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EFFECT OF SOWING METHODS AND WEED CONTROL TREATMENTS ON GROWTH OF SUGAR BEET AND WEED CHARACTERS UNDER NITROGEN FERTILIZER LEVELS

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ABSTRACT

Two field experiments were carried out at Kafr El-Hamam Research Station, Zagazig district, Sharkia Governorate, Agricultural Research Center during 2008/2009 and 2009/2010 seasons to study the effect of sowing methods (manual and mechanical), weed control treatments (one hand hoeing, Goltix 70 WG (metamitron) as herbicide, Goltix + one hand hoeing and two hand hoeing) and nitrogen fertilizer levels (60, 80 and 100 kg N/fed) on growth of sugar beet (*Beta vulgaris* L.*)* cv. Hanrike as well as weeds characters.

The obtained results could be summarized as follows:

1. Mechanical sowing method of sugar beet by planter machine significantly surpassed the traditional sowing method (manual) in all studied growth and minimized weed characters in both seasons.
2. Controlling weeds associated with sugar beet plants by two hand hoeings before the second and the third irrigations significantly recorded the highest values of studied growth attributes and minimized weed characters in both seasons. While, using Goltix 70 WG (metamitron) as herbicide + one hand hoeing before second irrigation came in the second rank in this respect in both seasons. On the other hand, the lowest values of all growth attributes and weed characters were resulted from the control treatment (one hand hoeing) in both seasons.
3. Fertilizing sugar beet plants with 100 kg N/fed significantly increased all studied growth and weed characters and markedly recorded the highest values of these characters in both seasons. However, application of 60 kg N/fed produced the lowest values of all studied characters in the two growing seasons.

From the obtained data in this study, it can be concluded that sowing sugar beet using mechanical sowing method (planter machine), controlling weeds by hand hoeing at two times and mineral fertilizing with 100 kg N/fed could be recommended in order to maximize its growth attributes and reduce weed growth under the environmental conditions of Sharkia Governorate.

Keywords: Sugar beet, *Beta vulgaris L*, sowing methods, weed control treatments, nitrogen fertilizer levels, growth, weed characters.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is an important crop not only in Egypt, but also all over the world. Sugar beet ranks the second sugar crop after sugar cane. In Egypt, sugar beet grown at the beginning of 1980 season, it has several advantages as suitable complementary crop for increasing local sugar production. It is also consider as an industrial crop to produce various products such as alcohol, feed for livestock and other products. Developing high yielding varieties and its high demand for agricultural practices and other production input is necessary. Thereby, sowing method, weed control

and nitrogen fertilizer levels are among factors that enhance sugar beet productivity.

Producers must try to use an optimum sowing methods, which is considered to be one of the most important elements of sugar beet production. There are a few investigations with respect to the effect of sowing methods on sugar beet productivity. In this concern; Zahoor *et al.* (2007) showed that planting methods significantly affected leaves fresh and dry weights. El-Maghraby *et al.* (2008) reported that sowing of sugar beet at a laser leveled soil + deep ploughing recorded significant increases in crop growth rate (CGR) and relative growth rate (RGR) in comparison to other treatments.

Sugar beet plants are characterized by their slow rate of growth during the early stages, *i.e*., from emergence to thinning during which they may be heavily infested with weeds. So, the final stand of beet plants and hence their yield are reduced. Therefore, weed control in sugar beet fields must be to achieved for high growth and sugar yield. Wiltshire *et al.* (2003) found that the precise hand hoeing and band spraying treatment was compared with overall herbicide use, and with treatments in which the herbicide applications were replaced by hand weeding to minimize competition between sugar beet and weeds. Kristek *et al.* (2004) showed that the total number of weeds without protection application was on the average 83.2 weeds/m^2 (weight 4012 g). Hand hoeing resulted a decrease in the number of weeds to 2.9 weeds/m^2, repeated herbicides application resulted 6.3 weeds/m^2, whereas the worst results were at weed control and obtained by the once herbicides control variant (9.1 weed/m^2). Melander *et al.* (2005) reported that weed harrowing and inter row hand hoeing provided promising results when they are part of strategy that also involved in cultural weed management in low external input and organic systems. Jursik *et al.* (2008) showed that treatments weeds were removed by hand until 4 leaf stage of sugar beet resulted dry weight of sugar beet top and LAI of sugar beet at first increased normally, but were markedly decreased from the half of the vegetation period. Olsson (2008) concluded that using the normal dose of Goltix [metamitron] (0.65 litres/ha), Betanal [desmedipham](1.0L/ha) and Tramat in oil (0.1 L/ha) gave the best weed control without significant reduction in sugar yield under normal weather conditions. Domaradzki (2009) studied some herbicide mixtures contained Betanal Progress 274 OF, Safari 50 WG and Adiuvant Trend 90 EC and additionally supplemented with Goltix 70 WP, Flirt 460 SC, Venzar 80 WP or Lontrel 300 SL. The applied herbicide mixtures showed high efficacy in weed control (93.7-97.3%). The activity of herbicides depended on the dose of mixture components. Tadayon and Islami (2010) investigated the effects of four types of herbicides (Control, Pyramin, Goltex and Betanal) on sugar beet. The highest dry weight of sugar beet shoot was obtained from Pyramin herbicide at 41.1 g/ha and the lowest with 29.0 g/ha was belong to control treatment. The highest LAI and root weight of sugar beet at 4.7 and 740.3 g/ha, respectively and belonged to Pyramin and the lowest LAI and root weight of sugar beet with 2.5 and 275 g/ha, respectively were belonged to control treatment.

Nitrogen fertilizer has a pronounced effect on the growth and physiological and chemical characteristics of the crop. So that nitrogen caused desirable effect on sugar beet growth (Seaada, 1998 ; Seadh, 2004 and Shewate *et al.*, 2008 and Zhang *et al.,* 2009). El-Sarag (2009) concluded that increasing nitrogen fertilizer rates from 60 to 120 kg N/fed substantially improved most of the studied growth criteria and root yield.) revealed that among the different treatments.

Therefore, this study aimed to study the effect of sowing methods, weed control treatments and nitrogen fertilizer levels on growth of sugar beet as well as associated weed characters under the environmental conditions of El-Sharkia Governorate.

MATERIALS AND METHODS

The present investigation was carried out at Kafr El-Hamam Research Station, Zagazig district, Sharkia Governorate, Agricultural Research Center, during 2008/2009 and 2009/2010 seasons to study the effect of sowing methods, weed control treatments and nitrogen fertilizer levels on growth attributes and associated weed characters of sugar beet (*Beta vulgaris* L.*)* cv. Hanrike as a monogerm variety.

Each sowing method (manual and mechanical) was performed in separate experiment. Manual sowing method was undertaken workers in ridges 60 cm in width and spaced 20 cm between hills (3-4 seeds/hill) on one side of ridges. Plants were thinned at the age of 30 days from sowing to obtain one plant/hill (35000 plants/fad). However, mechanical sowing treatment was done by using planter machine in ridges 60 cm in width and spaced 20 cm between hills (one seed/hill) on one side of ridges to secure 35000 plants/fed.

Soil samples were taken at random from the experimental field area at a depth of 0-30 cm from soil surface and prepared for both mechanical and chemical analysis, according to Jackson (1973).The results are presented in Table 1.

Each experiment of sowing method was performed in split plot with four replicates in the first and second seasons. The main plots were occupied at random with four weed control treatments as follow; 1- one hand hoeing before the second irrigation, 2- Goltix 70 WG (metamitron) as herbicide where the chemical composition was 4-Amino-3-methyl-6-phenyl-1,2,4-triazin-5 (4H)-one, originated by Bayer AG of Germany, which applied at 2 L/fed, after planting and before irrigation (pre emergency), 3- Goltix + one hand hoeing and 4- hand hoeing twice before second third irrigations.

The sub-plots were devoted at random with nitrogen fertilizer levels (60, 80 and 100 kg N/fed). Nitrogen was in form of ammonium nitrate (33.5%) was applied in two equal doses, the first was applied after thinning sugar beet plants (30 days after sowing) and the second portion was carried out before the third irrigation.

Each experimental basic unit (sub-plot) included ten ridges, each 60 cm apart and 3.5 m length, which resulted an area of 21m^2 (1/200 fad).The preceding summer crop was rice (*Oryza sativa* L.*)* in both seasons.

The experimental field well prepared by two ploughing, leveling, compaction, division and then divided to the experimental units. Calcium super phosphate (15.5 % P_2O_5) was applied during soil preparation at the rate of 150 kg/fed. Potassium sulphate (48 % K_2O) at the rate of 24 kg/fed was applied before the third watering.

Sugar beet balls (coated monogerm) were sown using dry sowing method as previously mentioned in the 1st and 10th of October in first and second seasons, respectively. The plots were irrigated immediately after sowing directly. Weed control and nitrogen fertilization in beet fields were done as previously mentioned. Other cultural practices for growing sugar beet were performed as recommendations by Ministry of Agriculture and were followed, except the factors under study. Harvesting took place after 200 days for sugar beet.

Table 1: Mechanical and chemical soil properties at the experimental site during the two growing seasons.

Soil analysis	**First season 2008/2009**	**Second season 2009/2010**
A: Mechanical properties:		
Sand (%)	9.5	9.5
Silt (%)	33.3	34.8
Clay (%)	57.2	55.7
Texture	Clayey loamy	Clayey loamy
B: Chemical analysis		
Soil reaction pH	7.8	7.6
EC (ds/m^2) in soil water extraction (1:5) at 25^{0}C	3.3	3.0
Organic matter (%)	1.69	1.82
Available N (ppm)	19.1	21.5
Available P (ppm)	9.0	10.8
Exchangeable K (ppm)	232.6	243.4

The recorded observations could be divided into the following parts:

I- Sugar Beet:

- **Growth attributes:**

Two samples were taken during the growth periods *i.e.* 120 and 150 days from sowing (DFS) of five guarded plants were chosen at random from outer ridges of each sub-plot. Each sample was separated into foliages and roots, then the roots and foliages were finally separated. The following growth attributes were determined:

1. Root fresh weight (g/plant).
2. Root dry weight (g/plant).
3. Foliage fresh weight (g/plant).
4. Foliage dry weight (g/plant).

To determine root and foliage dry weight, all plant fractions were air-dried, then oven dried at 70^{0}C till constant weight obtained.

5. Leaf area index (LAI): Leaf area measurement determined by the disk method using 10 disks of 1.0 cm diameter according to Watson (1958) and then the following equation was used.

$$LAI = \frac{\text{Unit leaf area per plant } (cm^2)}{\text{Plant ground area } (cm^2)}$$

6. Crop growth rate (CGR) in g/day: Determined according to Radford`s (1967), where: W_1 and W_2 refer to dry weight of plant at sampling time T_1 (120 DAS) and T_2 (150 DAS), respectively.

$$CGR = \frac{W_2 - W_1}{T_2 - T_1}$$

7. Relative growth rate (RGR) in g/g/day: Determined according to Watson (1958).

$$RGR = \frac{\log_e W_2 - \log_e W_1}{T_2 - T_1}$$

8. Net assimilation rate (NAR) in $g/cm^2/day$: Determined according to Radford`s (1967), where: W_1, A_1 and W_2, A_2, respectively refer to dry weight and leaf area of plant at sampling time T_1 and T_2, respectively.

$$NAR = \frac{(W_2 - W_1)(\log_e A_2 - \log_e A_1)}{(T_2 - T_1)(A_2 - A_1)}$$

II- Weed Characters:

1. Number of broad leaves weeds; the main dominant broad leaves weeds were account as sowthistle (*Sonchus oleraceus* L.), wild beet (*Beta vulgaris* L.), common lambsquarters *(Chenopodium album* L.) and the main dominant narrow leaves weed was account as beard grass (*Polypogon monospliensis* L.) were recorded in one random square meter (1 m^2) from each plot at 120 days after sowing.
2. Fresh weights of board and narrow weeds/m^2 (g): it were recorded after classified of weeds to species, cleaned and then weighted in gram per square meter.
3. Dry weights of board and narrow weeds/m^2 (g): it were recorded after dried oven at 105°C for 48 hours.

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for split plot design of each experiment (sowing method), then the combined analysis was carried out as outlined by Gomez and Gomez (1984) by using means of "MSTAT-C" computer software package. Least Significant Difference test (LSD) method was and test the differences between treatment means at 5% level of probability was reported as described by Waller and Duncan (1969).

RESULTS AND DISCUSSION

1- Sowing methods effect:

The statistical analysis of obtained results showed that all growth attributes which estimated at 120 and 150 days after sowing *i.e.* root fresh and dry weights, foliage fresh and dry weights, leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate

(NAR) exhibited significant effect due to mechanical sowing methods in the two growing seasons, excluding of foliage fresh weight at 150 day after sowing in the second season (Tables 2 and 3) as compared with hand sowing. Noteworthy, mechanical sowing method of sugar beet resulted in the highest values of all studied growth characters in both seasons. On the other hand, the lowest means of these traits were recorded from traditional sowing method (manual planting) in the first and second seasons. These results may be attributed to the regularity spacing and numbers of plants between hills in mechanical sowing method, which minimizing the intra competition between plants and led to high light use efficiency of solar radiation utilized by beet plants, in turn high in the conversion of light energy to chemical energy and consequently high accumulation of dry matter and improvement of growth characters. These findings are in harmony with those reported by Zahoor *et al.* (2007) and El-Maghraby *et al.* (2008).

Sowing methods showed significant effect on weed characters *i.e.* number, fresh and dry weights of board leaves weeds/m^2 such as: sowthistle (*Sonchus oleraceus* L.), wild beet (*Beta vulgaris* L.), common lambsquarters *(Cenopodium album* L.), which occurred in the site of experiment in the two seasons (Tables 4 and 5). Whilst, sowing methods had insignificant effect on number, fresh and dry weights of narrow leaves weed *i.e.* beard grass (*Polypogon monospliensis* L.) in the two growing seasons. The lowest means of number, fresh and dry weights (g/m^2) of the different weed varieties that spread in sugar beet fields were obtained from using mechanical sowing method of sugar beet in both seasons. However, the highest values of these traits were resulted from hand sowing method in both seasons. The reduction in number, fresh and dry weights of all previously mentioned weeds owing to sowing sugar beet by planter machine method may be attributed to fix number and regularity spacing of beet plants between hills, which minimized the intra competition between beet plants, which led to high light use efficiency of solar radiation utilized by sugar beet, in turn high vegetative growth, and maximizing in inter competition between beet and weed plants. This can be considered to be a negative interference that induces growth reduction of weeds plants because of an insufficient supply of some necessary environmental resource such as water, mineral elements and light and consequently weed plants became weak. Similar results were reported by El-Maghraby *et al.* (2008).

2- Weed control effect:

Weed control treatments exhibited significant effect on all studied growth characters of sugar beet which estimated at 120 and 150 days from sowing in both seasons (Tables 2 and 3). It can be observed that the two hand hoeings treatment was more effective than other studied weed control treatments in striving weeds, subsequently significantly increased sugar beet growth at the period of 120 and 150 day from sowing and produced the highest values of all growth characters. Controlling weeds associated with sugar beet plants by application of Goltex + one hand hoeing treatment which came in the second rank followed by application of Goltex treatment in both seasons.

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Whilst, one hand hoeing treatment gave the lowest means of all growth characters at 120 and 150 day from sowing in the first and second seasons. Such enhancement in sugar beet growth characters at 120 and 150 day from sowing due to goodness of weed control through two hand hoeings may be due to high efficiency in safety weed control, disassembly surface layer of soil and then increasing root system consequently improvement beet growth. In this connection Jursik *et al.* (2008) and Tadayon and Islami (2010) reported similar results.

Weed control treatments had a significant effect on number, fresh and dry weights of board leaves weeds/m^2 such as: sowthistle (*Sonchus oleraceus* L.), wild beet (*Beta vulgaris* L.), common lambsquarters *(Cenopodium album* L.) as well as narrow leaves weed *i.e.* beard grass (*Polypogon monospliensis* L.) in both seasons as shown in Tables 4 and 5. Hand hoeing twice was the best weed control treatment that resulted in the lowest number, fresh and dry weights of all studied weed in both seasons. Whereas, the highest values of number, fresh and dry weights per square meter of all studied weeds were obtained by controlling weeds by one hand hoeing treatment in both seasons. Superiority of twice hand hoeing treatment in controlling annual weeds could be attributed to high efficiency in weed control from through the continuous destroying effect of frequent hand hoeings of annual weeds, since these weeds are not capable to re-growth from the underground parts. However this favorable effect on weed germination is apparently offset by the more effective elimination of weed by frequent hand hoeing. Similar results obtained by Kristek *et al.* (2004) and Melander *et al.* (2005).

3- Nitrogen fertilizer levels effect:

From obtained results that listed in Tables 2 and 3, revealed that nitrogen fertilizer levels significantly affected all growth attributes under study at 120 and 150 days from sowing as well as number, fresh and dry weights of all studied weeds in both seasons, except LAI at 150 days from sowing in the first season only. It can be easily consider that raising nitrogen levels markedly accompanied with obvious increase in all growth measurements at the two samples as well as weed characters in both seasons. Application of 100 kg N/fed significantly resulted in the highest values of all studied characters of sugar beet and weeds in the two growing seasons. In addition, application of 80 kg N/fed produced the best results after aforementioned level in both seasons. however, the lowest values of all studied characters were resulted from application of 60 kg N/fed in the two seasons. The increment of growth attributes and weed characters gained by increasing nitrogen levels may be due to the role of nitrogen in developing root dimensions by increasing division or elongation of cells and also enhancing leaf initiation and increment of chlorophyll concentration in leaves and photosynthesis process. The aforementioned results generally are in good agreement with those stated by Seadh (2004), Shewate *et al.* (2008), El-Sarag (2009) and Zhang *et al.* (2009).

It could be stated that maximizing sugar beet growth and minimizing weed characters could be achieved by sowing sugar beet using mechanical

sowing method (planter machine), controlling weeds by hand hoeing at two times and fertilizing with 100 kg N/fed.

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تأثير طرق الزراعة ومعاملات مقاومة الحشائش على نمو بنجر السكر وصفات الحشائش تحت مستويات السماد النيتروجينى

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أجريت تجربتان حقليتان بمحطة البحوث الزراعية بكفر الحمام – مركز الزقازيق – محافظة الشرقية خلال موسمى ٢٠٠٨/٢٠٠٩ و٢٠٠٩/٢٠١٠ بهدف دراسة تأثير طرق الزراعة (الآلية واليدوية) وطرق مقاومة الحشائش (عزقة واحدة قبل الرية الاولى ، مبيد الجولتكس ، مبيد الجولتكس + عزقة واحدة قبل الرية الاولى وعزقتين قبل الرية الاولى وقبل الرية الثانية) تحت مستويات مختلفة من التسميد النيتروجينى (٦٠ ، ٨٠ و١٠٠ كجم نيتروجين/فدان) على نمو محصول بنجر السكر وصفات الحشائش المصاحبة له فى تلك المنطقة. أجريت كل طريقة زراعة فى تجربة مستقلة ثم نفذت كل تجربة فى تصميم القطع المنشقة مرة واحدة فى أربع مكررات ثم أجرى التحليل التجميعى لتجارب طرق الزراعة بعد إجراء إختبار التجانس.

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

١- أدت الزراعة الألية لبنجر السكر بآلة الزراعة فى خطوط إلى تفوق معنوى على طريقة الزراعة التقليدية (الزراعة اليدوية) فى جميع صفات النمو والحشائش تحت الدراسة فى كلا موسمى الزراعة.

٢- أظهرت مقاومة الحشائش المصاحبة لنبات بنجر السكر عن طريق عزقتين قبل الرية الثانية والثالثة تفوق معنوى على باقى المعاملات تحت الدراسة والحصول على أعلى القيم لجميع الصفات تحت الدراسة لبنجر السكر والحشائش فى كلا موسمى الدراسة. أما مقاومة الحشائش عن طريق مبيد الجولتكس + عزقة واحدة قبل الرية الثانية أتت فى المرتبة الثانية بعد المعاملة السابقة فى كلا الموسمين. فى حين أن مقاومة الحشاش عن طريق عزقة واحدة قد سجلت أقل القيم لجميع الصفات تحت الدراسة لبنجر السكر والحشائش فى كلا الموسمى.

٣- أدى التسميد النيتروجينى بمعدل ١٠٠ كجم/فدان إلى زيادة معنوية والحصول على أعلى القيم لجميع الصافات تحت الدراسة سواءً لبنجر السكر أوالحشائش فى كلا الموسمين. فى حين أن إستخدام ٦٠ كجم نيتروجين/فدان قد سجل أقل القيم لجميع الصفات تحت الدراسة فى كلا الموسمين.

من النتائج المتحصل عليها فى هذه الدراسة يمكن التوصية بزراعة بنجر السكر صنف هنرك (وحيد الاجنة) بطريقة الزراعة الالية باستخدام آلة الزراعة فى خطوط ومقاومة الحشائش النامية بالعزيق مرتين والتسميد النتروجينى بمعدل ١٠٠ كجم نيتروجين/فدان للحصول على أفضل صفات للنمو تحت ظروف محافظة الشرقية.

قام بتحكيم البحث

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Table 2: Averages of root and foliage fresh and dry weights (g/plant) at 120 and 150 DFS as affected by sowing methods, weed control treatments and nitrogen fertilizer levels during 2008/2009 and 2009/2010 seasons.

Characters	Root fresh weight (g/plant)				Root dry weight (g/plant)				Foliage fresh weight (g/plant)				Foliage dry weight (g/plant)			
Seasons	2008/2009		2009/2010		2008/2009		2009/2010		2008/2009		2009/2010		2008/2009		2009/2010	
Sampling times (DFS) / Treatments	120	150	120	150	120	150	120	150	120	150	120	150	120	150	120	150
A: Sowing methods:																
Manual	288.13	431.96	324.33	487.50	67.06	104.81	75.26	118.57	528.54	570.63	618.13	682.08	58.56	62.60	61.58	65.35
Mechanical	315.67	486.29	343.92	503.29	72.56	118.55	79.92	122.11	580.00	612.92	653.75	697.46	64.25	68.75	67.08	72.56
F. test	*	*	*	*	*	*	*	*	*	*	*	NS	*	*	*	*
B: Weed control treatments:																
One hand hoeing	240.83	389.00	262.67	404.25	56.23	94.09	63.02	98.11	372.08	420.42	431.25	510.00	53.50	57.29	56.21	60.13
Goltex	289.08	473.33	318.50	480.92	67.40	105.87	76.31	116.81	534.17	531.25	598.75	619.08	59.88	65.29	63.21	68.38
Goltex + one hoeing	327.58	484.67	344.75	532.17	75.19	118.40	82.56	129.31	595.42	656.67	704.58	767.08	63.88	68.17	67.33	72.29
Two hoeing	350.08	525.50	410.58	564.25	80.43	128.35	88.47	137.14	715.42	758.75	809.17	862.92	68.38	71.96	70.58	75.04
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	8.49	4.25	6.23	5.09	1.98	1.05	1.42	1.13	4.53	18.96	4.25	48.11	0.23	0.28	0.25	0.32
C: Nitrogen fertilizer levels:																
60 kg/fed	277.88	397.88	305.38	431.13	64.25	96.74	70.74	104.67	509.67	555.31	581.25	657.19	58.75	63.00	61.59	65.91
80 kg/fed	305.00	457.88	333.50	497.38	70.52	111.37	77.44	120.82	550.00	586.56	632.81	663.69	61.34	65.31	64.22	68.69
100 kg/fed	322.81	521.63	363.50	557.69	74.67	126.92	84.58	135.53	603.13	633.44	693.75	748.44	64.13	68.72	67.19	72.28
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	7.36	3.68	5.38	4.25	1.70	0.91	1.27	1.05	3.96	16.41	3.68	41.60	0.20	0.22	0.23	0.26

Table 3: Averages of leaf area index (LAI) at 120 and 150 days after sowing, crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) as affected by sowing methods, weed control treatments and nitrogen fertilizer levels during 2008/2009 and 2009/2010 seasons.

Characters / Seasons	LAI				CGR (g/day)		RGR (g/g/day)		NAR (g/cm^2/day)	
	2008/2009		2009/2010							
Sampling times (DFS) / Treatments	120	150	120	150	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010
A: Sowing methods:										
Manual	2.6	3.2	2.9	3.9	1.39	1.57	0.123	0.128	2.133	2.800
Mechanical	3.0	3.6	3.3	4.7	1.68	1.58	0.130	0.128	2.837	3.235
F. test	*	*	*	*	*	*	*	*	*	*
B: Weed control treatments:										
One hand hoeing	2.2	2.6	2.4	3.1	1.39	1.31	0.123	0.121	1.759	1.910
Goltex	2.5	3.2	2.7	4.0	1.46	1.52	0.125	0.127	2.210	2.783
Goltex + one hoeing	3.0	3.7	3.4	4.8	1.58	1.72	0.128	0.130	2.735	3.576
Two hoeing	3.5	4.2	3.9	5.2	1.72	1.76	0.131	0.132	3.235	3.802
F. test	*	*	*	*	*	*	*	*	*	*
LSD.5%	0.07	0.14	0.09	0.11	0.08	0.06	0.002	0.001	0.14	0.14
C: Nitrogen fertilizer levels:										
60 kg/fed	2.4	3.0	2.7	3.6	1.22	1.28	0.119	0.121	1.763	2.144
80 kg/fed	2.8	3.4	3.1	4.2	1.49	1.59	0.126	0.128	2.375	3.007
100 kg/fed	3.2	3.9	3.5	5.0	1.89	1.87	0.134	0.134	3.316	3.902
F. test	*	NS	*	*	*	*	*	*	*	*
LSD.5%	0.06	-	0.08	0.09	0.06	0.05	0.002	0.001	0.14	0.11

Table 4: Averages of number, fresh and dry weights of sowthistle (*Sonchus olereus* L.) and wild beet (*Beta vulgaris.* L.) as affected by sowing methods, weed control treatments and nitrogen fertilizer levels during 2008/2009 and 2009/2010 seasons.

Characters / Treatments	Number of sowthistle/m^2		Fresh weight of sowthistle g/m^2		Dry weight of sowthistle g/m^2		Number of wild beet/m^2		Fresh weight of wild beet g/m^2		Dry weight of wild beet g/m^2	
Seasons	**2008/2009**	**2009/2010**	**2008/2009**	**2009/2010**	**2008/2009**	**2009/2010**	**2008/2009**	**2009/2010**	**2008/2009**	**2009/2010**	**2008/2009**	**2009/2010**
A: Sowing methods:												
Manual	14.61	10.50	448.80	368.30	225.50	189.60	8.35	7.00	188.43	173.12	77.08	60.72
Mechanical	6.01	4.31	123.31	103.00	70.81	62.61	5.89	4.41	129.89	128.43	58.85	42.81
F. test	*	*	*	*	*	*	*	*	*	*	*	*
B: Weed control treatments:												
One hand hoeing	22.50	16.30	772.10	627.50	367.90	314.20	10.04	8.37	217.91	202.50	95.62	75.83
Goltex	10.01	6.71	227.10	195.21	139.60	121.91	8.04	6.58	180.62	173.54	79.37	59.58
Goltex + one hoeing	6.30	4.70	120.00	94.80	67.91	57.50	6.37	4.54	147.50	136.66	58.54	44.58
Two hoeing	2.51	1.81	25.00	19.80	17.30	10.81	4.04	3.33	90.62	90.41	38.33	27.08
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	3.40	2.30	59.50	44.70	30.30	26.40	0.27	0.26	3.74	6.69	4.02	2.16
C: Nitrogen fertilizer levels:												
60 kg/fed	6.90	4.60	187.50	165.90	97.20	81.40	5.71	4.62	126.71	112.03	52.34	39.37
80 kg/fed	10.31	7.11	265.01	213.81	140.21	119.21	7.28	5.75	160.00	157.34	70.78	52.65
100 kg/fed	13.80	10.40	405.60	323.30	207.20	177.70	8.37	6.75	190.78	182.96	80.78	63.28
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	2.90	2.00	51.50	38.80	26.30	22.90	0.23	0.22	3.25	5.79	3.48	1.87

Table 5: Averages of number, fresh and dry weights of common lambsquarters (*Cenopodium album* L.) and beard grass (*Polypogon monospeliensis* L.) as affected by sowing methods, weed control treatments and nitrogen fertilizer levels during 2008/2009 and 2009/2010 seasons.

Characters / Treatments / Seasons	Number of common lambs quarters/m^2		Fresh weight of common lambs quarters g/m^2		Dry weight of common lambs quarters g/m^2		Number of beard grass/m^2		Fresh weight of beard grass g/m^2		Dry weight of beard grass g/m^2	
	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010
A: Sowing methods:												
Manual	12.60	9.97	177.45	157.50	43.02	36.30	4.00	3.20	44.82	40.20	25.10	20.72
Mechanical	8.02	7.35	141.04	131.91	33.33	27.81	3.51	2.61	43.61	37.32	25.71	18.31
F. test	*	*	*	*	*	*	N.S	N.S	N.S	N.S	N.S	N.S
B: Weed control treatments:												
One hand hoeing	16.25	13.00	294.16	264.40	86.25	73.00	6.30	5.10	84.61	81.33	49.20	40.00
Goltex	10.00	8.37	169.16	156.51	40.41	34.61	5.41	4.01	59.10	47.31	34.10	25.00
Goltex + one hoeing	8.12	7.12	98.75	83.30	15.62	13.30	2.90	2.40	30.80	24.40	16.90	12.11
Two hoeing	6.87	6.16	74.91	74.61	10.41	7.21	0.41	0.30	2.52	2.10	1.52	1.041
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	2.40	2.1	26.00	24.10	8.70	8.20	2.80	2.20	31.40	28.50	17.70	14.22
C: Nitrogen fertilizer levels:												
60 kg/fed	5.93	4.31	83.75	74.30	15.31	11.40	1.31	0.90	13.11	10.50	8.30	7.30
80 kg/fed	10.00	8.84	151.50	136.60	36.25	29.31	3.80	2.91	50.62	42.51	29.40	21.12
100 kg/fed	15.00	12.84	242.50	223.11	62.96	55.30	6.31	5.10	69.11	63.30	38.61	30.11
F. test	*	*	*	*	*	*	*	*	*	*	*	*
LSD.5%	2.10	1.80	22.4	20.90	7.60	7.10	2.40	1.90	27.20	24.60	15.31	12.20