The Effect of Planting Dates and Varieties Interaction on Productivity and Some Morphological and Qualitative Traits of Fodder Beet (*Beta vulgaris* var. *crassa*)

Ahmad Mohanna[(1)] Entessar Al-Jbawi*[(2)] and Julnar Mansour[(1)]

(1). Crops Department, Faculty of Agriculture, AL Baath University, Homs, Syria
(2). Sugar beet Research Department, Crops Research Administration, General Commission for Scientific Agricultural Research (GCSAR), Damascus, Syria.
(*Corresponding author: dr.entessara@gmail.com, dr.entessara@gcsar.gov.sy).

Received: 21/04/2019 Accepted: 07/05/2019

Abstract

Fodder beet is a high production crop, and is a very promising crop to be grown in Syria, and attention has grown to the cultivation of this crop. However, recommended agronomic practices for maximizing productivity are limited. A field experiment was conducted in season 2017/2018 to study the effect of planting date and varieties interaction on the production, and some qualitative and morphological traits of five fodder beet cultivars (Caribou, Varians, SV Four 16, Tarine and Lipari). The experiment was a randomized complete block design (RCBD) in split plots arrangement with three replicates, planting dates (mid Feb. and mid Mar.) were assigned to the main plots and fodder beet cultivars were allotted to the sub plots. The results of the statistical analysis exhibited the superiority of mid Feb. date as compared with mid-March for all the studied traits. Varieties exhibited highly significant ($p \leq 0.05$) differences in most of the studied characteristics except plant number per hectare. Lipari and Tarine surpassed the other varieties in terms of the production, morphology and qualitative traits. The conclusion is to plant fodder beet in mid-February time in Homs, Syria, to attain the highest yield, and quality traits of fodder beet crop. Also, the study recommends further trials identify optimum agronomic practices especially harvesting date, fertilization and spacing in the other sites in Syria.

Key words*:* Planting date, Fodder beet, Production, Morphological and qualitative traits.

Introduction

Fodder beet (*Beta vulgaris* var. *Crassa)*, is a member of the *Chenopodiaceae* family, and is also known as mangel (Al JBawi, 2012). This crop is a high yield potential than any other arable fodder crops (Anonymous, 2006). The above and below growth parts (leaves and roots) are used to feed the animals but, the main fodder is tuberous roots (Ibrahim, 2005; El-Sarag, 2013). The origin of fodder beet is the Mediterranean area and was grown as a root crop in Germany and Italy as early as the sixteenth century (Al Jbawi, 2012).

Recently, in Syria attention has grown to the cultivation of fodder beet (Al-Jbawi, 2014). The production of forage crops is very important for livestock production in Syria, which contributes largely to the national income. Animal production in Syria depends mainly on natural pastures which are affected by rain fluctuations and low-quality grasses. This crop is considered a valuable source of fodder for cattle (Niazi *et al*., 2000), and when grown under suitable conditions can produce almost 20 $t.ha^{-1}$ dry matter yield (DAF, 1998).

In Tasmania fodder beet is sown in mid to late spring when soil temperatures are greater than 5°C and after the last frosts. Waiting till a soil temperature is greater than 10°C before planting will ensure a more even germination and improve seedling vigor (Pembleton and Rawnsley, 2011).

In Egypt Hassan and Hassany (2017) studied the effect four planting dates i.e. 15 Oct., 30 Oct., 15 Nov., 30 Nov. on fodder beet (*Beta vulgaris*) productivity, which harvested after 220 days. They indicated that the 2nd planting date, at 30 Oct., gave the highest values of fresh and dry weights per plant, whereas, fresh or dry fodder beet $yield.fed^{-1}$ was decreased significantly with delaying planting dates.

Selecting cultivar has a large effect on the yield and profitability of fodder beet crop. Abd El-Naby *et al*., (2014) evaluated seven fodder beet varieties under four different ecological locations in Egypt. They concluded that the maximum percentage of crude protein in seeds was noted in Rota, Beta Voroshanger and Monro (15.31, 14.51 and 14.5%); whereas, the minimum crude protein was observed in Jamon (13.32%). Total fresh Root yield and total dry yield of fodder beet varieties ranged from 28.22 to 59.02 t fed^{-1} and 3.88 to 11.00 t fed^{-1}, respectively. The total dry yield exhibited highly significant positive correlation coefficients with all studied characters except root length which reflected highly significant negative association.

Milne *et al*., (2014) evaluated yield, dry matter content of bulbs, and proportion out of the ground of 13 fodder beet cultivars, at four sites in the South Island. They found differences between cultivars for yield, field emergence, dry matter percentage (DM%) of the bulb, and percentage of the bulb out of the ground. The cultivars ‘Enermax’ (19.37 t dry $matter.ha^{-1}$), ‘Magnum’ (18.98), ‘Bangor’ (17.83), ‘Troya’ (17.54) and ‘Kyros’ (17.39) were more productive than ‘Brigadier’ (14.00), which was similar to ‘Feldherr’ (15.15). There were no interactions between cultivar performance and site.

In general, fodder beet roots had lower contents of crude protein CP and crude fibers comparing with the forage legumes. These are two potential problems with fodder beet as a ruminant feed: low CP, and low fiber percentages Matthew *et al*., (2011). Because of that most reported trials of fodder beet feeding involve a diet of fodder beet mixed with other legume forages (Chalupa and Sniffen, 2000).

There are many constrains facing forage production in Syria, like lack of information of forage cultivars and technological packages. Suggested solutions for these problems are application of technological packages, integration of animal production with forage production and introduction of new forage species of high yield (Khair, 1999) especially during periods of forage shortage like late winter and early summer. Recent research suggests high dry matter (DM) yields of 19–35 t $DM.ha^{-1}$ (Chakwizira *et al*., 2012; Matthew *et al*., 2011) are attainable in New Zealand. These DM yields are higher than the 10–15 t $DM.ha^{-1}$ for the traditional winter crops, e.g., kale and swedes (Chakwizira *et al*., 2011; Gowers *et al*., 2006; Wilson *et al*., 2006).

Fodder beet is good forage especially during the critical periods of forage shortage such as early summer season in Syria. The objectives of this research are to study the effect of planting dates on production and some morphological and qualitative traits of five fodder beet varieties in Homs governorate, Syria.

Materials and Methods

A field experiment was conducted in winter season; mid of February and mid of March (2017-2018), in Homs Agricultural Research Center, General Commission for Scientific Agricultural Research

(GCSAR), Damascus North East (latitude 35 ° 0′ N and Longitude 38 ° 55′ E). Table (1) shows some properties and texture of the studied soil surface layer 0–30 cm. The soil of the experimental site is clay sandy, characterized by high nitrogen content (64.8) and PH of 7.5. Two factors were conducted in a randomized complete block design (RCBD) in a split plot arrangement and three replications. The main plots were allotted to planting dates and the sub-plots to the five fodder beet varieties were used: Caribou, Varians, Tarine and Lipari (French cultivars) and SV Four 16 (Belgium cultivar). The land was disc-ploughed, harrowed twice, leveled and ridged 60 cm apart, and 25 cm the space between holes. The size of the plot was 8X5 m^2, consisting of eight ridges of 8m length. The seeds were sown manually on the shoulder of the ridge at a rate of 4.6 $kg.ha^{-1}$ (three seeds per hole) on February15th and March15th.

Table 1. Mechanical and chemical analysis of the soil.

Sand%	Silt%	Clay%	Organic matter%	EC $dS.m^{-1}$	pH	$CaCo_3$ %	P_2O_5 ppm	KOH ppm	الآزوت ppm	Bo ppm
31.26	28.64	40.10	1.38	0.34	7.5	2.9	20.5	180	64.8	0.44

The crop was irrigated at 7-10 days intervals depending on the temperature, relative humidity and soil moisture conditions. Nitrogen fertilization in the form of urea (46% N) at a rate of 446 kg $N.ha^{-1}$ was divided equally, the first half was added pre-planting, while the second half after thinning. Triple superphosphate (46% P_2O_5) and (K_2O) were added pre-planting at a rate of 180 and 185 $kg.ha^{-1}$, respectively. Hand thinning to one plant per hole and replanting by the removed seedlings were done simultaneously after 5-6 weeks from planting. Manual weeding was done, after 5 weeks from planting.

At harvest (6 months from planting), a sample of five plants of each variety was taken per plot from the inner two ridges randomly hand-pulled to determine: Root length and diameter (cm), and root and shoot $weight.plant^{-1}$ (g).

A bulk sample of roots and shoots chopped into thin slices thoroughly mixed to determine sucrose content by Saccharometer on a lead acetate basis according to Le-Docte, (1927), and then dried at 105°C to constant weights, then the dried samples were ground by an electrical grinder to pass through a 1 mm diameter thieve and kept for analysis. Proximate analysis for nutritive value was carried following the conventional methods recommended by A.O.A.C (1984) to determine crude protein percentage (CP %) by micro-Kjeldahl method (N% x 6.25). Three inner rows were harvested to determine number of $plants.ha^{-1}$, and root $yield.ha^{-1}$.

The temperatures during harvest at summer the temperatures ranged arround 31°C (Table 2).

Table 2: Temperatures and rainfall distribution during 2017/2018 season

Month	Max. Temperature °C	Min. Temperature °C	Rainfall mm
February	16.54	7.11	124.3
March	21.26	10.10	217.4
April	25	12.09	53.2
May	29.11	17.74	32.9
June	30.20	19.74	0
July	31.37	22.14	0
August	31.49	22.53	0

Source: Meteorology Station in Homs governorate.

Analysis of variance (ANOVA) appropriate for the split plot design was applied (Gomez and Gomez, 1984). The treatment means were compared using Least Significant Difference (LSD) procedures at 5% and 1% level using GeneStat Computer Program v.12.

Results and Discussion

Root length (cm):

Table (3) illustrates the effect of planting date and varieties on root length (cm). This trait was greater under D1 planting (15th Feb.) (35.9 cm) as compared with D2 (15th Mar.) (31.3 cm) ($P \leq 0.05$). Varieties were significantly ($P \leq 0.05$) different in root length. SV Four 16 and Varians varieties obtained the highest root length over planting dates (39.8, and 39.0 cm), respectively (Table 4). These results may be due to increasing some extent no. of harvested plants.ha^{-1} (Hassan and Hassany, 2017).

Table 3. Analysis of variance (ANOVA) of root length and diameter (cm)

Source of variance	df	Root length (cm)			Root diameter (cm)		
		MS	Variance %	P	MS	Variance %	P
Replications	**2**	2.233	0.89	-	0.233	0.04	-
Planting date (D)	**1**	158.700*	63.48	0.015	83.333	13.81	0.065
Error	**4**	2.500	0.46	-	6.033	2.45	-
Varieties (V)	**4**	189.617**	34.53	<.001	14.717	5.97	0.004
D * V	**4**	4.617	0.84	0.519	0.917	0.37	0.825
Pooled error	**12**	5.492			2.467		

DF: Degree of Freedom = n – 1, MS: Mean Square = SS / DF, SS: Sum of Squares,
Variance % = (MS Factor/MS Total) * 100, P: Probability at a level of 0.05

Table 4: The effect of planting date on root length and diameter (cm) of five fodder beet varieties.

Varieties (V)	Root length (cm)			Root diameter (cm)		
	Planting date (D)		Mean	Planting date (D)		Mean
	Mid Feb.	Mid Mar.		Mid Feb.	Mid Mar.	
Caribou	29.0	24.3	26.7[c]	20.0	16.0	18.0[a]
Varians	41.7	36.3	39.0[a]	17.0	14.0	15.5[b]
SV Four 16	42.3	37.3	39.8[a]	17.0	14.3	15.7[b]
Tarine	34.3	28.0	31.2[b]	19.7	17.0	18.3[a]
Lipari	32.3	30.7	31.5[b]	21.0	16.7	18.8[a]
Mean	35.9	31.3	33.6	18.9	15.6	17.3
$LSD_{0.05}$	**(D)** = 2.5*, **(V)** = 2.9**, **(D*V)** = 3.8			**(D)** = 3.9*, **(V)** = 1.9**, **(D*V)** = 3.2		
CV%	**7.0**			**9.1**		

****: significant, at 0.01 level of probability, ns: not significant, at 0.05 level of probability.**

Root diameter (cm):

Plants grown at different planting dates significantly different regarding root diameter (cm) (Table 3). Higher root diameter was significantly ($p \leq 0.05$) recorded for D1 planting (18.9 cm), as compared with D2 planting (15.6 cm) (Table 4). The effect between varieties shoot weight.$plant^{-1}$ showed the superiority of Tarine (343 g). This agrees with the work of Khogali (2011), who reported that fodder beet cultivars differed in root diameter significantly. The highest root diameter was achieved by planting in mid Feb. using the variety Lipari (21.0 g).

Root weight.plant^{-1}(g):

Table (6) illustrates the effect of planting date and varieties on root weight.plant^{-1}. This trait was greater under D1 planting (15th Feb.) (2523 g) as compared with D2 (15th Mar.) (2023 g) ($P \leq 0.05$). Varieties were significantly ($P \leq 0.05$) different in root weight.plant^{-1}. Lipari variety obtained the highest root weight.Plant^{-1} in both planting dates (2673, and 2224 g), followed by SV Four 16 variety (2548, 2005 g), respectively (Table 6). These results may be due to increasing root traits, i.e. length, diameter, and to some extent no. of harvestable plants.ha^{-1} (Hassan and Hassany, 2017).

Table 5. Analysis of variance (ANOVA) of root and shoot weight.plant^{-1} (g)

Source of variance	df	Root weight.plant^{-1} (g)			Shoot weight.plant^{-1} (g)		
		MS	Variance %	P	MS	Variance %	P
Replications	**2**	1316	4.54	-	466.27	16.42	-
Planting date (D)	**1**	1878574	6475.55	<.001	4930.13	173.64	0.006
Error	**4**	290	0.09	-	28.39	0.52	-
Varieties (V)	**4**	66537	19.96	<.001	16182.06	295.46	<.001
D * V	**4**	3860	1.16	0.366	198.08	3.62	0.028
Pooled error	**12**	3333	-	-	54.77	-	-

DF: Degree of Freedom = n – 1, MS: Mean Square = SS / DF, SS: Sum of Squares,
Variance % = (MS Factor/MS Total) * 100, P: Probability at a level of 0.05.

Table 6. The effect of planting date on root and shoot weight.plant^{-1} (g) of five fodder beet varieties.

Varieties (V)	Root weight.plant^{-1}			Shoot weight.plant^{-1}		
	Planting date (D)		Mean	Planting date (D)		Mean
	Mid Feb. (D1)	Mid Mar. (D2)		Mid Feb. (D1)	Mid Mar. (D2)	
Caribou	2465	1927	**2196^{c}**	293.2	262.9	**278^{b}**
Varians	2521	1990	**2256^{bc}**	252.4	234.7	**244^{c}**
SV Four 16	2548	2005	**2277^{b}**	241.9	224.0	**233^{d}**
Tarine	2408	1967	**2188^{c}**	365.2	321.4	**343^{a}**
Lipari	2673	2224	**2449^{a}**	218.9	200.5	**210^{e}**
Mean	**2523^{a}**	**2023^{b}**	**2273**	**274^{a}**	**249^{b}**	**262**
$LSD_{0.05}$	**(D)** = 26.8**, **(V)** = 70.7**, **(D*V)** = 90.1^{ns}			**(D)** = 8.37**, **(V)** = 9.06**, **(D*V)** = 12.07**		
CV%	**2.5**			**2.8**		

****: significant, at 0.01 level of probability, ns: not significant, at 0.05 level of probability.**

Shoot weight.plant^{-1} (g):

Plants grown at different planting dates significantly different regarding shoot weight.plant^{-1} (Table 5). Higher shoot weight.plan^{-1} was significantly ($p \leq 0.05$) recorded for D1 planting (274 g), as compared with D2 planting (249 g) (Table 6). The effect between varieties of shoot weight.plant^{-1} showed the superiority of Tarine (343 g). This agrees with the work of Khogali (2011), who reported that fodder beet cultivars differed in foliage fresh weight significantly. The highest shoot weight.plant^{-1} was achieved by planting in mid Feb. using the variety Tarine (365.2 g).

Root protein content (%):

The results exhibit a significant difference in root protein content (%) between planting dates ($P \leq 0.05$) (Table 7). The varieties Caribou, SV Four 16 were comparable in root protein content (Table 8). The interaction between planting dates and varieties was significant, therefore, the highest value of root protein content achieved by planting in D1 using the variety Caribou (8.44 %). As the researchers Abd El-Naby *et al*., (2014) who explained in their study, the existence of significant differences in crude protein of several fodder beet varieties.

Table 7. Analysis of variance (ANOVA) of root protein content (%) and sucrose (%)

		Root protein content (%)			Sucrose (%)		
Source of variance	**df**	**MS**	**Variance %**	**P**	**MS**	**Variance %**	**P**
Replications	**2**	0.0664	0.50	-	0.2170	0.12	
Sowing date (D)	**1**	3.0274	22.84	0.041	0.1203	0.06	0.823
Error	**4**	0.1326	2.60	-	1.8523	3.47	
Varieties (V)	**4**	1.6133	31.64	<.001	6.1462	11.52	<.001
D * V	**4**	0.1516	2.97	0.052	1.8012	3.38	0.035
Pooled error	**12**	0.0510	-	-	0.5334		

DF: Degree of Freedom = n – 1, MS: Mean Square = SS / DF, SS: Sum of Squares,
Variance % = (MS Factor/MS Total) * 100, P: Probability at a level of 0.05.

Table 8. The effect of planting date on root protein content (%), and sucrose (%) of five fodder beet varieties.

Varieties (V)	**Root protein content (%)**			**Sucrose (%)**		
	Planting date (D)		**Mean**	**Planting date (D)**		**Mean**
	Mid Feb.	**Mid Mar.**		**Mid Feb.**	**Mid Mar.**	
Caribou	8.44	7.37	**7.91**^{a}	8.2	8.2	8.2^{c}
Varians	7.13	6.73	**6.93**^{c}	8.4	10.0	9.2^{b}
SV Four 16	8.27	7.40	**7.83**^{a}	10.5	10.5	10.5^{a}
Tarine	6.93	6.57	**6.75**^{c}	11.0	9.6	10.3^{a}
Lipari	7.57	7.10	**7.33**^{b}	10.3	10.7	10.5^{a}
Mean	**7.67**	**7.03**	**7.35**	9.7	9.8	9.7
LSD$_{0.01}$	**(D)** = 0.57*, **(V)** = 0.28**, **(D*V)** = 0.47*			**(D)** = 2.14^{ns}, **(V)** = 0.89**, **(D*V)** = 1.68*		
CV%	**3.1**			**7.5**		

***,**: significant, at 0.05 and 0.01 levels of probability, ns: not significant, at 0.05 level of probability.**

Sucrose (%):

The results exhibit no significant difference in sucrose (%) between planting dates ($P \geq 0.05$) (Table 7). The varieties SV Four 16, Lipari and Tarine were comparable in sucrose percentage (Table 8). The interaction between planting dates and varieties was significant, therefore, the highest value of sucrose achieved by planting in D1 using the variety Tarine (11.0 %).

Root yield (t.ha^{-1}):

The difference in yield between cultivars makes it possible for farmers to gain significant increases in yield depending on their choice of cultivar. Yield of a cultivar is the main determinant of its profitability, as there was no evidence of differences in feed quality.

Plants grown at different planting dates were significantly ($P \leq 0.05$) differed regarding root yield (Table 9), this may refer to the difference in the temperatures during the growing season (Table 2). It is well known that fodder beet when grown under suitable conditions, can produce almost 20 t. ha^{-1} dry matter yield (DAF, 1998) compared with 13±15 t DM/ha^{-1} from four harvests of grass. Higher root yield was recorded for Lipari (202.2 t.ha^{-1}) (Table 10). Interaction between planting dates and varieties was not significant, but the highest root yield was achieved by planting on mid Feb. using the variety Lipari (228.5 t.ha^{-1}).

Table 9. Analysis of variance (ANOVA) of root and shoot yields (ton.ha^{-1}) and plant number (thousand.ha^{-1})

		Root yield (ton.ha^{-1})			Shoot yield (ton.ha^{-1})			Plant number (thousand.ha^{-1})		
Source of variance	**df**	**MS**	**Variance %**	**P**	**MS**	**Variance %**	**P**	**MS**	**Variance %**	**P**
Replications	**2**	60.75	2.41	-	1.740	2.74	-	4.944	3.32	
Sowing date (D)	**1**	24662.51	978.15	0.001	117.011	184.23	0.005	106.032	71.26	0.014
Error	**4**	25.21	0.67	-	0.635	0.63	-	1.488	0.42	
Varieties (V)	**4**	365.30	9.69	<.001	122.366	122.06	<.001	0.828	0.23	0.915
D * V	**4**	47.73	1.27	0.324	2.049	2.04	0.136	0.312	0.09	0.985
Pooled error	**12**	37.71	-	-	1.002	-	-	3.531		

DF: Degree of Freedom = n – 1, MS: Mean Square = SS / DF, SS: Sum of Squares,
Variance % = (MS Factor/MS Total) * 100, P: Probability at a level of 0.05.

Table 10. The effect of planting date on root and shoot yields (ton.ha^{-1}), and plant number (thousand.ha^{-1}) of five fodder beet varieties.

Varieties (V)	**Root yield (ton.ha^{-1})**		**Mean**	**Shoot yield (ton.ha^{-1})**		**Mean**	**Plant number (thousand.ha^{-1})**		**Mean**
	Planting date (D)			**Planting date (D)**			**Planting date (D)**		
	Mid Feb.	**Mid Mar.**		**Mid Feb.**	**Mid Mar.**		**Mid Feb.**	**Mid Mar.**	
Caribou	212.4	152.3	**182.4^{b}**	25.27	20.79	**23.03^{b}**	46.2	42.4	44.3^{a}
Varians	217.3	156.1	**186.7^{b}**	21.77	18.41	**20.09^{c}**	46.2	42.0	44.1^{a}
SV Four 16	220.6	157.9	**189.3^{b}**	20.94	17.66	**19.30^{c}**	46.4	42.2	44.3^{a}
Tarine	209.4	159.4	**184.4^{b}**	31.77	26.02	**28.90^{a}**	46.6	43.4	45.0^{a}
Lipari	228.5	175.8	**202.2^{a}**	18.70	15.83	**17.27^{d}**	45.8	42.4	44.1^{a}
Mean	**217.6^{a}**	**160.3^{b}**	**189.0**	**23.69^{a}**	**19.74^{b}**	**21.72**	46.2	42.5	44.4
LSD$_{0.05}$	**(D)** = 7.89**, **(V)** = 7.52^{ns}, **(D*V)** = 10.19^{ns}			**(D)** = 1.25**, **(V)** = 1.23**, **(D*V)** = 1.65^{ns}			**(D)** = 1.9*, **(V)** = 2.3^{ns}, **(D*V)** = 3.0^{ns}		
CV%	**3.2**			**4.6**			**18.0**		

***,**: significant, at 0.05 and 0.01 levels of probability, ns: not significant, at 0.05 level of probability.**

Shoot yield (t.ha^{-1}):

Table (10) showed an increment in shoot yield when sown on mid Feb. (23.69 t.ha^{-1}) as compared with mid Mar. (19.74 t.ha^{-1}) ($P \leq 0.05$). Significant differences were observed between the varieties regarding shoot yield (Table 9). Shoot yield was not significantly affected by interactive effect between planting dates and varieties, but when Tarine sown on mid Feb. attained the greatest shoot yield (31.77) (Table 10). Tarine attained the greatest shoot yield (28.90 t.ha^{-1}).

Plant number (thousand.ha^{-1}):

Plants grown at different planting dates were significantly ($P \leq 0.05$) differed regarding plant number per hectare (Table 9). No significant differences were noticed between the varieties (Table 10). Also, the interaction between planting dates and varieties was not significant (399.8 Kg.ha^{-1}).

Conclusion:

The highest ($p \leq 0.05$) root yield was obtained under mid Feb. planting. In terms of varieties, Lipari and Tarine varieties were superior over the other varieties in all of the studied traits, except protein (%) where SV Four surpassed the other varieties. Besides there were no significant differences between the varieties regarding number of plants per hectare. Most interactions between planting dates and varieties were not significant for the studied traits.

References:

A.O.A.C. (1984). Official methods of analysis, 14th ed. Association of Analytical Chemistry, Washington, D.C. DAF Department of Agriculture and Food 1988. Root, fodder crop, pulse and oilseed varieties. Irish. Recommended List Government Stationary Office, Dublin, 17p.

Abd El-Naby Z.; M. Wafaa; A.W.M Shafie; S.M. Sallam; M. El-Nahrawy; and M.F. Abdel-Ghawad (2014). Evaluation of seven fodder beet genotypes under different egyptian ecological conditions using regression, cluster models and variance measures of stability. Int. J. Curr. Microbiol. App. Sci., 3(4): 1086-1102.

Al-Jbawi, E.M. (2012) " Fodder beet ". Journal of Agriculture, Ministry of Agriculture publications, no. 41. (In Arabic) http://moaar.gov.sy/site_ar/agrimag/mag41/41.pdf

AL-Jbawi, E.M.; M. Bagdadi; and Y. Nemr (2014). The effect of plant spacing on some quality traits of fodder beet (*Beta Vulgaris* var. *crassa*) varieties. International Journal of Environment 3(3): 286-293.

Anonymous (2006). http:// www. Seed 2 grow. Co. UK/acatalogy/Fodder-Beet- seed. himl (2006).

Chakwizira, E.; A.L. Fletcher; E. Meenken; P. Johnstone; S. Maley; N. Arnold; S. Armstrong; M. George; R.E. Sim; R. Minchin; J.D. Morton; and A.D. Stafford (2011). Dry matter response of swede crops to phosphorus (P) and nitrogen (N) application in Southland and central North Island regions of New Zealand. Proceedings of the Agronomy Society of New Zealand 41: 23-37.

Chakwizira, E.; S. Maley; M. George; R. Hubber; J.D. Morton; and A.D. Stafford (2012). Effects of potassium, sodium and chloride fertilizer on fodder beet yield and mineral composition. In: Proceedings of the 5th Australasian Dairy Science Symposium. Ed. Jacobs, J. National Dairy Alliance, Melbourne, Australia pp. 431-434.

Chalupa, W.; and C.J. Sniffen (2000). Subacute rumen acidosis in Italian dairy herds: occurrence and diagnostic tools. pp. 388-396 In: Animal production for a consuming world. Ed. Stone, G.M Volume A. Asian- Australasian Journal of Animal Sciences Supplement.

DAF, (Department of Agriculture and Food) (1988). Root, fodder crop, pulse and oilseed varieties. Irish recommended list. Government Stationary Office, Dublin, 17p. [C.F. Albayrak, S. and Camas, N. 2006. Yield components of Fodder beet (*Beta vulgaris* var. *crassa* mansf.) under the middle Black Sea region conditions. Tarim Bilimleri Dergisi., 12 (1): 65-69.

DAF, (Department of Agriculture and Food) (1998). Root, fodder crop, pulse and oilseed varieties. Irish recommended list. Government Stationary Office, Dublin, 17 p.

DLF, (2013). Fodder beet trials, 2013. www.dlfseeds.co.nz.

El Sarage, E. (2013). Response of fodder beet cultivars to water stress and nitrogen fertilization in semi-arid regions. American Eurasian J. Agric. and Environ. Sci., 13 (9):1168-1175.

Milne, G.D.; C. Direen; E. Kitson; P. Evans; R.G. Cleland; and D. Treder (2014). Performance of fodder beet cultivars in the South Island. Proceedings of the New Zealand Grassland Association. 76: 141-144.

Gomez, K.A.; and A.A. Gomez (1984). Statistical procedures for agricultural research. 2nd edition, john Willy and sons Inc. New York. 680p.

Gowers, S.; R. Butler; and S.D. Armstrong (2006). Yield comparisons of old and new cultivars of Swedes (*Brassica napus*ssp. *napobrassica*) in Southland, New Zealand. New Zealand Journal of Crop and Horticultural Science. 34:109-114.

Hassan, Kh.H.; and W.M. Hassany (2017). Effect of planting dates and method on fodder beet productivity under saline conditions at Siwa Oasis, Egypt. J. Plant Production, Mansoura Univ., 8(11): 1121 – 1125.

Ibrahim, Y.M. (2005). Ranges and forage (In Arabic). Dar Azza for Publication, Khartoum, Sudan 300p.

Khair, M.A.M. (1999). Principles of forage production (in Arabic). 1st edition. Publisher: Training and Publication Administration, Agricultural Research Corporation, Sudan, 219p.

Khogali, M.E.; M.I.Y. Dagash; and M.G. EL-Hag (2011). Productivity of fodder beet (*Beta vulgaris* var.*Crassa*) cultivars affected by nitrogen and plant spacing. Agric. Biol. J. N. Am., 2(5): 791-798.

Kiely, P.O.; A.P. Moloney; and J. Meagher (1991). Ensiling and feeding whole-crop Fodder beet. Landbau forchung-voelkerode Sonderheft. 123: 269-272.

Kipps, M.S. (1970). Production of field crops (A textbook of Agronomy). Sixth edition. McGraw-Hill, Inc. New York. 790 p.

Le Docte, A. (1927). Commercial determination of sugar in beet root using the shacks-Le Docte process, Int. Sug. J., 29, 488-92. [C.F. Sugar Beet Nutrition, April 1927 Applied Science Publishers LTD, London. A.P. Draycott].

Matthew, C.; N.J. Nelson; D. Ferguson; and Y. Xie (2011). Fodder beet revisited. Proceedings of the Agronomy Society of New Zealand. 41: 39-48

Niazi, B.H.; J. Rozema; R.A. Broekman; and M. Salim (2000). Dynamics of growth and water relations of fodder beet and sea beet in response to salinity. Journal of Agron. and Crop Sci., 184: 101-109.

Pembleton, K.; and R. Rawnsley (2011). Growing fodder beets on Tasmanian dairy farms. Tasmania Institute of Agriculture (TIAR). November 2011. http://www.utas.edu.au/__data/assets/pdf_file/0006/388113/Growing-fodder-beets-on-Tasmanian-dairy-farms.pdf.

Shalaby, A.S.; A.M. Rammah; G.M. Abdul-Aziz; and M.G. Beshay (1989). Fodder beet, a new forage in Egypt. 1. Productivity and the chemical analysis of some Fodder beet (*Beta vulgaris* L.) cultivars sown at different locations in Egypt. In proceedings of the third Egyptian British Conference on Animals, fish and poultry production. Alexandria, Egypt, 13: 133-143.[C.F. Nadaf SK, Ibrhaim YM, Akhtar M, El Hag MG and Al-Lawati AH (1998a). Performance of Fodder beet in Oman. Annals of Arid Zone. 37 (4): 377-382.

Wilson, D.R.; J.B. Reid; R.F. Zyskowski; S. Maley; A.J. Pearson; S.D. Armstrong; W.D. Catto; and A.D. Stafford (2006). Forecasting fertilizer requirements of forage brassica crops. Proceedings of the New Zealand Grassland Association. 68: 205-210.

تأثير التفاعل بين مواعيد الزراعة والأصناف في الإنتاجية وبعض الصفات الشكلية والنوعية للشوندر العلفي (*Beta vulgaris* var. crassa)

أحمد مهنا[1] وانتصار الجباوي*[2] وجلنار منصور[1]

(1). قسم المحاصيل، كلية الزراعة، جامعة البعث، حمص، سورية.

(2). قسم بحوث الشوندر السكري، إدارة بحوث المحاصيل، الهيئة العامة للبحوث العلمية الزراعية، دمشق، سورية.

(*للمراسلة: د. انتصار الجباوي. البريد الإلكتروني: dr.entessara@gmail.com و dr.entessara@gcsar.gov.sy).

تاريخ الاستلام: 2019/04/21 تاريخ القبول: 2019/05/07

الملخص

الشوندر العلفي من المحاصيل العلفية عالية الإنتاج، ويعد من المحاصيل الواعدة للزراعة في سورية، وبدأت تحظى زراعته بالكثير من الاهتمام. لكن لازالت التجارب المتعلقة بعمليات الخدمة الواجب تقديمها لهذا المحصول من أجل رفع إنتاجيته محدودة. لذا نفذت تجربة حقلية خلال الموسم 2018/2017 لدراسة تأثير التفاعل بين مواعيد الزراعة والأصناف في الإنتاج وبعض الصفات الشكلية والنوعية لخمسة أصناف من الشوندر العلفي (Caribou، Varians، SV Four 16، Tarine، وLipari). صممت التجربة وفق تصميم القطاعات الكاملة العشوائية بترتيب القطع المنشقة وبثلاثة مكررات. توضعت مواعيد الزراعة (منتصف شباط، ومنتصف آذار) في القطع الرئيسية، في حين توزعت الأصناف بشكل عشوائي في القطع الثانوية. أظهرت نتائج التحليل الإحصائي تفوق الزراعة في منتصف شهر شباط على موعد الزراعة في منتصف شهر آذار بالنسبة لكافة الصفات المدروسة. كما أظهرت الأصناف اختلافات معنوية فيما بينها بالنسبة لكافة الصفات المدروسة باستثناء صفة عدد النباتات بالهكتار. تفوق كل من الصنفين Lipari وTarine على بقية الأصناف المختبرة في كافة الصفات المدروسة. وبالنتيجة يفضل زراعة الشوندر العلفي في منتصف شهر شباط في حمص بسورية، للحصول على أفضل المؤشرات الإنتاجية والشكلية والنوعية لمحصول الشوندر العلفي، وتنصح الدراسة بتنفيذ تجارب تتعلق بعمليات الخدمة الأخرى لهذا المحصول، كمواعيد القلع، والتسميد، والكثافات في مواقع أخرى من سورية.

الكلمات المفتاحية: مواعيد الزراعة، الشوندر العلفي، الإنتاجية، الصفات الإنتاجية والنوعية.