J. Plant Production, Mansoura Univ., Vol. 8(11): 1121 - 1125, 2017

Effect of Sowing Dates and Method on Fodder Beet Productivity under Saline Conditions at Siwa Oasis, Egypt

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ABSTRACT

Fodder Beet is potentially the highest yielding winter forage crops and is high in energy, palatability and digestibility. However, due to susceptibility of fodder beet to salinity at early growth stages and a relatively long growing season, transplanting technique and appropriate sowing date could help to fodder beet production particularly in saline soils. Therefore, two field trials were conducted in Agricultural Experimental Station of Desert Research Center at Tegzerty, Siwa Oasis, Matrouh Governorate, Egypt during 2006/2007 and 2007/2008 growing seasons. These trials were carried out to study the effect of four planting dates i.e. 15 Oct., 30 Oct., 15 Nov., 30 Nov. and two planting methods i.e. direct seeding and transplanting at 45 days on fodder beet productivity under saline conditions.Results indicated that top fresh or dry weights as well as fresh and dry weights of root either per plant or fed. (fed. =0.42 ha.) were decreased with delaying planting dates from 30 Oct. to 30 Nov. in both growing seasons. These reductions may be attributed to reducing length and diameter of roots with delaying planting dates. Whereas, number of harvestable plants/fed., at harvest, was increased with delaying planting date up to the 3rd planting date of 15 Nov. and after then it was decreased with the latest planting date at 30 Nov. Moreover, the percentage of abnormal roots (%) was significantly decreased with delaying planting dates in both growing seasons.Concerning the effect of planting methods, transplanting method markedly increased number of harvestable plants and abnormal root percentage as comparing with the traditional planting method of direct seeding in both growing seasons. Furthermore, top and root fresh or dry weights per plant were decreased with planting fodder beet by transplants. However, fresh or dry fodder beet yield/fed. was increased with planting method of direct seeding in the 1st growing season, but did not reach to a significant level in the 2nd one. These increments may be due to one or more the following reasons; increasing fresh or dry root/plant, top fresh or dry weight/plant, root length and/or root diameter.
Keywords: Fodder beet, Planting dates, Planting methods, Transplanting, Direct seeding, Salinity, Siwa Oasis.

INTRODUCTION

Fodder beet offers a higher yield potential than any other arable fodder crop (Anonymous, 2006) and when grown under suitable conditions can produce almost 20 t/ha dry matter yield (DFA, 1998) and also yields more than 80 t/ha and this makes it popular in many countries like New Zealand, Germany, America, Australia, Syria and Egypt (Shalaby, *et al*., 1989). The above and below growth parts (leaves and roots) are used to feed the animals but, the main fodder is tuberous roots, therefore the optimum population which produces maximum leaves and roots yield must be carefully determined (Ibrahim, 2005). He added that fodder beet is a good forage especially during the critical period of forage shortage such as early summer season in Egypt. However, beet plants are relatively sensitive to salinity at germination and seedling stages, with a 50% reduction at Ec_e of 6.0 dsm^{-1} (Ayers and Hayward, 1948; Francois and Goodin, 1972; Shannon, 1984 and Marschner, 1995), This creates the main problem for sugar beet production under salinity conditions by decreasing plant stand at harvest. Although, thereafter, beet plants are tolerant to salinity, without yield reduction at Ec_e of 7.0 dSm^{-1} or with 50% reduction in yield potential at Ec_e of 15 dSm^{-1} (Ayers and Westcot, 1976 and Doorenbos *et al*., 1977). Moreover, Matthew1 *et al*. (2011) reported that the first phase of fodder beet crop growth is leaf area accumulation. It takes between 60-150 days from sowing for a LAI of 3 to be achieved and this LAI represents 80-90% light capture (Martin, 1983; Martin *et al.,* 1984). Because of the comparatively low density and long establishment time the crop must be sown with a precision seeder and good weed control is essential. As well as early sugar beet canopy usually is very slow developing, with 70 or more days from planting to a leaf area index of 1.0. Therefore, sugar beet seems to have a higher soil water requirement for its germination than some other crops (Martin, 1983). Also, Draycott (2006) found that as direct-seeding in main field, due to more susceptibility of plant early growth stages to environmental conditions, have a negative effect on crop and reduce desirable yields of sugar beet, usually transplants raised under greenhouse or nursery conditions used in sugar beet production which help to accelerate the sugar beet germination and growth to prevent seed exposure to not appropriate environmental conditions. Transplanting method lengthen the growing season by earlier planting in greenhouse when direct seeding may impossible due to not appropriate environmental condition outside the greenhouse and this prolongation of growing season have a positive effect on yield. In addition, due to sugar beet susceptibility to salinity at early stages of growth, using transplanted sugar beet in which transplant were raised in appropriate mixture of soil could help to sugar beet production especially in saline soils (Gohari *et al*., 1995). Considering the above points, this study conducted with the objective to determine the most appropriate sowing date and sowing method by transplants or direct seeding on fodder beet production.

Regarding planting dates, Besheit (1986) found that, on sugar beet, the best length, diameter and weight of roots resulted from Oct. sowing, thereafter a clear reduction in root size and its quality was recorded as sowing was delayed under Egyptian conditions.

The objectives of this study are to study the effects of sowing method and sowing dates on yield and yield components of fodder beet under Siwa Oasis conditions.

MATERIALS AND METHODS

Two field trials were conducted in Agricultural Experimental Station of Desert Research Center at Tegzerty, Siwa Oasis, Matrouh Governorate, Egypt during the successive growing seasons 2006/2007 and 2007/2008, to study the effect of four planting dates i.e. 15 Oct., 30 Oct., 15 Nov., 30 Nov. and two planting methods i.e. direct seeding and transplanting at 45 days on fodder beet (*Beta vulgaris*) productivity under saline conditions. The experimental design was split plot design with 3 replicates in the both growing seasons. Sowing dates were randomly arranged in the main plots, while, sowing methods were allocated randomly in the sub-plots. The experimental unit area was 10.5 m^2 (3 m x 3.5 m) containing 5 rows (3 m long and 60 cm apart). When fodder beet transplants, at 45 days, were available, they were transplanted at two plants/hill on one side of rows, 20 cm between hills. Regarding direct seeding, about 3 seeds/hill were sown with 20 cm apart. Two months after sowing dates, hand thinning to one plant per hole and resowing by the removed seedlings were done simultaneously during both seasons. For obtaining fodder beet transplants, in both growing seasons, nursery soil was prepared and leveling after added 15 kg P_2O_5/fed. as superphosphat (15.5% P_2O_5). Fodder beet seeds were sown, at a rate of 4 kg/fed., four times with 2 weeks intervals started from 1st Sept. The soil type of the experimental site was loamy sand in texture having 13.6 % $CaCO_3$, 7.8 pH, organic matter 3.05% and EC 15 dSm^{-1}. Plants were irrigated with saline water which contained 3500 - 3800 ppm as total dissolved salts. Prior to sowing, 20 m^3 organic manure and 30 kg P_2O_5 per feddan, as calcium superphosphate (15.5% P_2O_5), were added during the soil preparation. Moreover, two equal doses of 30.0 kg N/fed. as ammonium nitrate (33.5% N) were added after 15 and 60 days from planting date of transplanting and direct seeding methods, respectively.

At harvest dates, after 235, 225, 220, 210, for direct seeding and 200, 190, 175, 160 days, for transplanting method, from sowing dates of the 1st, 2nd, 3rd, 4th sowing dates, respectively, when plants showed signs of maturity which is indicated by leaf yellowing and partial drying of the lower leaves, three plants from the inner row of plot were randomly taken to determine root characters, length, diameter, fresh and dry weights of top and root. Number of harvestable plants/fed., abnormal roots percentage, green and dry fodder yield was obtained by weighing plants in one row (3 x 0.6 =1.8m^2 and then transformed to ton per fed.

Statistical analysis:

Data were analyzed statistically according to the procedure outline Snedecor and Cochran (1967). Means followed by the same alphabetical letter (s) are not statistically different at the 0.05 level of significance according to Duncan's multiple test (1955).

RESULTS AND DISCUSSION

1. Effect of sowing methods:

Data in Table (1) show that direct seeding method significantly increased fresh and dry weight of plant in the 1st growing season. However, in the 2nd one, these increaments did not reach a significant level. These increment may be attributed to increasing root length, root diameter and root, top fresh or dry wt./plant. Moreover, fresh or dry yield/fed. was increased significantly with direct seeding method in the 1st season, however, in the 2nd one, these increases did not reach to the significant level. On the other hand, No. of harvestable plants/fed. was decreased significantly with the above mention sowing method in both growing seasons. The inverse relationship between No. of harvestable plants/fed. and root characters, i.e. length, diameter and weight of root, was shown in this study.

Table 1. Effect of sowing methods of fodder beet on yield and its components under saline conditions at Siwa Oasis, Egypt.

Sowing Methods	Root Length (cm)	Root Diameter (cm)	No. of harvestable plants/fed. (1000)	Abnormal root (%)	Fresh weight (kg/plant)			Dry weight (kg/plant)			Fresh yield/fed, (t/fed.)	Dry yield/fed. (t/fed.)
					Root	Top	Total	Root	Top	Total		
1st season												
Direct seeding	24.50 a	22.17 a	15.07 b	12.86 b	1.244 a	0.658 a	1.902 a	0.187 a	0.071 a	0.258 a	28.58 a	3.890 a
Transplanting	17.83 a	19.67 b	17.61 a	35.59 a	0.968 a	0.505 b	1.473 b	0.142 b	0.054 b	0.196 b	25.68 b	3.423 b
2nd season												
Direct seeding	23.58 a	19.50 a	14.450 b	9.17 b	1.126 a	0.629 a	1.754 a	0.170 a	0.068 a	0.238 a	25.34 a	3.445 a
Transplanting	18.67 b	16.92 b	16.970 b	30.58 b	0.912 b	0.524 b	1.436 b	0.131 b	0.058 b	0.189 b	24.32 a	3.200 a

Regarding root traits, i.e. length, diametter, fresh and dry weights of root, were reduced significantly with transplanting sowing method as compared with the direct seeding method in the two growing seasons. Moreover, top fresh and dry weights were decreased significantly with transplanting method. In this respect, opposite results were found by Abid Hussain and Field (1991), they found that total dry matter or root dry

matter yields of the transplanted beet were significantly greater than those of the seed sown beet. Also, Karbalaeil *et al.* (2012) found that transplanting method had a significant preference in comparison to direct seeding and the highest transplant root size was preferred.

2. Effect of sowing dates:

Results in Table (2) indicated that the 2nd sowing date, at 30 Oct., gave the highest values of fresh and dry weights per plant or fed. in both growing seasons. These results may be due to increasing root traits, i.e. length, diameter, fresh and dry root weights, top fresh weight/plant and to some extent No. of harvestable plants/fed. Whereas, fresh or dry fodder beet yield/fed. was decreased significantly with delaying sowing dates.

Table 2. Effect of sowing dates of fodder beet on yield and its components under saline conditions at Siwa Oasis, Egypt.

Sowing Dates	Root Length (cm)	Root Diameter (cm)	No. of harvestable plants/fed. (1000)	Abnormal root (%)	Fresh weight (kg/plant)			Dry weight (kg/plant)			Fresh yield/fed, (t/fed.)	Dry yield/fed. (t/fed.)
					Root	Top	Total	Root	Top	Total		
1st season												
1st sowing date	24.17 a	24.33 a	14.32 a	22.60 a	1.260 ab	0.718 a	1.978 a	0.185 a	0.075 a	0.260 ab	27.96 b	3.669 b
2nd sowing date	23.50 a	23.50 a	16.80 a	25.40 ab	1.333 a	0.696 a	2.029 a	0.196 a	0.076 a	0.262 a	33.80 a	4.523 a
3rd sowing date	21.00 a	19.67 b	17.350 a	21.28 c	1.138 b	0.541 b	1.679 b	0.167 a	0.063 a	0.230 b	29.11 b	3.980 b
4th sowing date	16.00 b	16.17 c	16.790 b	22.62 bc	0.690 c	0.371 c	1.065 c	0.110 b	0.038 b	0.148 c	17.65 c	2.454 c
2nd season												
1st sowing date	22.67 a	22.83 a	14.47 c	21.45 a	1.190 a	0.704 a	1.894 a	0.172 a	0.075 a	0.248 a	27.23 b	3.556 b
2nd sowing date	23.17 a	19.33 ab	16.250 a	23.53 a	1.229 a	0.756 a	1.985 a	0.176 a	0.076 a	0.253 a	32.05 a	4.067 a
3rd sowing date	21.67 a	16.33 bc	16.600 a	18.27 b	1.007 b	0.490 b	1.497 b	0.152 a	0.057 b	0.209 b	24.61 c	3.424 b
4th sowing date	17.00 b	14.33 c	15.500 b	16.23 b	0.649 c	0.355 c	1.004 c	0.103 b	0.043 c	0.146 c	15.44 d	2.243 c

In this respect, Abid Hussain and Field (1991) found that total dry matter or root dry matter yields of sugger beet at the mid-August sowing date were significantly greater than those for the mid-September sowing date. Furthermore, Karbalaei, S. *et al.* (2012) found that the highest root, sugar and white sugar yield obtained in D1 (9 May) on average 66.77, 10.35 and 8.219 t ha^{-1}, respectively.

Root length, diamettrt and abnormal root percentage were decreased significantly with delaying sowing dates from 15 Oct. to 30 Nov. in the 1st season and to some extent in the 2nd one, Whereas, in the two growing seasons, the 3rd sowing date (15 Nov.) produced the maximum value of harvestable plants/fed. and then decreased with early and/or dealying sowing sowing dates. In this regard, in Egypt, Abd-El Gawad *et al*. (2000) found that early planting dates produced thicker, heaviest sugar beet root/plant and top yield per plant and fed. as well as sugar yield/fed. However, planting sugar beet at 1st Nov. was more favorable for emergence %, plant stand at harvest and root length.

3. Effect of the interaction between sowing method and sowing dates:

Results in Table (3) indicated that direct seeding at the 2nd (30 Oct.), and to some extent, at the 1st (15 Oct.) sowing dates produced the higher values of root length, diameter, fresh or dry weights per plant and fed. as well as top fresh and dry weights/plant or fed. in both growing seasons. On the other hand, transplanting sowing method at the 4th and 3rd sowing dates, in the 1st and 2nd growing seasons, respectively gave the higher values of harvestable plants number per fed.

Although, sowing method by direct seeding at the 2nd sowing date (30 Oct.) had a significant increase in fresh or dry yields per fed. in both growing seasons. However, in the 2nd season, the two sowing methods did not differ significantly in fresh yield/fed. only at the same sowing date.

Concerning the percentage of abnormal root, it increased significantly with transplanting sowing method at any sowing date as compared with the same sowing date by direct seeding method.

Table 3. Effect of the interaction between sowing methods and sowing dates of fodder beet on yield and its components under saline conditions at Siwa Oasis, Egypt.

Sowing Methods x Dates	Root Length (cm)	Root Diameter (cm)	No. of harvestable plants/fed. (1000)	Abnormal root (%)	Fresh weight (kg/plant)			Dry weight (kg/plant)			Fresh yield/fed, (t/fed.)	Dry yield/fed. (t/fed.)
					Root	Top	Total	Root	Top	Total		
Direct seeding							1st season					
1st sowing date	27.33 a	26.33 a	12.41 f	12.10 de	1.360 ab	0.794 a	2.154 a	0.200 ab	0.081 ab	0.281 ab	26.71 de	3.490 c
2nd sowing date	28.67 a	26.67 a	15.99 d	14.10 d	1.556 a	0.802 a	2.358 a	0.236 a	0.089 a	0.325 a	37.69 a	5.191 a
3rd sowing date	23.0 ab	18.67 b-d	16.80 c	9.03 e	1.290 bc	0.620 b	1.910 b	0.187 bc	0.073 ab	0.260 bc	32.06 b	4.361 b
4th sowing date	19.0 bc	17.00 cd	15.06 e	16.20 d	0.771 ef	0.416 c	1.187 d	0.125 de	0.043 d	0.168 ef	17.85 f	2.518 d
Transplanting												
1st sowing date	21.0 b	22.33 ab	16.23 cd	43.10 a	1.160 b-c	0.642 b	1.802 b	0.169 b-c	0.068 bc	0.238 b-d	29.22 cd	3.848 bc
2nd sowing date	18.33 bc	20.33 bc	17.60 b	36.70 b	1.110 cd	0.590 b	1.700 b	0.156 b-d	0.063 bc	0.219 cd	29.81 bc	3.855 bc
3rd sowing date	19.0 bc	20.67 bc	18.10 ab	33.53 b	0.987 de	0.461 c	1.448 c	0.147 cd	0.052 cd	0.199 de	26.16 e	3.599 c
4th sowing date	13.0 c	15.33 d	18.53 a	29.03 c	0.616 f	0.326 d	0.942 e	0.096 e	0.033 d	0.129 f	17.14 f	3.390 d
Direct seeding							2nd season					
1st sowing date	25.67 ab	25.00 a	13.09 f	9.97 e	1.290 ab	0.760 a	2.049 a	0.190 ab	0.079 a	0.269 ab	26.84 b	3.523 b
2nd sowing date	27.67 a	21.00 ab	15.19 d	9.07 e	1.390 a	0.780 a	2.171 a	0.207 a	0.084 a	0.291 a	32.94 a	4.422 a
3rd sowing date	22.67 bc	16.67 bc	15.31 d	8.20 e	1.123 b	0.570 c	1.694 b	0.173 a-c	0.062 b-d	0.234 bc	25.92 bc	3.585 b
4th sowing date	18.33 de	15.33 bc	14.20 e	9.43 e	0.699 de	0.404 d	1.103 d	0.112 de	0.047 de	0.159 ef	15.66 d	2.252 c
Transplanting												
1st sowing date	19.67 c-e	20.67 ab	15.89 c	32.93 b	1.089 bc	0.649 b	1.738 b	0.155 b-d	0.071 ab	0.226 c	27.62 b	3.589 b
2nd sowing ate	18.67 c-e	17.67 bc	17.31 b	38.00 a	1.068 bc	0.732 a	1.799 b	0.145 cd	0.069 bc	0.215 cd	31.16 a	3.712 b
3rd sowing date	20.67 cd	16.00 bc	17.89 a	28.33 c	0.891 cd	0.410 d	1.301 c	0.130 c-e	0.052 c-e	0.183 de	23.30 c	3.263 b
4th sowing date	15.67 e	13.33 c	16.79 b	23.03 d	0.599 e	0.306 e	0.905 e	0.094 e	0.039 e	0.133 f	15.21 d	2.234 c

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تأثير مواعيد وطريقة الزراعة على إنتاجية محصول بنجر العلف تحت الظروف الملحية بواحة سيوة ، مصر

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يعتبر محصول بنجر العلف من محاصيل العلف الشتوية الاعلى انتاجية ، ويمتيز بارتفاع محتواه من الطاقة والقابلية للاستساغة والهضم. بالرغم من ذلك وبسبب تاثره بالملوحة فى مراحل النمو المبكرة وطول موسم النمو نسبيا ، يمكن لطريقة الزراعة بالشتل وتحديد ميعاد الزراعة المناسب العمل على زيادة انتاجية بنجر العلف خاصة فى الاراضى الملحية. لذلك تم اجراء تجربة حقلية بمحطة بحوث تجزيرتى بواحة سيوة بمحافظة مطروح بجمهورية مصر العربية والتابعة لمركز بحوث الصحراء خلال موسمين زراعيين ٢٠٠٦/٢٠٠٧ و ٢٠٠٧/٢٠٠٨ ، اجريت هذه التجارب لدراسة تاثير ميعاد الزراعة (فى ١٥ اكتوبر ، ٣٠ اكتوبر ، ١٥ نوفمبر ، ٣٠نوفمبر) وطريقتين زراعة (الزراعة التقليدية بالبذرة ، الزراعة بشتلات عمر ٤٥ يوما) على انتاجية محصول بنجر العلف تحت الظروف الملحية. وأوضحت النتائج ان الوزن الغض اوالجاف للعرش وكذلك الوزن الغض والجاف للجذور سواء للنبات او الفدان (الفدان = ٠.٤٢ هكتار) نقص مع تاخر مواعيد الزراعة من ٣٠ اكتوبر الى ٣٠ نوفمبر فى كلا موسمى النمو. وقد يعزى هذا النقص الى نقص طول وقطر الجذور مع تاخر ميعاد الزراعة. وبينما زاد عدد النباتات / فدان عند الحصاد مع تاخر ميعاد الزراعة حتى ميعاد الزراعة الثالث فى ١٥ نوفمبر ، فانه انخفض مع اخر ميعاد زراعة فى ٣٠ نوفمبر. كما ادى التاخر فى ميعاد الزراعة الى نقص ملحوظ فى النسبة المئوية للجذور المتفرعة خلال موسمى النمو.أما فيما يتعلق بتأثير طرق الزراعة، فقد زادت طريقة الزراعة بالشتل بشكل ملحوظ من عدد النباتات عند الحصاد والنسبة المئوية للجذور المتفرعة مقارنة مع طريقة الزراعة التقليدية بالبذرة مباشرة في كلا من موسمى النمو. وعلاوة على ذلك، فقد نقصت أوزان العرش والجذر سؤاء الغض او الجاف مع زراعة بنجر العلف عن طريق الشتل. كما اظهرت النتائج زيادة الوزن الغض والجاف لمحصول الفدان من العرش والجذور باستخدام طريقة الزراعة التقليدية بالبذرة فى موسم النمو ، ولكن لم تصل إلى مستوى المعنوية فى موسم النمو الثانى. قد تكون هذه الزيادات بسبب واحد أو أكثر من الأسباب التالية ؛ زيادة الوزن الغض والجاف لجذر النبات ، زيادة الوزن الغض والجاف لعرش النبات ، زيادة طول الجذر و/ أو قطر الجذر.