The Effect of Seaweed Extracts Spray on Some Productivity and Quality Traits of Fodder Beet (*Beta vulgaris* L.)

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Abstract

The production of forage crops is very important for livestock production in Syria, which contributes largely to the national income. The study was conducted on summer date (1st of September), during 2016/2017 season, to study the effect of seaweed extracts on the productivity and quality traits (Root weight/plant (g), shoot weight/plant (g), dry matter content (%), and crude protein content (%) of shoot and root) of fodder beet, assigned in randomized completely block design (RCBD), with three replicates. The results showed that seaweed extracts surpassed the control significantly for all the studied traits, and this reflects the importance of new source of (seaweeds), which are increasingly used in crop production. Sea weeds are environmentally benign and safe for the health of animals and humans. Also, seaweed extracts includes many components such as macro- and microelement nutrients, amino acids, vitamins, cytokinins, auxins, and abscisic acid (ABA)-like growth substances affect cellular metabolism in treated plants leading to enhanced growth and crop yield.

Key words: Fodder beet, Seaweed, Summer sowing, Syria.

Introduction:

Fodder beet (*Beta vulgaris* L.) is a member of the *Chenopodiaceae* or goosefoot family. Fodder beet, also called mangold, mangel, or mangel-wurzel, is grown for its nutritious tops and roots that are used as animal fodder (Al Jbawi, 2019).

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 range which is affected by rain fluctuations and low-quality grasses. This necessitates the introduction of irrigated forage crops in the irrigated schemes and in farms around cities like Damascus. 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 (Al Jbawi, 2014) especially during periods of forage shortage like late winter and early summer.

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 ton. ha^{-1} dry matter yield (DAF, 1998), and also yields more than 80 ton. ha^{-1} and this makes it popular in many countries like New Zealand, Germany, America, Australia, Syria and Egypt (Shalaby *et al*., 1989). It contains 10-15% dry matter and may yield 20 ton. ha^{-1} of dry matter in one harvest as compared to 13-15 ton. ha^{-1} from four cuts of grass (Kiely *et al.*, 1991).

Beet is a high energy, low protein, and low fibre feed. Treat it as a forage concentrate as it digests very quickly in the rumen (Al Jbawi, 2014). Fodder beet has many advantages as compared to sugar beet such as: Soil contamination at harvest is usually lower than with sugar beet but depends on variety choice. The softer varieties tend to grow higher out of the ground and have fewer grooves in the root, and therefore retain less soil, huge dry matter (DM) yields, expect protein to be 1-2% higher, with soft fodder beet varieties you have the option of grazing in the field and fodder beet will have lower soil contamination and will reduce the need to wash roots before feeding.

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).

Beet should be chopped as this greatly increases intakes, this is most important for younger cattle and for sheep. Beet is a high palatable and highly digestible feed and in a properly balanced diet it should result in excellent animal performance and more efficient milk and meat production (Niazi *et al*., 2000).

Fodder beet can thrive on a wide range of soils but a light to medium, free draining field is ideal. A soil pH of 7 is the target and good accessibility is vital for heavy harvesting machinery. Monogerm seed has eliminated the need for labour intensive singling.

As the crop can take over 200 days to mature later sown crops will not have enough time to fully develop before winter which will limit yield (Pembleton and Rawnsley, 2011).

Recent research suggests high dry matter (DM) yields of 19–35 t DM/ha (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 for the traditional winter crops, e.g., kale and swedes (Chakwizira *et al.*, 2011; Gower et al., 2006; Wilson *et al.*, 2006).

Growth characters and yield and or yield attributes of fodder beet responded positively to the fertilization with NPK fertilizers (Abd Allah and Yassen, 2008; Šrek, *et al*., 2010).

Seaweeds and seaweed products are increasingly used in crop production. Further, seaweed extracts are considered an organic farm input as they are environmentally benign and safe for the health of animals and humans (Khan *et al*., 2009). Seaweed components such as macro- and micronutrients, amino acids, vitamins, cytokinins, auxins, and abscisic acid (ABA)-like growth substances affect cellular metabolism in treated plants leading to enhanced growth and crop yield (Durand *et al*., 2003; Stirk *et al*., 2003; Ordog *et al*., 2004). Plants sprayed with seaweed extracts also exhibit enhanced salt and freezing tolerance (Mancuso et al., 2006).

Fodder beet is a good forage especially during the critical period of forage shortage such as early summer season in Syria. Besides there is also limited information on the nutritive qualities of fodder beet crops in Syria. The objectives of this research are to study the effects

of bio-fertilizer fertilizers on yield and quality traits of fodder beet to provide information on cultural practices concerning this important crop under Syrian conditions.

Materials and Methods:

A field experiment was conducted on summer season of September (2016/2017), at Homs Agricultural Research Center, General Commission for Scientific Agricultural Research (GCSAR), Syria. The location coordinates are Latitude 34 º 43′ N and Longitude 36 º 42′ E. The soil of the experimental site is sandy clay, characterized by high nitrogen content (44.9) and PH of 8.33. Two treatments (control, and sea weeds extracts) were conducted in a randomized complete block design (RCBD) and three replications. The first spray of seaweed (Amalgerol, Table 1) was after two months of sowing, while the second spray applied after one months since the first one. The variety Vermon was used (French cultivar). The land was disc- ploughed, harrowed twice, leveled and ridged 60 cm apart, and 30 cm the space between holes. The size of the plot was 6X3 m, consisting of six ridges of 6 m length. The seeds were sown manually on the shoulder of the ridge at a rate of 4.6 kg/ha (three seeds per hole) on September 1st.

The crop was irrigated at 7-10 days intervals depending on the temperature, relative humidity and soil moisture conditions. Hand thinning to one plant per hole and re-planting 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 sowing), when plants showed signs of maturity which is indicated by leaf yellowing and partial drying of the lower leaves, a sample of five plants of each plot was taken from the inner two ridges randomly hand-pulled to determine: Root weight/plant (g), shoot weight/plant (g), dry matter content (%), and crude protein content (%) of shoot and root. Three inner rows were harvested to determine root and shoot yield/ha.

Table 1. Amalgerol composition according to www.amalgerol.com.

Component	Contents (w/w %)
Seaweed extracts	30%
Phyto extract	20%
Soluble (water, distilled mineral oil)	40%
Stabilizers and emulsions	10%

The addition was 5 L/ha (www.amalgerol.com).

The temperatures during harvest at spring reached 17°C, while the lowest temperature reached approximately 8°C (Table 2).

Table 2. Temperatures and rainfall distribution during 2016/2017 season

Month	Max. Temperature °C	Min. Temperature °C	Rainfall mm
September	30.157	19.66	-
October	28.60	15.35	-
November	20.32	6.4	4.3
December	9.81	3.44	120.9
January	10.34	2.65	92.7
February	12.28	2.43	7.4
March	17.27	7.93	50.9

Source: Meteorology Station in Homs governorate.

Analysis of variance (ANOVA) appropriate for randomized complete block design was applied (Gomez and Gomez, 1984). The treatment means were compared using T-test at 5% level of probability using GeneStat Computer Program v.12.

Results and Discussion

Effect of seaweed addition on root and shoot weights and yields:

Table (3) shows that seaweed applications had no significant effects on shoot yield of fodder beet and shoot weight per plant. But there were significant ($p \leq 0.05$) effects on root weight per plant and root yield. In general, all traits were higher with the addition of seaweeds. The increase with the addition of seaweed in root and shoot yields, and root and shoot weight per plant were 14.4, 1.7, 22.8 and 10.9 % respectively. This increase may due to the positive effect of sea weed extracts on cellular metabolism leading to enhance growth and crop yield (Durand *et al*., 2003; Stirk *et al*., 2003; Ordog *et al*., 2004).

Table 3. The effect of seaweed fertilizer on root and shoot weigh. plant^{-1} (g), and root and shoot yields (t. ha^{-1}) of fodder beet

Treatments	Root weight. plant^{-1} (g)	Shoot weight. plant^{-1} (g)	Root yield (t. ha^{-1})	Shoot yield (t. ha^{-1})
Control (no addition of seaweed extracts)	1446	1372	52.48	49.42
Seaweed extract	1873	1540	61.09	50.26
Mean	**1660**	**1456**	**56.79**	**49.84**
Increment with the addition of seaweed (%)	**22.8**	**10.9**	**14.1**	**1.7**
Sig	*	ns	*	ns
CV	**6.7**	**7.5**	**8.0**	**8.3**

ns: Not significant, at 0.05 level of probability. *: significant at 0.05 level of Probability.

Effect of seaweed addition on root and shoot dry percentages and crude protein percentage in root and shoot:

The addition of seaweed extracts caused significant increase in crude protein in both root and shoots which accounted 11.1 and 1.2 % respectively, this increase may be because seaweed extract has macro- and micronutrients, amino acids, vitamins, cytokinins, auxins, and abscisic acid (ABA) that enhance the creation of protein in plant cell (Durand *et al*., 2003; Stirk *et al.*, 2003; Ordog *et al*., 2004), while the addition decreased significantly both root and shoot dry matter which amounted 2.7 and 17.6 % respectively (Table 4). This may due to the positive effect of seaweed extract on growth enhancement at the expense of dry matter (Mancuso *et al.*, 2006).

Table 4. The effect seaweed extract addition on root and shoot dry matter (%), and root and shoot crude protein contents (%) of fodder beet.

Treatments	Root dry matter (%)	Shoot dry matter (%)	Crude protein in roots (%)	Crude protein in shoots (%)
Control (no addition of seaweed extracts)	12.67	13.72	13.90	8.37
Seaweed extract	12.33	11.33	15.63	8.27
Mean	**12.50**	**12.53**	**14.77**	**8.32**
Increment or decrease with the addition of seaweed (%)	**-2.7**	**-17.6**	**+11.1**	**+1.2**
Sig	*	*	*	**
CV	**5.9**	**12.6**	**6.0**	**4.1**

***, **: significant at 0.05 and 0.01 levels of Probability.**

Conclusion:

The highest ($p \leq 0.05$) production and quality traits were obtained with the addition of sea weed extracts.

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تأثير التسميد بمستخلصات الأعشاب البحرية في بعض الصفات الإنتاجية والنوعية للشوندر العلفي (*Beta vulgari* L.)

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الملخص

يعتبر إنتاج المحاصيل العلفية أحد أهم العوامل التي تدعم قطاع الثروة الحيوانية في سورية، وتسهم بشكل كبير في الدخل القومي. نفذت هذه الدراسة في العروة الصيفية (الأول من شهر أيلول)، خلال الموسم 2017/2016، بهدف دراسة تأثير مستخلصات الأعشاب البحرية في الصفات الإنتاجية والنوعية (وزن الجذر للنبات (غ)، وزن المجموع الخضري للنبات (غ)، نسبة المادة الجافة (%)، ونسبة البروتين (%) في الجذر والمجموع الخضري) للشوندر العلفي، وذلك وفق تصميم القطاعات كاملة العشوائية (RCBD)، وبثلاثة مكررات. بينت النتائج تفوق معاملة الرش بمستخلص الأعشاب البحرية على المعاملة الشاهد وبشكل معنوي بالنسبة لكافة الصفات، مما يعكس أهمية هذا المنتج الطبيعي المصدر (أعشاب بحرية) بدأ استخدامه بالازدياد في زيادة إنتاجية المحاصيل، حيث تعتبر الأعشاب البحرية آمنة بيئياً على صحة الإنسان والحيوان، كما تحتوي على العديد من المعادن الكبرى والصغرى، والأحماض الأمينية، والفيتامينات، والسيتوكينات، والأوكسينات وحمض الأبسيسيك (ABA) الذي يمتلك تأثير منظم نمو للنبات ويؤثر في عمليات الاستقلاب في الخلية النباتية محفزاً النبات على النمو ورفع إنتاجيته.

الكلمات المفتاحية : الشوندر العلفي، أعشاب البحر، العروة الصيفية، سورية.