	67.03	68.79	3.41	3.58
a_4. a_1+ faba bean on 60 cm (23333 plants/fad)	103.96	104.06	3.87	3.91	22.18	23.05	3.75	4.28	69.18	69.98	3.10	3.29
F-test	NS	*	**	*	**	**	NS	**	**	*	**	**
LSD at 5%	--	18.66	0.21	0.58	0.49	0.74	--	0.12	0.76	1.97	0.38	0.53
at 1%	--	--	0.32	--	0.74	1.12	--	0.18	1.23	--	0.57	0.73
B- Weed control:												
b1. Without weeding	108.59	108.27	3.22	3.32	21.29	21.88	3.13	3.14	64.96	65.43	5.08	5.38
b2. Hand weeding	116.83	117.13	4.13	4.14	22.65	23.00	4.38	4.72	71.26	71.67	6.53	6.72
b3. Pyrazon (2.0 kg/fad)	112.96	113.45	3.88	3.90	22.28	22.58	3.98	4.48	69.35	70.08	6.02	6.18
b4. Eptam (2.5 kg/fad)	110.06	108.58	3.68	3.70	21.77	22.14	3.60	4.19	67.42	69.12	5.78	5.94
F-test	*	*	**	*	**	**	**	**	**	**	**	**
LSD at 5%	11.04	11.93	0.10	0.37	0.49	0.24	0.27	0.06	0.57	0.45	0.22	0.18
at 1%	--	--	0.14	--	0.67	0.32	0.36	0.12	0.79	0.61	0.36	0.24
Interaction:												
A x B	NS	NS	NS	NS	NS	**	NS	NS	NS	NS	**	**

Table (2): Averages of root length, root diameter, fresh top weight /plant, fresh root weight/plant, fresh top yield, fresh root yield and dry root yield of sugar beet as affected by intercropping patterns and weed control in both seasons.

Characters / Treatments	Root length (cm)		Root diameter (cm)		Fresh top weight /plant (g)		Fresh root weight/ plant (g)		Fresh top yield (ton/fad)		Dry top yield (ton/fad)		Fresh root yield (ton/fad)		Dry root yield (ton/fad)	
	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000	1998/99	99/2000
A- Intercropping patterns:																
a_1. Solid sugar beet (35000 plants/fad)	26.89	27.94	27.82	28.05	391.1	401.8	808.4	830.7	8.00	8.08	0.99	1.00	24.97	25.91	5.27	5.35
a_2. a_1 + faba bean on 20 cm (70000 plants/ fad)	22.95	22.99	24.39	25.02	336.2	353.2	683.4	688.9	7.43	7.45	0.68	0.70	22.72	23.19	4.50	4.72
a_3. a_1+ faba bean on 40 cm (35000 plants/ fad)	24.44	25.51	26.33	26.43	364.1	361.9	744.8	765.2	7.62	7.65	0.74	0.76	23.42	23.85	4.66	4.46
a_4. a_1+ faba bean on 60 cm (23333 plants/ fad)	25.77	26.05	26.67	27.33	377.7	367.1	777.7	830.1	7.64	7.96	0.84	0.85	24.23	24.65	4.94	5.03
F-test	*	**	*	**	**	**	**	*	*	NS	**	**	**	**	*	*
LSD at 5%	2.45	1.56	1.44	0.63	17.9	18.3	55.9	93.6	0.29	--	4.63	4.69	0.74	0.40	0.41	0.53
at 1%	--	2.37	--	0.96	27.3	27.8	85.0	--	--	--	6.99	7.13	1.19	0.61	--	--
B- Weed control:																
b1. Without weeding	22.92	23.66	24.29	24.11	328.9	329.1	653.3	685.3	6.50	6.50	0.73	0.71	22.63	23.10	4.28	4.31
b2. Hand weeding	26.98	27.19	28.33	28.85	409.1	408.6	847.5	864.5	9.23	9.24	0.93	0.93	25.28	25.80	5.33	5.43
b3. Pyrazon (2.0 kg/fad)	25.76	26.23	27.17	27.58	380.0	381.7	784.8	811.5	7.98	8.12	0.86	0.87	24.34	24.76	5.00	5.06
b4. Eptam (2.5 kg/fad)	24.41	25.42	25.92	26.29	351.0	354.6	728.8	755.3	6.99	7.28	0.78	0.79	23.67	24.23	4.71	4.77
F-test	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
LSD at 5%	0.48	0.45	0.37	0.43	4.74	10.8	29.7	29.4	0.26	0.31	2.85	3.12	0.50	0.68	0.17	0.24
at 1%	0.65	0.61	0.51	0.59	6.44	14.7	40.3	39.9	0.35	0.42	3.87	4.23	0.68	0.92	0.23	0.33
Interaction:																
A x B	NS	*	**	NS	**	NS	NS	NS	NS	*	**	**	NS	NS	NS	NS

Table (3): Means of number of pods/plant, 100-seed weight and seed yield of faba bean as affected by intercropping patterns and weed control in both seasons.

Characters / Treatments	No. of pods/plant				100-seed weight (g)				Seed yield (ardab/fad)							
	1999/2000				1998/1999				1998/1999				1999/2000			
	B_1	B_2	B_3	B_4	B_1	B_2	B_3	B_4	B_1	B_2	B_3	B_4	B_1	B_2	B_3	B_4
Intercropping patterns:																
a_1. Solid faba bean (70000 plants/fad)	21.90	24.10	23.43	22.93	66.03	74.47	72.13	68.67	10.83	13.47	12.93	12.17	10.93	13.23	13.10	12.67
a_2. a_1 + faba bean on 20 cm (70000 plants/ fad)	20.20	21.83	21.30	21.10	64.23	65.67	65.13	65.30	3.33	4.86	4.53	3.97	4.13	4.60	4.43	4.27
a_3. a_1+ faba bean on 40 cm (35000 plants/ fad)	23.33	22.20	22.20	21.70	65.53	69.63	68.13	66.83	2.97	3.89	3.57	3.30	3.83	4.30	4.20	4.07
a_4. a_1+ faba bean on 60 cm (23333 plants/ fad)	22.10	23.87	23.40	22.83	66.83	72.27	70.80	69.30	2.70	3.63	3.40	3.03	2.80	3.47	3.36	3.10
F-test	**				**				**				**			
LSD at 5%	0.47				1.13				0.35				0.22			
at 1%	0.64				1.54				0.52				0.29			

B1. Without weeding , B2. Hand weeding, B3. Pyrazon (2.0 kg/fad) and B4. Eptam (2.5 kg/fad).

Table (4): Means of root length, root diameter, fresh top weight /plant, fresh top yield and dry top yield of sugar beet as affected by interaction between intercropping patterns and weed control in both seasons.

Characters	Root length (cm)				Root diameter (cm)				Fresh top yield (g/plant)			
	1999/2000				1998/1999				1998/1999			
Treatments	B_1	B_2	B_3	B_4	B_1	B_2	B_3	B_4	B_1	B_2	B_3	B_4
Intercropping patterns:												
a_1. Solid sugar beet (35000 plants/fad)	25.50	30.3	27.33	28.63	25.30	29.97	28.77	27.23	329.73	439.00	409.70	365.90
a_2. a_1 + faba bean on 20 cm (70000 plants/ fad)	24.53	20.97	22.77	23.70	22.87	26.40	25.67	24.63	309.10	373.37	344.87	317.27
a_3. a_1+ faba bean on 40 cm (35000 plants/ fad)	26.33	24.33	25.43	25.93	24.33	27.53	27.07	26.03	321.47	401.97	377.47	355.33
a_4. a_1+ faba bean on 60 cm (23333 plants/ fad)	27.60	23.83	26.13	26.63	24.67	29.40	27.17	25.77	335.17	422.03	388.10	365.67
F-test	*				**				**			
LSD at 5%	0.90				0.75				9.49			
at 1%	--				1.02				12.88			

	Fresh top yield (ton/fad)				Dry top yield (ton/fad)							
	1999/2000				1998/1999				1999/2000			
a_1. Solid sugar beet (70000 plants/fad)	6.83	9.97	8.27	7.23	0.80	1.17	1.06	0.93	0.81	1.18	1.09	0.94
a_2. a_1 + faba bean on 20 cm (70000 plants/ fad)	6.27	8.8	7.97	6.77	0.64	0.82	0.75	0.68	0.65	0.80	0.74	0.66
a_3. a_1+ faba bean on 40 cm (35000 plants/ fad)	6.40	9.03	8.13	7.03	0.68	0.83	0.77	0.69	0.68	0.83	0.80	0.73
a_4. a_1+ faba bean on 60 cm (24000 plants/ fad)	6.50	9.17	8.10	8.07	0.79	0.88	0.87	0.82	0.80	0.91	0.86	0.84
F-test	*				**				**			
LSD at 5%	0.62				0.18				0.17			
at 1%	--				0.21				0.20			

B1. Without weeding , B2. Hand weeding, B3. Pyrazon (2.0 kg/fad) and B4. Eptam (2.5 kg/fad).