EFFECT OF NITROGEN AND BIO-FERTILIZATION WITH DIFFERENT PLANTING DISTANCES ON IMPROVING THE GROWTH AND QUALITY OF BEET YIELD AND ITS EFFECT ON DIGESTION BY IN-VITRO GAS PRODUCTION TECHNIQUE.

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SUMMARY

This study was conducted to investigate the effects of row spacing and different rate of mineral nitrogen fertilization with / or without Bio-fertilizer on fodder beet productivity, quality and soil properties. We evaluated the effects of N level placement at rate of 60, 90, 120 kg/fed with and without bio-fertilizer and row spacing. The treatments content : A1: 58 cm, A2: 76 cm, T1: 60 kg/ fed N. without bio- fertilizer, T2: 60kg/ fed N with bio- fertilizer, T3: 90 kg/ fed N. without bio- fertilizer, T4: 90 kg/ fed N with bio- fertilizer, T5: 120 kg/ fed N without bio- fertilizer and T6: 120 kg/ fed N with bio- fertilizer. The results showed that the nitrogen application on number of leaves and root diameter value were non-significantly increased 47.38 and 14.43 cm for T6, while the root length value 53.25 cm for T4 was significantly increased. The highest values of fresh and dry leaves in T4 were 6.90 and 0.90 ton/fed as effected by applying nitrogen fertilizer at rate of 90 kg N/fed with bio-fertilizer under 76 cm row spacing, while the highest values of fresh and dry root yield in T1 were 71.93 and 10.51 ton/fed, respectively. We may conclude that using as soil application 90 kg N fed⁻¹ inter row spacing 58 cm could led to improving soil chemical properties, which in turn led to producing the highest root and leaves of fodder beet yield/ fed. The highest crude protein and fiber observed with leaves and roots under density row in (A2) 76 cm spaces compared with spacing raw 58 cm (A1), while NFE% content had a significant decrease with applying nitrogen fertilizer alone or combined with bio - fertilizer with leaves and roots under (A2) the values were 49.57, 68.21 compared with (A1). The T6 (120 kg/fed N + bio-fertilizer) recorded the highest values in crude protein while were 14.99 and 12.91 in laves and roots, respectively, while the highest value in crude fiber was obtained from 60 kg fed⁻¹ nitrogen treatment without bio-fertilizer (T1), where values were 25.23 and 8.01%, respectively. In addition, the values of NFE% decrease significantly in T6. The values were increased significantly for IV-DMD%, GP (ml/200mgDM), IV-DOM% and ME (MJ/kg DM) under (A2) 76 cm spaces between rows compared with spacing raw 58 cm (A1) in leaves. While the roots were increased in GP, IV-DOM% and ME (MJ /kg DM) from 29.04 (ml/200mgDM), 77.33% and 10.20(MJ/kg DM) spacing raw 58 cm (A1) to 31.95 (ml/200mgDM), 81.79% and 11.02(MJ/kg DM) density of row in (A2) 76 cm spaces, respectively. The treatment T6 recorded the highest value in leaves. while in the root the highest value recorded on treatment T5 in GP, IV-DOM% and ME (MJ/kg DM) analysis, where the values are 42.12 (ml/200mg DM) ,86.92% and 11.95 (MJ /kg DM), respectively except IV-DMD% were recorded high value 63.37% were recorded with T1. and GPSF with T2. These significantly increase may be due to short chain fatty acid (SCFA mmol/ml gas), Gas production structure fractions (GPSF ml/g DM), Gas production non structure fractions (GPNSF ml/g DM) and Microbial protein (MP g/kg DOM) in (A2) 76 cm spaces between row compared with spacing raw 58 cm (A1) in beet roots. The values are 1.10, 5.14, 48.18 and 79.54, respectively. In the other hand, the beet leaves are insignificant due to short chain fatty acids (SCFA mmol/ml gas), Gas production structure fractions (GPSF ml/g DM), Gas production non structure fractions (GPNSF ml/g DM) and Microbial mas production (MP g/kg DOM) the mineral nitrogen fertilizer alone and spacing row in (A1) 58 cm compared with spacing row in (A2) 76 cm. The treatment T6 (120 kg/fed N + bio-fertilizer) recorded highest value SCFA mmol/ml gas, Gas production nonstructural fractions GPNSF (ml/g DM) and Microbial protein (MP g/kg DOM) in leaves, where the values are 1.18, 51.61 and 82.30. while for the root where highest value recorded for treatment T5 (120 kg N/ fed without bio- fertilizer) in short chain fatty acids (SCFA mmol/ml gas). Gas production nonstructural fractions (GPNSF ml/g DM) and Microbial protein (MP g/kg DOM), where the values are 1.76, 70.70 and 104.30, respectively. The roots have an excellent feed quality and they are very palatable to ruminant stock. This increase was attributed to the positive effect of fertilizers on the root growth, which consequently led to increasing the absorption of different nutrients. Fodder beet has extremely high yield potential when grown on high fertile soils. Fodder beet requires large amounts of nitrogen. In conclusion nitrogen fertilization has a positive effect on diameter and length of roots. The highest growth with nitrogen fertilization was associated with bio-fertilization. The quality and production of tubers were increased by increasing the distance between rows by increasing the nitrogen rates and giving the highest

percentage of raw protein in roots with the nitrogen rate of 120 kg of T6 highest amount of leaves with high digestive value, while recorded the highest digestive value of roots recorded with the T5.

Keywords: *nitrogen levels, Bio-fertilizer, Row spacing, Growth, Yield, Chemical composition, Digestible gas test, soil properties and Fodder beet.*

INTRODUCTION

Fodder beet has extremely high yield potential when grown on high fertile soils. Fodder beet requires large amounts of nitrogen. Nitrogen fertilizers are one of the major costs for production of these crops (Abdel-Gwad *et al.* 2008, Sarhan and Ismail 2003). Zamfir *et al.* (2001) and Zaki (1999) reported those increasing nitrogen fertilizations led to increasing dry matter yield and crude protein content of fodder beet. Previous studies with fodder beet indicated that the nitrogen rates influenced root yield and yield components (Yüksel *et al.* 2009, Prokopenko *et al.* 1997, Geweifel and Aly 1996 and Karczmarczyk *et al.* 1995). However, field experiments on the effects of nitrogen rates and harvest time on the root yield and quality components are very limited in fodder beet.

Bio-fertilizers application can lead to increasing the availability of nutrients by their biological activity and help to improve the soil health. Microbes involved in the formulation of bio-fertilizers not only mobilize N and P but increase the process of producing crops and foods naturally. This method avoids the use of synthetic chemical fertilizers and genetically modified organisms to influence the growth of crops (Ramdan *et al.* 2013). Plant growth promotes rhizobacteria through the cycling and availability of nutrients where led to increasing the health of the roots during the growth stage by increasing the absorption of nutrients (Vessey, 2003). Feeding of green forage to livestock is essential for the maintenance of normal health and reproduction (Roy and Khandaker, 2010). Beet is an excellent high energy source and economic milking and fattening feed for both dairy and beef cattle, especially when fed in combination with high quality silage. These crops are used because they are high yielding and typically have high metabolizable energy (ME) content of over 12 MJ/kg dry matter (DM), even at advanced stages of maturity Judson and Edwards (2008).

Recently *in vitro* gas production technique with chemical composition have been widely used to evaluate the potential nutritive value of previously uninvestigated forages since *in vitro* gas production technique is quick, cheap and less time consuming (Maheri - Sis *et al.* 2008 & 2007, Chumpawadee *et al.* 2005 and Getachew *et al.* 2004). *In vitro* rumen degradability and gas production (GP) techniques have been used for estimating quality of feed fodder beet for ruminants. The gas production of different classes of feed incubated *in vitro* in buffered rumen fluid was closely related to the production of SCFA, s which was based on carbohydrates fermentation (Kanak *et al.* 2012, Sallam *et al.* 2007 and Blummel & Oraskov 1993).

Fodder beet has a dietary effect, being easily digestible. Fodder beet is an excellent feed for dairy cows, increasing milk production and it makes possible the decreasing of concentrates quantity. It can be chopped and mixed with grounded concentrate fodders. Fodder beet can be fed until late autumn and winter, after feeding with green forage (Halga P. and col., 2000). The diet is not balanced and does not correspond to dairy cows' nutrient needs. This is what makes fodder beet excellent forage in this type of farms. Recently *in vitro* gas production technique with chemical composition have been widely used to evaluate the potential nutritive value of previously uninvestigated forages since *in vitro* gas production technique is quick, cheap and less time consuming (Kamalak and Canbolat 2010, Maheri-Sis *et al.* 2008 and 2007, Chumpawadee *et al.* 2005 and Getachew *et al.* 2004).

The objective of this study was to investigation the mineral nitrogen fertilizer with different rates alone or combined with bio-fertilizer and row spacing on availability of roots and leaves of fodder beet productivity, growth, mineral elements and Quality. The final product in the recent paper was determining on digestibility artificial rumen by gas test production.

MATERIALS AND METHODS

Site and sample collection: Two field experiments were carried out at Sides Agricultural Research Station, Bani Seweif Governorate (Middle Egypt), Agricultural Research Center, Ministry of Agriculture, Egypt, during two successive seasons of winter 2015/2016 and 2016/2017. Some soil physical and chemical

properties were determined before sowing according to the methods described by Cottenie *et al.* (1982) and Page *et al.* (1982). Bio-fertilizer *Rhizobium radiobacter* sp. strain (salt tolerant PGPR) Production Unit, Department of Microbiology, Soils, Water and Environment Research Institute, Agric. Res. Cent., Giza, Egypt.

Experimental design: In both seasons each experiment was carried out in a split-split plot design with six treatments and three replicates: A1: 58 cm, A2: 76 cm, T1: 60 kg/ fed N. without bio- fertilizer, T2: 60kg/ fed N with bio- fertilizer, T3: 90 kg/ fed N. without bio- fertilizer, T4: 90 kg/ fed N with bio- fertilizer, T5: 120 kg/ fed N without bio- fertilizer and T6: 120 kg/ fed N with bio- fertilizer. The used bio-fertilizer *Rhizobium radiobacter* sp. strain was arranged randomly as main plot, the N level was allowed at sub –sub Plot and the spaces between raw were distributed randomly as Sub – sub blot. The experimental plot size was (2 m × 3 m) = 6 m². The soil was disc-ploughed, harrowed twice, leveled and ridged 65 and 76 cm apart. The experimental area was divided two divisions for first division without bio-fertilizer and second division with bio-fertilizer. Harvesting is usually carried out from April through last September. The bio-fertilizer was adhesive liquid (Arabic gum). Seeds were thoroughly mixed with the inoculation in the shade, then sown immediately and covered with soil in order to minimize *Rhizobium radiobacter* sp. exposure to the sun. Two of coated seeds were sown in hole with 5 cm depth. The distance between each two holes was 25 cm. After 30 days from planting was manual thinned to one plant. The same time freshly collected leaves samples from each plot were cut into small pieces and dried for determining chemical analysis.

Table (1): Physical and chemical properties in soil under study.

Crosse sand (%)	Fin sand %	Silt %	Clay %	Texture	O.M%	SAR	CaCO ₃ %
5.90	22.58	30.80	40.72	Clay	0.75	6.19	6.18
pH	EC (d S /m)	Ca ⁺⁺	Cations (m eq /l)		Anions (m eq/l)		
7.83	3.50	8.15	Mg ⁺⁺	Na ⁺	K ⁺	HCO ₃ ⁻	Cl ⁻ SO ₄ ⁻
Macronutrients (mg/kg)		Micronutrients (mg/kg)					
N	P	K	Fe		Mn		Zn
44.85	4.90	179	2.34		1.77		0.69

Urea (46 % N) was applied as N fertilizer at rate of 60, 90 and 120 kg /fed on three equal doses after 30, 55 and 85 days after sowing. Potassium sulphate (48 K₂O) was applied at a rate 100 kg /fed on three doses after 30, 45 and 60 days after sowing. Super phosphate (15.5 % P₂O₅) was applied at rate 200 kg /fed during tillage soil. Seeds of fodder beet were Monoverse cultivar. At harvest after five months from sowing, when plants showed signs of maturity which is indicated by leaf yellowing and partial drying of the lower leaves, six plants per plot from the inner two ridges were randomly hand-pulled to determine root length (cm), roots diameter (cm), fresh and dry weights (ton/fed) of leaves and root.

Chemical composition: Samples were sieved after dried and milled through a 1 mm sieve for chemical composition of crude protein, crude fiber and ether extract and ash were determined according to AOAC (2000). The contents of macro-micronutrients in leaves and root were determined in plant digestion using the methods described by Cottenie *et al.* (1982) and Page *et al.* (1982).

In- vitro gas production techniques: Gas production test was carried out in the laboratory of Total Nutrient Digestibility, Regional center for food and feed, Giza, Egypt. The samples were incubated *in vitro* with rumen fluid in calibrated glass syringes following the procedures of Menke *et al.* (1979). Two hundred milligram dried samples were weighed in triplicate into calibrated glass syringes of 100 ml. The syringes were prewarmed at 39°C before the injection of 30 ml rumen fluid- buffer mixture into each syringe followed by incubation in a water bath at 39°C. Reading of gas production was recorded before incubation 0 and 2, 4, 6, 8, 24, 48 h after incubation. Total gas values were corrected, digestible dry matter (IV-DDM), digestible organic matter (IV-DOM), short chain fatty acids (SCFA), metabolizable energy (ME) and net energy lactation (NEL) values in experimental by- products were calculated using equations as below according to Menke *et al.* (1979). Gas production soluble fraction (GPSF) and gas production non- soluble fraction (GPNSF) were calculated according to van Gelder *et al.* (2005), metabolizable energy (ME), net

energy lactation (NEL), organic matter digestibility (IV-OMD) and dry matter digestibility (IV-DMD) values were calculated using equations below according to Menke and Steingass (1988).

In vitro digestibility crude protein intake (IV-DCPI) (G/day) = $(-203.242 \times 14.797) + GP24 + 6.249 \times GP48$.

In vitro digestibility organic matter intake (IV-DOMI) (g/ day) = $(-1763.07 + 42.5 \times PG24) + 13.52 \times GP48$.

Short chain fatty acid (SCFA) (mmol /ml gas) = $(0.0239 \times GP + 0.0601)$. (van Gelder *et al.*, 2005)

Gas production structure fraction (GPSF) (ml/g DM) = $(GP3h - 5.5) \times 0.99 - 3$.

Gas production non- structure fraction GPNSF (ml/g DM) = $(1.02 \times (GP24h - 5.5) - (GP3h - 5.5) + 2)$.

Net energy (NE) (M cal./Lb.) = $(2.2 + (0.0272 \times \text{gas}) + (0.057 \times \text{cp}) + (0.149 \times \text{EE})) / 14.64$. (Manke and steingass, 1988)

Metabolic energy (ME) (MJ/kg DM) = $2.04 + 0.1448 \times GP + 0.0036 \times CP + 0.0243 \times EE$.

Net energy lactation (NEL) (MJ/Kg DM) = $0.08 + 0.1101 \times GP + 0.0022 \times CP + 0.0161$.

MP = Microbial protein g/kg (DOM) = $120 \times \text{DOM} / 100$. (Czerkawski, 1986)

Statistical analysis: The statistical analysis was done using MSTAT- C program in a completely Randomized Design (CRD), and differences among the treatment means were determined by the least Significant Difference (LSD) for comparing means at 5% level was calculated according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Fodder beet yield and growth:

Data presented in Table (2) showed that the effect of mineral nitrogen fertilizer alone and spacing row in (A1) 58 cm led to increasing in fresh and dry leaves and roots, number of leaf's compared with spacing row in (A2) 76 cm. The utilization of bio-fertilizer caused non-significantly increase in weight of fresh and dry leaves yield (ton/fed) for fodder beet in T4 compared with other treatment but mineral nitrogen fertilizer alone recorded highly significant increase of fresh and dry root yield (ton /fed) with T1. This result agrees with Khogali *et al.* (2011) who found that the effected of nitrogen high rate (120 kg /ha) and wider spacing had significant increase of shoot fresh weight. In additional Kandil *et al.* (2004) suggested that the effect of bio-fertilizer had effect on the growth of plant, which reflected to yield increase. This increase may be due to of N was produced by bacteria species, in addition of some growth regulators like IAA and GA₃ which stimulated growth. Fodder beet is particularly productive and is the highest yielding crop grown under temperate climates. Abo-El-Goud (2000) found that using bio-fertilizer had a positive effect on the weight of the fresh and dry root. The spacing levels effects between rows were not significant for fresh leaves yield, while was significant for dry leaves yield. Interaction effects between nitrogen different rate alone or combined with bio - fertilizer and spacing rows for fresh weight yield were not significant. The increase in root yield and leaves yield /fed with the increasing in nitrogen levels alone or combined with bio-fertilizer may be attributed to the role of nitrogenous in enhancing growth, chlorophyll formation and photosynthesis process.

The highest values of root length 53.25cm with T4, root diameter 14.23 cm with T6 and number of leaves 47.38 cm with T3 for fodder beet treated with nitrogen different rate and spacing 76 cm between rows. Mustafa (2007) working on sugar beet in the Sudan suggested that the nitrogen element may be play an important role in increasing cell elongation and cell division. As well as the increase of root length and root diameter as affected by bio fertilizer reflect to some growth regulators like IAA and GA₃ which stimulated growth produced These results disagree with the obtained by Khogali *et al.* (2012) who indicated that the increasing mineral nitrogen fertilizer rate and wider spacing led to increase of root diameter. Also, Amin *et al.* (2013) found that application of nitrogen fertilizer at the rate of 100 kg/fed recorded the highest values in root length and root diameter for sugar beet. This increasing in root length and root diameter may be reflecting using of nitrogen with respect of row spacing and high nitrogen rate.

The highest number of leaves is significantly increased 47.38 cm in T3. The leaves and roots growth parts are used to feed animals but, the main fodder is tuberous roots (Ibrahim, 2005). Therefore, the optimum population which produces maximum leaves and roots growth and hence productivity must be carefully determined.

Table (2): Effect of different mineral nitrogen fertilizer rate alone or combined with bio-fertilizer and density row on growth and weight yield of fodder beet.

Rate of N (kg/fed) B	Fresh weight Of leaves (ton/fed)	Dry weight Of leaves (ton/fed)	Fresh weight Of root (ton/fed)	Dry weight Of root (ton/fed)	Number of leaf	Root diameter (cm)	Root length (cm)
A1	6.65	0.86	78.28	11.69	47.25	13.81	51.04
A2	5.91	0.73	53.90	7.70	45.54	13.50	51.46
LSD 0.05 A	0.65	0.08	2.80	0.75	1.23	Ns	Ns
T1	5.66	0.73	71.93	10.51	45.88	13.65	49.63
T2	6.00	0.75	67.58	9.88	46.75	13.51	52.38
T3	6.41	0.84	68.85	10.37	47.38	13.65	49.88
T4	6.90	0.90	65.78	9.93	45.63	13.01	53.25
T5	5.81	0.73	61.43	9.03	45.50	13.68	49.88
T6	6.90	0.83	60.98	8.44	47.25	14.43	52.50
LSD 0.05 B	n.s.	n.s.	3.53	0.64	n.s.	n.s.	2.69
A1 x T1	5.70	0.74	85.65	12.42	46.25	14.05	49.50
A1 x T2	6.08	0.78	78.45	12.26	46.50	14.50	52.50
A1 x T3	6.45	0.86	75.00	11.81	48.00	13.53	51.50
A1 x T4	7.80	1.02	85.80	12.61	45.75	13.10	51.25
A1 x T5	6.53	0.88	76.20	11.07	44.75	13.80	50.25
A1 x T6	7.35	0.89	68.55	9.95	52.25	13.90	51.25
A2 x T1	5.63	0.72	58.20	8.59	45.50	13.25	49.75
A2 x T2	5.93	0.73	56.70	7.50	47.00	12.52	52.25
A2 x T3	6.38	0.81	56.55	8.93	46.75	13.78	48.25
A2 x T4	6.00	0.77	51.90	7.24	45.50	12.93	55.25
A2 x T5	5.10	0.57	46.65	6.94	46.25	13.55	49.50
A2 x T6	6.45	0.78	53.40	7.00	42.25	14.95	53.75
LSD 0.05 A X B	Ns	Ns	4.99	0.91	4.77	Ns	3.80

A1: 58 cm, A2: 76 cm, T1: 60 kg/ fed N, without bio- fertilizer, T2: 60kg/ fed N with bio- fertilizer, T3: 90 kg/ fed N, without bio- fertilizer, T4: 90 kg/ fed N with bio- fertilizer, T5: 120 kg/ fed N without bio- fertilizer and T6: 120 kg/ fed N with bio- fertilizer.

Effect of different mineral N fertilizer rate and spacing of row on some soil properties

Soil clay lemon (EC dSm⁻¹).

Data presented in Table (3) showed significant effect of row spacing between rows on soil clay lemon. Increasing the row spacing led to increasing of soil clay. The increase in row spacing led to accumulation of salt on surface layer because of increasing the evaporation. The effect of bio-fertilizer combined with mineral nitrogen led to decreasing of soil clay lemon may be to the microorganism's product of organic matter led to improving soil aggregation, water movement and leaching the excessive soluble salts. On the other hand, the increase of mineral nitrogen rate led to decreasing of soil clay lemon. These results are in agree that with those obtained by Siam *et al.* (2013) who found that the effect of N rates application was reducing the soil clay lemon. Tarek *et al.* (2008) reported that the soil clay lemon was significantly reduced from 60 dSm⁻¹ to about 17 dSm⁻¹, for the leached fodder beet.

Soil pH:

Data presented in Table (3) demonstrated that the effect of mineral N- fertilizer different rates alone or combined with bio-fertilizer and spacing rows on soil pH had positive effect specially soil treated with high mineral nitrogen combined with bio-fertilizer and low spacing rows.

These results are in agreement with those obtained by Shaban and Omar (2006) who suggested that the increasing mineral nitrogen levels of combined with bio-fertilizer led to decreasing soil pH. Abd El-Ghany *et al.* (2010) indicated that inoculation of seeds by Rhizobium may be led to increasing the uptake of N, P and K. Wu *et al.* (2006) found that, the activity of bacteria Bacillus mucilaginous, led to an increase of water

dissolved organic carbon concentration and a decreased pH value, which enhanced macronutrients mobility and bio-availability in soil. Seeds of fodder beet inoculation may be attributed to N₂-fixation which reduced to the soil pH especially in the rhizosphere, thereby increase the availability of most essential macro- and micro-nutrients (Kandil *et al.*, 2004). Root yield was influenced by N fertilizer and may be increased by increasing rate of N supplying (Bahman *et al.*, 2013).

Macronutrient N, P and K availability in studied soil:

Data in Table (3) showed that the macronutrients N, P and K available in soil may be increased with increasing mineral nitrogen fertilizer rate alone or combined with bio-fertilizer. In addition, the effect of space (A2) 76cm between rows on N and K available in soil are decreased significantly, while the P available in soil was non-significantly decrease, values are 50.03,190 and 5.40, respectively. The values of macronutrients N and K in soil are increased significantly 58.10 and 200% in T6 but the P value is non-significant increased 6.22%. These results showed that the increase was attributed to the positive effect of

Table (3): Effect of different mineral nitrogen fertilizer rate alone or combined with bio-fertilizer and density row on some chemical properties of soil.

Rate of N (kg/fed) B Density of row (cm) A	pH (1:2.5)	EC (dsm ⁻¹)	Concentration of Macronutrients (%) for soil		
			N	P	K
A1	8.00	1.90	53.77	6.04	195
A2	7.80	2.40	50.03	5.40	190
LSD 0.05 A	-	0.05	1.72	Ns	0.73
T1	7.82	2.15	48.20	5.60	188
T2	7.85	2.36	51.44	5.85	192
T3	7.90	1.98	52.94	5.88	195
T4	7.92	2.27	54.50	5.96	196
T5	7.94	1.45	55.85	6.10	198
T6	7.96	2.18	58.10	6.22	200
LSD 0.05 B	-	0.08	1.26	Ns	0.94
A1 x T1	7.98	2.70	45.69	4.90	185
A1 x T2	7.93	2.75	47.55	5.12	188
A1 x T3	7.96	2.16	48.50	5.23	190
A1 x T4	7.95	2.30	49.88	5.45	194
A1 x T5	7.94	1.70	50.65	5.56	195
A1 x T6	7.90	1.85	51.91	5.70	196
A2 x T1	8.02	2.50	52.70	5.95	198
A2 x T2	7.93	2.55	55.47	5.97	199
A2 x T3	8.00	2.35	57.07	5.98	199.5
A2 x T4	7.87	2.28	57.50	6.02	200
A2 x T5	7.98	2.85	59.80	6.04	202
A2 x T6	7.88	2.62	62.10	6.10	205
LSD 0.05 A X B	-	0.051	1.22	Ns	0.75

A1 58 cm., A2 76 cm., T1: 60 kg/fed N without bio- fertilizer, T2: 60kg/fed N with bio- fertilizer, T3: 90 kg/fed N without bio- fertilizer, T4: 90 kg/fed N with bio- fertilizer, T5: 120 kg/fed N without bio- fertilizer and T6: 120 kg/fed N with bio- fertilizer.

fertilizers on the root growth, which consequently led to increasing the absorption of different nutrients. Abdel-Gwad *et al.* 2008, Sarhan and Ismail, 2003 found that the fodder beet has extremely high yield potential when grown on high fertile soils. Fodder beet requires large amounts of nitrogen, nitrogen fertilizers are one of the major costs for production of these crops. Shaban *et al.* (2014) found that the increase of nitrogen fertilizer rates led to increasing available N and P (mg kg⁻¹) in the soil. While applied bio-fertilizer can fix atmospheric nitrogen and solubilize phosphate. Also, Blumenthal, *et al.*, (1998) reported that the microorganisms contribute to nutrient availability in the soil and improve soil structure. Nitrogen is a vital element for plant growth as it is a component of protein. It is thus, essential for growth. Nitrogen is

needed in greater amount than other elements and it is often the most limiting factor in crop production. Hence, application of nitrogen fertilizer results in higher biomass yield.

The effect of different mineral N fertilizer rate and spacing of row on Chemical composition of fodder beet:

Chemical composition illustration (Table 4) showed that the spaces between rows led to increasing significantly values of crude protein, which were 12.66, 10.72, respectively compared with spacing row 58 cm (A1) in leaves and roots, which were 12.08 and 9.42%, respectively. The T6 (120 kg/fed N + bio-fertilizer) recorded highest values of crude protein in leaves and roots. The highest crude protein contents are

Table (4): Effect of different row spacing and mineral nitrogen, Bio- fertilization on chemical composition of fodder beet for means of two seasons 2015-16 and 2016-17 (as dry matter basis)

Rate of N (kg/fed) B	CP%		CF%		EE%		Ash%		Nitrogen free extract NFE (%)	
	Leaves	Root	Leaves	Root	Leaves	Root	leaves	Root	Leaves	Root
Density of row (cm)A										
A1	12.08	9.42	24.07	6.7	2.38	3.17	10.96	9.1	50.51	71.61
A2	12.66	10.72	24.25	8.04	2.53	3.4	10.99	9.63	49.57	68.21
LSD 0.05 A	0.111	0.045	0.045	0.064	0.045	0.045	n.s	0.31	0.12	0.05
T1	11.03	8.67	25.23	8.01	2.42	3.18	10.68	8.43	50.64	71.71
T2	10.86	8.96	24.58	7.95	2.43	3.13	9.41	8.77	52.72	71.19
T3	11.73	9.62	23.96	6.98	2.41	3.15	10.82	8.75	51.08	71.5
T4	12.46	10.02	24.11	7.6	2.44	3.22	11.09	9.2	49.9	69.96
T5	13.17	10.24	23.11	5.98	2.49	3.22	11.63	9.7	49.6	70.86
T6	14.99	12.91	23.95	7.7	2.58	3.83	12.24	11.33	46.24	64.23
LSD 0.05 B	0.148	0.17	0.166	0.14	0.076	0.09	0.232	0.45	0.101	0.09
A1 x T1	10.6	7.7	24.54	7.33	2.27	3.04	10.18	8.27	52.41	73.66
A1 x T2	10.68	8.51	24.5	7.45	2.39	3.09	10.17	8.88	52.26	72.07
A1 x T3	11.65	9.09	24.12	6.51	2.33	3.11	10.82	8.54	51.08	72.75
A1 x T4	11.94	9.72	24.36	7.18	2.37	3.19	10.98	9.15	50.35	70.76
A1 x T5	12.53	10.25	22.53	5.46	2.39	3.15	11.33	9.44	51.22	71.7
A1 x T6	14.87	11.22	24.34	6.24	2.56	3.43	12.27	10.31	45.96	68.8
A2 x T1	11.46	9.64	25.92	9.15	2.58	3.32	11.17	8.6	48.87	69.29
A2 x T2	11.03	9.41	24.66	8.44	2.46	3.16	8.64	8.66	53.21	70.33
A2 x T3	11.8	10.14	23.79	7.44	2.48	3.19	10.81	8.95	51.12	70.28
A2 x T4	12.98	10.31	23.86	8.01	2.5	3.25	11.19	9.24	49.47	69.19
A2 x T5	13.8	10.22	23.68	6.5	2.58	3.28	11.94	9.96	48	70.04
A2 x T6	15.11	14.59	23.56	8.68	2.59	4.22	12.2	12.35	46.54	60.16
LSD 0.05 A X B	0.209	0.25	0.235	0.19	0.108	0.13	0.328	0.63	0.143	0.12

A1: 58 cm, A2: 76 cm, T1: 60 kg/fed N without bio- fertilizer, T2: 60kg/fed N with bio- fertilizer, T3: 90 kg/fed N without bio- fertilizer, T4: 90 kg/fed N with bio- fertilizer, T5: 120 kg/fed N without bio- fertilizer and T6: 120 kg/fed N with bio- fertilizer.

obtained from 60, 90 and 120 kg/fed nitrogen treatments (11.03, 11.73 and 13.17) for leaves without bio-fertilizer and (10.86, 12.46 and 14.99%) for leaves with bio fertilizer, respectively, and 8.67, 9.62 and 10.24 % for roots without bio-fertilizer and 8.96, 10.02 and 12.91% for root with bio fertilizer, respectively. Effect of mineral N fertilizer and row spacing on fresh weight of shoot was not significant under increase of N rate and greater spacing, while dry shoot and root of fodder beet were significantly increased with increasing mineral nitrogen fertilizer Muna *et al.* (2011). Sarhan and Ismail (2003) found that root dry matter yield and crude protein yield of fodder beet were significant increased by increasing nitrogen fertilizer rate.

The crude fiber content is shown in Table (4). The highest significant increase values are obtained of density of row and leaves in (A2) 76 cm spaces between row (24.25%) and roots (8.04%) compared with spacing row 58 cm (A1), which leaves and roots values are 24.07 and 6.70%, respectively. The highest value on leaves and roots forage fodder beet in crude fiber are obtained from 60 kg /fed nitrogen treatment without bio-fertilizer (T1), which values are 25.23 and 8.01, respectively. The effect of mineral nitrogen fertilizer and bio-fertilizer of row spaces on crude fiber are significant. As well as, the interaction between nitrogen fertilizers different rate alone or combined with bio-fertilizer and spacing row on crude fiber (%) was significant. These results are in agreement with those obtained by Khogali *et al.* (2011) who showed that the applying of 120 kg N/ha to fodder beet had significantly increased of crude fiber. Vladeta *et al.* (2012) found that the crude fiber content was increased significantly with increasing row spacing for all cultivars in both years.

The nitrogen free extract was increased in fodder beet with increasing mineral nitrogen fertilizer and wider row spacing with or without bio - fertilizer. Nitrogen free extract increased significantly with nitrogen fertilizer alone or combined with bio – fertilizer, also the space between rows were increased. Nitrogen free extract in leaves and roots are increased in 60 kg /fed N (A1), where the values were 50.51 and 71.61%, respectively. The best results were recorded with T1 in leaves and roots without bio-fertilizer were 52.41 and 73.66%, respectively. Finding results agree with those obtained by Hellal *et al.* (2011) who showed that the utilization chemical N fertilizer alone or combined with bio-fertilizers treatments alone led to increasing yield and carbohydrates. Abdel-Gwad *et al.* (2008) reported that the crude protein and ash of fodder beets were significantly increased by increasing nitrogen fertilizer level, while crude fibers and NFE take an opposite trend. Carbohydrates contents were about 71.69 % in dry mater yield of fodder beets as reported by Abdallah and Yassen (2008). Fodder beets have high yield productivity when grown in fertile soil. The fodder beet requires high amount of nitrogen fertilizer by Albayrak and Camas (2007).

The effect of different mineral N rates with or without bio- fertilizer and row spacing on gas parameters, short chain fatty acids and microbial protein by in-vitro gas production:

The data in Table (5) indicated insignificantly increase of Microbial protein (MP g/kg DOM), Gas production structure fractions (GPSF ml/g DM), Gas production non structure fractions (GPNSF ml/g DM), SCFA, s (mmol /ml gas) and gas production in (A2) 76 cm spaces between row compared with raw spacing 58 cm (A1) in leaves beet. The values are 79.54, 5.14, 48.18 and 1.10 and 14.19, respectively. In the other hand, the beet roots had significantly higher regard in Microbial protein (MP g/kg DOM), Gas production structure fractions (GPSF ml/g DM), SCFA, s (mmol /ml gas) and gas production (GP) for row spacing (A2) 76 cm compared with row spacing (A1) 58 cm..

The treatment T6 (120 kg/fed N + bio-fertilizer) recorded the highest value SCFA, s (mmol /ml gas), Gas production nonstructural fractions (GPNSF ml/g DM) and Microbial protein (MP g/kg DOM) in leaves, the values are 1.18, 51.61 and 82.30, while the root recorded highest value on treatment T5 120 kg N/ fed without bio- fertilizer in SCFA, s (mmol /ml gas), Gas production nonstructural fractions GPNSF(ml/g DM) and Microbial protein (MP g/kg DOM) the values are 1.76 , 70.70, and 104.30, respectively. The values of Gas production structure fractions (GPSF ml/g DM) are increased non-significantly in leaves T2 but in roots are significantly increase, the values are 5.09 and 23.73 (ml/g DM). The roots have an excellent feed quality and they are very palatable to ruminant stock. The leaf can be utilized if required to boost the total fodder output even further (Anonymous, 2006). Approximately 75% of fodder beet dry matter is in the root component (DAF (1998). The gas production of different classes of feed incubated *in vitro* in buffered rumen fluid was closely related to the production of SCFA, s which was based on carbohydrates fermentation (Kanak *et al.* 2012, Sallam *et al.* 2007 and Blummel and Oraskov 1993).

The effect of different mineral N rates with or without bio- fertilizer and row spacing nutritive values by in-vitro gas production:

Data in Table (6) showed that the row density in (A2) 76 cm spaces between rows were insignificantly increased for IV-DMD%, IV-DOM% and IV- DCPI compared with raw spacing 58 cm (A1) in leaves. These values were increased from 37.96%, 64.29, and 220.61 g/day spacing raw 58 cm (A1) to 44.18%, 66.28% and 233.26g/ day of row density (A2) 76 cm spaces, respectively, except IV-DOMI value 1459.57g/day was significant increased, While the roots were significantly increased for IV-DOM%, IV-DOMI and IV- DCPI, the values 81.79%, 3148.87 g/day and 346.31g/day, but the value of IV-DMD% insignificantly increased between the different spacing.

Table (5): Effect of different mineral N rates with or without bio- fertilizer and row spacing on gas parameters, short chain fatty acids and microbial protein by in-vitro gas production.

Rate of N (kg/fed) B	Microbial protein g/kg DOM		GPSF ml/g DM		GPNSF ml/g DM		SCFA, s mmol /ml gas		GP ml/200mgDM	
Density of row (cm) A	Leaves	Root	Leaves	Root	leaves	Root	Leaves	Root	Leaves	Root
A1	77.15	92.80	3.46	16.55	46.53	57.73	1.04	1.46	11.35	29.04
A2	79.54	98.14	5.14	20.27	48.18	61.97	1.10	1.60	14.19	31.95
LSD 0.05 A	n.s	1.84	n.s	3.18	n.s	3.59	n.s	0.05	n.s	2.0
T1	78.27	96.45	4.59	19.44	46.18	58.38	1.07	1.55	12.10	32.59
T2	76.95	91.80	5.09	23.73	46.87	53.03	1.03	1.43	11.53	28.18
T3	79.73	88.79	4.84	12.68	48.48	56.55	1.11	1.35	14.72	24.76
T4	73.23	93.76	2.69	23.07	43.00	57.44	0.93	1.48	7.46	30.25
T5	79.58	104.30	4.84	14.99	47.97	70.70	1.10	1.76	14.35	42.12
T6	82.30	97.71	3.77	16.55	51.61	63.00	1.18	1.59	16.46	33.78
LSD 0.05 B	2.81	3.74	n.s	7.78	4.58	6.89	0.07	0.11	3.10	4.19
A1 x T1	76.07	94.50	4.10	14.66	45.66	60.84	1.01	1.50	10.44	31.46
A1 x T2	74.60	92.08	5.09	19.94	44.32	55.50	0.97	1.44	8.81	28.50
A1 x T3	77.04	76.02	2.61	14.92	47.16	46.53	1.04	1.01	11.68	10.66
A1 x T4	74.28	93.98	1.62	22.58	44.08	58.28	0.96	1.09	8.47	30.53
A1 x T5	77.80	103.09	2.94	16.64	47.51	67.68	1.06	1.73	12.38	40.79
A1 x T6	81.50	97.12	4.43	20.60	50.43	57.56	1.16	1.57	16.34	32.32
A2 x T1	80.48	98.39	5.09	24.23	46.70	55.93	1.13	1.61	13.75	33.72
A2 x T2	79.31	91.53	7.07	27.53	49.42	50.56	1.10	1.42	14.25	27.87
A2 x T3	82.42	101.57	5.09	20.43	49.80	66.56	1.18	1.69	17.77	38.86
A2 x T4	72.18	93.55	3.77	23.57	41.92	56.60	0.91	1.48	6.44	29.97
A2 x T5	81.35	105.51	6.74	13.34	48.44	73.73	1.15	1.80	16.31	43.46
A2 x T6	83.10	98.31	3.11	12.51	52.78	68.44	1.20	1.60	16.58	32.24
LSD 0.05 A X B	3.97	5.29	n.s	11.01	n.s	9.75	0.11	0.14	n.s	5.92

A1: 58 cm, A2: 76 cm, T1: 60 kg/fed N without bio- fertilizer, T2: 60kg/fed N with bio- fertilizer, T3: 90 kg/fed N without bio- fertilizer, T4: 90 kg/fed N with bio- fertilizer, T5: 120 kg/fed N without bio- fertilizer and T6: 120 kg/fed N with bio- fertilizer.

The effect of nitrogen fertilization treatment with or without bio- fertilizer on digestibility value in Sixth treatment. The treatment T6 (120 kg/fed N + bio-fertilizer) had recorded highest values of IV-DOM% and IV-DOMI in leaves except IV-DMD and IV-DCPI were insignificantly increased with T1, while the roots where recorded the highest value on treatment T5 (120 kg N/ fed without bio- fertilizer) in IV-DOM, IV-DOMI and IV-DCPI of row density in (A2) 76 cm spaces except IV-DMD% were recorded high value 63.37% with T1 (60 kg N/fed without bio- fertilizer). Kaur *et al.* (2011) reported rapid rates of CP degradation 0.21/hr. for rape leaf, though in the current study the low values observed may reflect the low CP values of the forage 14 to 11% CP and the associated difficulties with microbial colonization of incubated residue.

The interaction between row density cm and nitrogen (with and without biofertilizer) the best results recorded with T6 (120 kg/fed N with bio- fertilizer) in the leaves with IV-DMD%, GP(ml/200mg DM) and IV-DOM% but in the roots the best results recorded with treatment T5 (120 kg/fed N) except with IV-DMD% recorded with T1(60 kg/fed N). Fodder beet is highly digestible: IV-OMD% is in the 87-90% range (Dulphy *et al.*, 2000), although a value of 96% has been reported (Sabri *et al.*, 1988). Adequate balance of N to OM available in the rumen has the potential to improve microbial protein synthesis and increase metabolizable protein supply to the ruminant. Increasingly farmers are adopting low N feeding systems, to the point where diets offered during the winter may have less than 12% CP. Zamfir *et al.* (2001) and Zaki (1999) reported that increasing nitrogen fertilization led to increasing dry matter yield and crude protein content of fodder beet. Previous studies with fodder beet indicated that the nitrogen rates influenced root yield and yield components (Yüksel *et al.* 2009, Prokopenko *et al.* 1997, Geweifel and Aly 1996 and Karczmarczyk *et al.* 1995).

Table (6): Effect of different mineral N rates with or without bio- fertilizer and row spacing nutritive values by in-vitro gas production.

Rate of N (kg/fed) B	IV-DMD%		IV-DOM%		IV-DOMI (g/day)		IV-DCPI (g/day)	
Density of row (cm) A	leaves	Root	Leaves	Root	Leaves	Root	Leaves	Root
A1	37.96	47.74	64.29	77.33	1459.57	2768.27	220.61	534.26
A2	44.18	46.94	66.28	81.79	1676.24	3148.87	233.36	346.31
LSD 0.05 A	n.s	n.s	n.s	1.53	186.42	170.01	n.s	34.63
T1	35.46	63.37	65.23	80.37	1532.43	2940.67	213.72	481.24
T2	39.82	48.82	64.13	76.50	1563.99	2826.06	239.32	499.78
T3	45.32	35.04	66.44	73.99	1724.31	2449.89	211.14	422.91
T4	38.52	37.00	61.03	78.14	1196.00	3121.60	197.02	489.46
T5	40.60	45.91	66.31	86.92	1619.68	3356.64	242.27	553.03
T6	46.67	53.90	68.59	81.43	1771.00	3056.57	258.44	485.08
LSD 0.05 B	n.s	5.81	2.34	3.12	156.22	232.14	n.s	73.58
A1 x T1	27.20	65.82	63.39	78.75	1471.90	2809.96	207.26	461.30
A1 x T2	37.97	46.90	62.16	76.73	1403.66	2900.09	227.32	419.64
A1 x T3	40.54	38.60	64.20	63.35	1462.89	1490.99	211.42	270.99
A1 x T4	46.06	35.55	61.90	78.32	1184.73	3126.76	202.23	498.56
A1 x T5	38.84	44.77	64.84	85.91	1482.21	3295.46	225.45	535.38
A1 x T6	37.12	54.83	67.92	80.93	1752.00	2986.38	250.00	471.60
A2 x T1	43.73	60.91	67.06	81.99	1592.96	3071.38	220.19	501.19
A2 x T2	41.67	50.74	66.09	76.27	1724.32	2752.04	251.31	570.68
A2 x T3	50.10	31.48	68.68	84.64	1790.00	3408.80	210.85	574.84
A2 x T4	30.99	38.46	60.15	77.96	1207.26	3116.45	191.81	480.36
A2 x T5	42.37	47.05	67.79	87.93	1757.16	3417.81	259.10	579.91
A2 x T6	56.22	52.98	69.25	81.92	1985.72	3126.76	266.88	498.56
LSD 0.05 A X B	n.s	n.s	3.31	4.41	220.93	328.30	n.s	104.06

A1: 58 cm, A2: 76 cm, T1: 60 kg/fed N without bio- fertilizer, T2: 60kg/fed N with bio- fertilizer, T3: 90 kg/fed N without bio- fertilizer, T4: 90 kg/fed N with bio- fertilizer, T5: 120 kg/fed N without bio- fertilizer and T6: 120 kg/fed N with bio- fertilizer.

Effect of different mineral N rates with or without bio- fertilizer and row spacing on energy parameters by in-vitro gas production:

Data in Table (7) showed that the row density in (A2) 76 cm spaces between rows led to increasing insignificantly in ME (MJ/kg DM), NE M cal./Lb. DM and NEL MJ /kg DM compared with row spacing 58 cm (A1) in leaves. These values were increased from 7.86, 3.22 and 4.35 in (A1) to 8.23, 3.36 and 4.79 (MJ/kg DM) in (A2) 76 cm spaces, While readily the roots were significantly increased in ME (MJ /kg DM), NE M cal./Lb. DM and NEL MJ /kg DM from 10.20, 3.59 and 77.33% and 6.19 in row spacing 58cm (A1) to 11.02, 3.80 and 6.77 row density in (A2) 76 cm spaces, respectively.

The treatment T6 (120 kg/fed N + bio-fertilizer) recorded highest significant value in leaves, the values are 8.67, 3.54 and 5.09, respectively. While the root where recorded highest significant value on treatment T5 (120 kg N/ fed without bio- fertilizer) in ME (MJ/kg DM), NE M cal./Lb. DM and NEL MJ /kg DM, the values were 11.59, 3.99 and 7.43, respectively. The interaction between row density cm and nitrogen (with and without biofertilizer the best results recorded with T6 (120 kg/fed N with bio- fertilizer) in the leaves with ME (MJ/kg DM), NE M cal./Lb. DM and NEL MJ /kg DM, but recorded these results the highest significant with treatment T5 (120 kg/fed N) in the roots. The high sugar content makes fodder beet palatable and a valuable energy source (Draycott *et al.* (2003). Henry (2010) found that the conversion efficiency of gross energy in milk and meat net energy were 48 and 52%, respectively. This is due to the low content in CP from the fodder beet samples analyzed. These crops are used because they are high yielding and typically have high metabolizable energy (ME) content of over 12 MJ/kg (DM), even at advanced stages of maturity (Judson and Edwards 2008).

Table (7): Effect of different mineral N rates with or without bio- fertilizer and row spacing on energy parameters by in-vitro gas production.

Rate of N (kg/fed) B	ME (MJ /kg DM)		NE (M cal./Lb. DM)		NEL (MJ /kg DM)	
Density of row (cm) A	Leaves	Root	Leaves	Root	Leaves	Root
A1	7.86	10.20	3.22	3.59	4.53	6.19
A2	8.23	11.02	3.36	3.80	4.79	6.77
LSD 0.05 A	n.s	0.28	n.s	0.05	n.s	0.20
T1	8.02	10.75	3.20	3.62	4.64	6.58
T2	7.82	10.05	3.18	3.54	4.50	6.08
T3	8.24	9.61	3.29	3.56	4.80	5.77
T4	7.27	10.36	3.14	3.66	4.11	6.30
T5	8.24	11.95	3.40	3.99	4.80	7.43
T6	8.67	10.96	3.54	3.79	5.09	6.72
LSD 0.05 B	0.40	0.57	0.08	0.11	0.30	0.40
A1 x T1	7.68	10.45	3.15	3.55	4.41	6.36
A1 x T2	7.46	10.09	3.09	3.53	4.25	6.11
A1 x T3	7.83	7.66	3.17	3.09	4.51	4.40
A1 x T4	7.41	10.38	3.11	3.65	4.22	6.32
A1 x T5	7.97	11.77	3.32	3.96	4.60	7.30
A1 x T6	8.56	10.87	3.51	3.74	5.01	6.66
A2 x T1	8.35	11.05	3.26	3.68	4.88	6.79
A2 x T2	8.18	10.01	3.27	3.55	4.75	6.05
A2 x T3	8.65	11.57	3.41	4.03	5.09	7.15
A2 x T4	7.12	10.33	3.17	3.68	4.00	6.28
A2 x T5	8.52	12.14	3.49	4.03	4.99	7.56
A2 x T6	8.79	11.05	3.57	3.84	5.18	6.79
LSD 0.05 A X B	0.60	0.80	n.s	0.16	0.42	0.57

A1: 58 cm, A2: 76 cm, T1: 60 kg/fed N without bio- fertilizer, T2: 60kg/fed N with bio- fertilizer, T3: 90 kg/fed N without bio- fertilizer, T4: 90 kg/fed N with bio- fertilizer, T5: 120 kg/fed N without bio- fertilizer and T6: 120 kg/fed N with bio- fertilizer.

CONCLUSIONS

Nitrogen fertilization had significant positive effects on growth of fodder beet, root diameter and root length. The highest growth was associated with (90 kg/fed nitrogen + bio-fertilization). So, the optimum dose under new agriculture spacing harvest can be used. Root yield and quality changed with spacing harvest. Increasing N rates resulted in increased root yield of fodder beet. The highest root crude protein and minerals were obtained with the 120 kg/fed nitrogen rate. There was a trend to increase at a wider plant space. The results of 120 kg per fed nitrogen treatments and spacing 76 cm can led to recommending for similar ecological conditions. The increasing microbial population in rhizosphere of root led to effect on transforming inorganic substances. The highest crude protein contents are obtained of row in (A2) 76 cm spaces. The highest increasing values crude protein, crude protein, ether extract contents (MP g/kg DOM), Gas production structure fractions (GPSF ml/g DM), Gas production non structure fractions (GPNSF ml/g DM), SCFA, s (mmol /ml gas), gas production IV-DMD%, IV-DOM%, IV- DCPI, ME (MJ/kg DM), NE M cal./Lb. DM and NEL MJ /kg DM were obtained of row in (A2) 76 cm spaces compared with raw spacing 58cm (A1) in leaves and roots. The best treatment recorded with T6. T6 (120 kg/fed N + bio-fertilizer) recorded the highest values of crude protein and ether extract in leaves and roots. T6 (120 kg/fed N + bio-fertilizer) recorded the highest values of SCFA, s (mmol /ml gas), Gas production nonstructural fractions (GPNSF ml/g DM), Microbial protein (MP g/kg DOM), IV-DMD, IV-DOM%, IV-DOMI and IV-DCPI, ME (MJ/kg DM), NE M cal./Lb. DM and NEL MJ /kg DM in leaves compared with other treatments. Readily the root where recorded the highest value on treatment T5 (120 kg N/ fed without bio- fertilizer) in SCFA, s (mmol /ml gas), Gas production nonstructural fractions GPNSF(ml/g DM), Microbial protein

(MPg /kg DOM), IV-DOM%, IV-DOMI, IV- DCPI, ME (MJ/kg DM), NE Mcal./Lb. DM and NEL MJ /kg DM compared with the other treatments.

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تأثير التسميد النتروجيني والحيوي مع اختلاف مسافات الزراعة في تحسين نمو و جودة محصول بنجر العلف وتأثيره على الهضم بواسطة *in-vitro* gas production technique

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الهدف من الدراسة معرفة تأثير استخدام المعدلات المختلفة من السماد النتروجيني المعدنى مع او بدون الاسمدة الحيوية و استخدام مسافات مختلفة للزراعة على انتاجية محصول بنجر العلف ، وجودته وخصائص التربة وتأثير ذلك على القياسات الهضمية باستخدام تقنية الكرش الصناعي بواسطة انتاج الغاز . تم اضافة السماد النتروجيني بمعدلات 60، 90، 120 كجم / فدان بدون او مع التسميد الحيوي وباستخدام مسافتين مختلفتين للزراعة بين الصفوف وهي 58 سم و 76 سم. وكان تقسيم المعاملات كالآتى: المسافات التى استخدمت فى الزراعة هى مسافتين مختلفتين A1 : 58 cm و A2 : 76 cm والمعدلات المختلفة من السماد النتروجيني المعدنى مع او بدون الاسمدة الحيوية: المعاملة الاولى: 60 كيلوجرام / فدان نيتروجين بدون التسميد الحيوي. المعاملة الثانية: 60 كيلوجرام / فدان مع السماد النتروجيني والسماد الحيوي. المعاملة الثالثة: 90 كيلوجرام / فدان نيتروجين بدون التسميد الحيوي. المعاملة الثانية: 90 كيلوجرام / فدان مع السماد النتروجيني والسماد الحيوي. المعاملة الخامسة: 120 كيلوجرام / فدان نيتروجين بدون التسميد الحيوي. المعاملة الثانية: 120 كيلوجرام / فدان مع السماد النتروجيني والسماد الحيوي. أظهرت النتائج أن اضافة النيتروجين زاد عدد الأوراق و قطر الدرنات مع المعاملة السادسة (T6) وهي 47.38 و 14.43 سم، على التوالي، في حين ازداد طول الدرنات الي 53.25 سم مع المعاملة الرابعة T4. كانت أعلى قيم للأوراق الطازجة والجافة في المعاملة الرابعة (T4) وهي 6.90 و 0.90 طن / للفدان مع الاسمدة النتروجينية بمعدل (90 كجم نيتروجين / فدان مع اضافة الاسمدة الحيوية) في المسافة 76 سم ، في حين أن أعلى قيم للدرنات الطازجة والجافة كانت مع المعاملة الاولى ولى 71.93 و 10.51 طن / فدان على التوالي. أدى استخدام النتروجين المعدنى ب 90 كجم / فدان مع المسافة بين الصفوف 58 سم إلى تحسين الخواص الكيميائية للتربة مما صاحبه أعلى انتاج من الدرنات والأوراق / فدان.

لوحظ ان أعلى نسبة من البروتين والألياف الخام كانت فى الأوراق والجذور مع المسافة 76 (A2) سم بالمقارنة مع المسافة 58 سم (A1) ، بينما انخفضت مستخلص خالى الازوت بدرجة كبيرة باضافة التسميد المعدنى مع اوبدون التسميد الحيوي للأوراق والجذور في المسافة 76 سم (A2)، وكانت القيم 49.57 ، 68.21 على التوالي مقارنة مع المسافة 58 سم (A1). سجلت المعاملة السادسة (T6) أعلى قيم من البروتين الخام 14.99 و 12.9 للأوراق والدرنات ، على التوالي ، تم الحصول على أعلى قيمة من الألياف الخام مع المعاملة الاولى ، والتي تقدر قيمتها 25.23 و 8.01 % ، على التوالي. بالإضافة إلى ذلك ، انخفض قيم مستخلص خالى الازوت بنسبة كبيرة في المعاملة السادسة (T6). حدثت زيادة معنوية في (IV-DDM %) و (GP (mmol / 200mg DM) و IV_DOM% (ME (MJ / kg DM) مع (A2) والتي المسافات بين الصفوف 76 سم بالمقارنة مع المسافة 58 سم (A1) في الاوراق . بينما فى الدرنات مع 65 سم (A1) كانت القيمة GP (mmol / 200mg DM) و IV_DOM% و ME (MJ / kg DM) من 29.04 و 77.33 و 10.20 ، على التوالي بالمقارنة مع (A2) والتي المسافة بينها 76 سم والتي زادت إلى 31.95 و 81.79 و 11.02 ، على التوالي ، باستثناء IV-DDM % التى انخفضت من 47.74% إلى 46.94%.

المعاملة T6 سجلت أعلى قيمة فى الأوراق. في حين أن الدرنات سجلت أعلى قيمة مع المعاملة T5 في قيم GP (ml/200mg DM)، IV_DOM% و ME (MJ / kg DM) ، فإن القيم هي 42.12 ، 86.92 % و 11.95 (MJ / kg DM)، على التوالي باستثناء IV-DMD % اعلى قيمة 63.37% سجلت مع المعاملة الاولى (T1) و GPSF مع المعاملة الثانية (T2). حدثت زيادة معنوية كبيرة في نتائج الأحماض الدهنية قصيرة السلسلة (SCFA mmol / ml gas) ، الغاز الناتج من البناء الهيكل للنبات (GPSF ml / g DM) ، الغاز الناتج من البناء الغير هيكلية للنبات و (GPNSF ml / g DM) والبروتين الميكروبي (MP g / kg DOM) فى المعاملة (A2) مع المسافة (76) سم مقارنة مع المعاملة (A1) والتي المسافة بينها 58 سم في درنات بنجر العلف والقيم هي 1.10 و 5.14 و 48.18 و 79.54 على التوالي. اما الدرنات حدث انخفاض معنوى فى نتائج الأحماض الدهنية قصيرة السلسلة (SCFA مل/مول) (مل الغاز) ، الغاز الناتج من البناء الهيكل للنبات (GPSF مل / جرام مادة جافة) ، الغاز الناتج من البناء الغير هيكل للنبات (GPNSF مل/ جرام مادة جافة) والبروتين الميكروبي (MP g / kg DOM).

سجلت T6 (120 كجم / فدان N + سماد حيوي) أعلى قيمة في القيم الهضمية فى الاوراق . بينما الدرنات سجلت أعلى قيمة في الغاز الناتج GP (mmol / 200mg DM) و المادة العضوية المهضومة IV_DOM% مع المعاملة T5 (والتي تحتوى على 120 كجم سماد نيتروجيني/ فدان بدون اضافة التسميد الحيوي وباستثناء طاقة التمثيل الغذائى ME (MJ / kg DM) ، والقيم الناتجة هي 42.12 و 86.92 و 11.95 ، على التوالي ، بالإضافة الى المادة الجافة المهضومة سجلت اعلى قيمة مع IV-DMD % 63.37% مع T1 والتي تحتوى على 60 كجم / فدان سماد نيتروجيني بدون التسميد الحيوي) وسجلت اعلى قيمة للغاز الناتج من البناء الهيكل للنبات GPSF مع T2 60 كجم / فدان .بالاضافة الى الاحماض الدهنية الطيارة قصيرة السلسلة (مللى مول / مللى غاز)، الغاز الناتج من البناء الغير هيكل للنبات والبروتين الميكروبي سجلت أعلى قيمة مع الاوراق والقيم هي 1.18 و 51.61 و 82.30. بينما الدرنات سجلت أعلى قيمة مع T5 فى الأحماض الدهنية الطيارة قصيرة السلسلة (SCFA mmol / ml gas)، الغاز الناتج من البناء الغير هيكل للنبات (GPNSF ml / g DM) والبروتين الميكروبي (MP g / kg DOM) ، وكانت القيم 1.76 و 70.70 و 104.30 على التوالي، والدرنات لها جودة غذائية ممتازة، وهي مستساغة جدا للمجترات. وترجع هذه الزيادة فى المحصول إلى التأثير الإيجابي للأسمدة على نمو الدرنات، مما أدى بالتالي إلى زيادة امتصاص العناصر الغذائية المختلفة. يتمتع بنجر العلف بإمكانيات محصولية عالية للغاية عند نموه في تربة خصبة عالية. يتطلب بنجر العلف كميات كبيرة من النيتروجين.

اثبتت الدراسة ان التسميد النيتروجيني له تأثير ايجابي على قطر وطول الدرنات وارتبط اعلى نمو مع التسميد النتروجيني 90كجم / فدان مع التسميد الحيوى وتغيرت جودة وانتاج الدرنات بزيادة المسافة بين الصفوف بزيادة المعدلات النيتروجينية واعطت اعلى نسبة للبروتين الخام فى الدرنات مع معدل النيتروجين 120 كجم / للفدان وظهرت T6 اعلى كمية من الاوراق مع ارتفاع القيمة الهضمية ، بينما الدرنات اعطت أعلى قيمة هضمية مع T5.