Effect of some fertilization treatments and planting distances on fodder beet productivity and quality under new reclaimed lands conditions

Yousef, M. S. H
Agronomy Department, Faculty of Agriculture, Suez Canal University, 41522 Ismailia, Egypt

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Abstract: Two field experiments were conducted during 2003/2004 and 2004/ 2005 seasons at the Experimental Farm of Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, to study the effect of foliar nutrition with (0, 335 ppm Cu + 335 ppm Fe + 420 ppm Zn+500 ppm Mn and 670 ppm Cu + 670 ppm Fe + 840 ppm Zn + 1000 ppm Mn) after 45 and 60 days from sowing on fodder beet cv. Voroshenger grown under three levels of nitrogen fertilizer i.e. 40, 80 and 120 kg N/fad and two planting distances (20 and 30 cm between hills) under newly reclaimed lands conditions. It was found that foliar spraying with Mn, Zn Cu and Fe had significant effects on yield, yield components and yield quality. Top and root yields were gradually and significantly increased by increasing nitrogen rates from 40 up to 120 kg/fad. Moreover, plant spacing had a significant effect on top and root weight /plant of fodder beet. Increasing distance between hills from 20 to 30 cm improved fodder beet growth characters/plant. On contrary, decreasing distance between hills from 30 to 20 cm increased significantly top and root yields. The highest productivity and quality from fodder beet yield were obtained from sowing at 20 cm between hills and soil fertilized with 40 kg N/fad and spraying with 670 ppm Cu + 670 ppm Fe + 840 ppm Zn + 1000 ppm Mn. Also, crude protein, Ash (%) and EE (%) increased significantly with increasing N and micronutrients levels, as well as plant spaces but crude fiber and NFE decreased significantly with increasing N levels. Meanwhile TDN. insignificantly decreased with increasing plant spaces and N levels.

Keywords: Fodder beet, Fertilization treatment, Plant distance, Micronutrients, Productivity and Quality

INTRODUCTION

In Egypt, production and distribution of forage crops have become one of the most problems which lead to shortage in available quantities of forage crops around the year. So, the increase of cultivated new lands to produce more green forage has become the most promising solution to close up the gap between production and consumption especially under the limited area of the Nile Valley. Fodder beet (Beta vularis, L.) is a winter forage crop in Egypt and very successful crop in the new reclaimed lands because it is tolerant to high salinity in the soil and water. Fodder beet can easily fulfill both aims, the first is its high content of carbohydrate (in the average 71.6% in the dry matter) and the second is the production in some new regions ranging between 20-30 tons fed-1. Moreover, 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).

Soil of new reclaimed lands is characterized by physical and chemical problems in crop production. Several reports revealed the possibility of using micronutrients to increase productivity of fodder beet (Till and Alloways, 1983 and Yagodin and Starovoitova, 1984). A significant increase in fresh and dry yields (ton/fed) was obtained with micronutrients when sprayed twice or more to fodder beet (Nabila and Ahmed, 1994).

Zn application increased dry matter accumulation in roots of fodder beet (Sun *et al.,* 1994). Moreover Domska (1996) found that when sugar beet was treated with 0.1 kg Cu/ha, it gave the highest root and top yields. Osman *et al.* (2005) showed that increasing of zinc and cupper levels resulted in a significant increase in number of leaves, total dry weight / plant and top and root yields of sugar beet.

Nitrogen is considered one of the major nutrient elements, especially in new reclaimed lands which are characterized as poor fertility soil. It affects growth, yield and nutritive value of fodder beet. It is considered an essential constituent for several physiological and biochemical processes which are reflected on vegetative growth and yield (Albayrak and Camas, 2006)

Mohamed, (1997) noticed that many workers used different nitrogen doses from low to very high with fodder beet and reported the range from 30 to 200 kg N/ha under different agro-climatic and different varieties. The positive effect of nitrogen application on root fresh and dry weights and quality of fodder beet was reported by many investigators, where, increasing nitrogen levels up to 80 kg N/fed (El-Kasaby and Lielah, 1992), up to 92 kg N/fed (El-Shafai, 2000), up to 90 kg N/fed (Ouda, 2001) and up to 90 kg N/fed (Eman 2004) gave a significant increase in yield, yield components and quality of fodder beet. Meanwhile, increasing N levels up to 120 kg N/fed increased significantly top fresh and day weight/plant, root fresh and dry weight/plant and top and root yields. While, no significant effect was found on quality of beet. (Aboshady *et al.*, 2007 and Nemeat Alla *et al.*, 2007).

It is necessary to find out the optimum dose of micronutrients, and planting density as well as N-level which give the highest yield and quality of fodder beet. Many investigators found that yield and quality of fodder beet were influenced by hill spaces in this respect. Storey and Barry (1979) found that 20 cm between hills gave good results in root yield of fodder beet than 10 or 30 cm between hills. Gomma (1997) indicated that productivity of the individual plant was enhanced under light density planting but under dense planting, the single plant produced much less.

Bassal *et al.* (2001) stated that each increase in hill spacing until 30 cm was associated with marked increase in top and root weights/plant, while top and root yields/fed were increased significantly with decreasing hill spacing until 20cm. Also, Bassal *et al.* (2002) found that increasing hill spacing up to 35cm decreased significantly top and root yields/fed, while crude protein in top and root was increased.

Ouda, (2005) showed that plant densities had significant effects on yield, yield components and quality of sugar beet. The maximums values of yield were obtained by increasing plant population up to 46000 plant/fed. Nemeat Alla *et al.* (2007) found that growing sugar beet plants in ridges of 50 cm and hill space of 20 cm caused a significant increase in root and top yields.

In this research, it was tried to determine the effect of foliar micronutrients, nitrogen fertilizers and planting distances on yield and quality of fodder beet under new reclaimed lands conditions.

MATERIALS AND METHODS

Two field experiments were conducted during 2003/2004 and 2004/2005 seasons at the Experimental Farm of the Faculty of Agriculture, Suez Canal University, Ismailia, Egypt to study the effect of foliar nutrition with different concentrations of Cu + Fe + Zn + Mn on growth, yield and yield components of fodder beet crop cv. Voroshenger grown under different levels of nitrogen fertilizer at two planting distances under newly reclaimed sandy soil conditions. Chemical and physical properties of the experimental soil are presented in Table (1).

Each experiment consisted of 18 treatments which were the combination of three concentrations of aqueous solution of Cu + Fe + Zn + Mn (F0: control, spray with tap water; F1: 335 ppm Cu + 335 ppm Fe + 420 ppm Zn + 500 ppm Mn and F2: 670 ppm Cu + 670 ppm Fe + 840 ppm Zn + 1000 ppm Mn) sprayed twice on the foliage after 45 and 60 days from sowing, three rates of nitrogen fertilizer applied to the soil i.e. 40, 80 and 120 kg N/fad and two planting distances (20 and 30 cm between hills). A split-split plot design with four replications was used in both seasons. The main plots were devoted to the foliar application with micronutrients then N fertilization distributed in sub-plots, while, plant spaces were allocated in sub-sub plots. Each experimental plot consisted of 5 rows, 4.2 m in long and 75 cm in width (plot area = 3.75 x 4.2 = 15.75 m^2). Fodder beet seeds were sown in rows 75 cm apart on October 26 and 21 in 2003 and 2004, respectively. Farmyard manure (20 m^3/fad), as well as basal dose of calcium super phosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O) at a rate of 200 and 50 kg/fad, respectively were applied to the soil for all treatments during preparing of experimental soil.

After one month, the plants were thinned to two plants per hill, and then were singled to one plant per hill after 45 days from sowing. Nitrogen fertilizer in the form of ammonium sulphate (20.5% N) was added at two equal doses at 45 and 66 days from sowing, respectively. Micronutrients spray treatments were applied twice after 45 and 60 days from sowing at a rate of 400 L/fad and Tepool was added as a wetting agent by a concentration of 1 ml/L. The normal recommended cultural practices of growing fodder beet were followed.

At harvest, a central of three rows from each plot were harvested at both seasons, to estimate the following characters:

1. Top dry weight (kg/plant).
2. Root dry weight (kg/plant).
3. Top fresh yield (ton/fed).
4. Root fresh yield (ton/fed).
5. Top dry yield (ton/fed).
6. Root dry yield (ton/fed).
7. Crude protein %: Total nitrogen in dried forage yield was determined by using Micro–Kjeldahl method. Crude protein % was calculated by multiplying the total N by a factor 6.25 according to A.O.A.C. (1980).
8. Crude fiber (%): the crud fiber was determined by using the procedures described by A.O.A.C.(1980).
9. Ash (%): the samples were ashes in a muffle furnace at 600 C0 and the ash content was determined in the samples on dry matter basis according to A.O.A.C. (1980).
10. Ether extract (%): extracted using petroleum ether (40-60 C0) in a soxhelt apparatus for 12 hours with a rate of 6 siphons/hour according to A.O.A.C. (1980).
11. Nitrogen free extract (%): was determined according to the method described by A.O.A.C. (1980).
12. Total digestible nutrient (TDN %): was determined according to the following formula given by Naga and El-Shazly(1971).

TDN (%) = Organic matter (OM) + 1.25 x Ether extract (EE) – 0.40 x Crude protein (CP).

A split-split plot design with four replications was used in both seasons. The main plot was devoted to the foliar application of micronutrients then N fertilization distributed in sub-plots. While, plant spaces were allocated in sub-sub plots.

Table (1): Physical and chemical analysis of the experimental soil

Particle size analysis			
Sand%	**Silt%**	**Clay %**	**Texture**
74.4	18.6	7.0	Sand

Chemical analysis								
	Available micronutrients (ppm)				**Available macronutrients (ppm)**			
PH	**Fe**	**Zn**	**Cu**	**Mn**	**N**	**P**	**K**	**OM**
7.88	4.5	0.60	0.70	2.89	3.65	1.78	9.53	0.06

RESULTS AND DISCUSSIONS

Effect of micronutrients application:

Top and root yields reflect the essential role of macro and micronutrients on growth criteria of fodder beet plants. Data in Tables (2&3) showed the response of yield, yield components and its quality to different micronutrients levels. Foliar application by Mn, Zn, Cu and Fe had significant effects for all the studied traits.The values of fodder beet reading were significantly higher with the maximum level of micronutrients (F2) than the minimum level (control, F0).This positive response of yield traits to micronutrient application reflects that soil micronutrients content was not enough for fodder beet requirements. Foliar application of micronutrient on fodder beet plants compared with control increased root fresh yield from 28.884 to 34.046 and from 26.77 to 34.966 ton/fad for the first and second seasons while, root dry yield was increased from 5.338 to 6.437 and from 4.991 to 6.129 ton/fad for both seasons, respectively. The effect of micronutrients on improving root and top yields may be due to the important role of micronutrients on hormonal balance, enzymes activity and enhancing physiological and biochemical processes in plant (Marschner, 1995).

Increasing foliar application by micronutrients caused a significant increase in fodder beet quality. The amounts of crude protein produced were highest and significant when applied (F2) 670 ppm Cu & 670 ppm Fe +840 ppm Zn + 1000 ppm Mn. It could be concluded that applying micronutrients to fodder beet plants induced a simulation for forming more protein in the plant and its parts. Total carbohydrates which calculated in terms of nitrogen free extract (NFE) decreased with increasing foliar micronutrients. Moreover, crude fiber responded inversely with nitrogen free extract (%). The total amounts of ash produced in whole plant increased with increasing foliar application. These results are in agreement with (Nabila and Ahmed 1994).

Effect of nitrogen fertilization:

Tables (2 & 3) showed the effect of different nitrogen rates (40, 80 and 120 kg N/ fad) on yield and quality of fodder beet. Results indicated that top and root yields were gradually and significantly increased by increasing N rates from 40 up to 120 kg N/fed. The maximum top and root dry yields were 1.06 and 6.236 t/ fad in the first season while they were 0.998 and 5.979 in the second season, which gained with application of 120 kg N/ fad The increasing in top and root yields response to N fertilizer levels may be due to that N improving photosynthetic area and root dimensions by enhancing cell division and elongation which results in more accumulation for dry matter (Eman, 2004).The positive response of top and root yields to N fertilization was described by many investigators among them, (Aboshady *et al.*, 2007 and Nemeat Alla *et al.*, 2007).

Results, also, indicated that application N with rates 40 and 80 kg/N fad had insignificant effects on most traits. This result indicated that increasing N rate from 40 to 80 kg/N fad was without economic increase of dry matter, so, the economic costs must be taken in consideration. Increasing nitrogen levels increased the crude protein and ash contents but the contents of crude fiber and nitrogen free extract (carbohydrates) were decreased. Improving protein content of plant may be due to that increasing nitrogen dose in fodder beet media due to N fertilization enhanced the plants absorption of more nitrogen with more rapid rate than the other constituents of plant tissues.In other words, such increase in CP in response to high N rates may be due to the role of N in amino acid formation, which condensed through the peptide bands in forming the different kinds of CP in the growing plants. It seem that the highest rate of N fertilizer, which gave the lowest content of NFE, may refer to the role of N in increasing CP on the expense of NFE. Similar results observed by (Eman, 2004).The increment of ash content in root by increasing N level up to 120 kg N/fed confirms the function of N element in plant growth through absorbing and accumulating more nitrogen and other micro and macro elements in plant tissue in form of ash content, similar results recorded by (Aboshady *et al.*, 2007 and Nemeat Alla *et al.*, 2007).

In the other hand, the reduction in CF % in root due to increasing N level reveals that N increased the other constituents of fodder beet plants i.e. protein and soluble carbohydrate (NFE) at more rapid rate than insoluble carbohydrate i.e. cellulose and hemicelluloses. Similar results were mentioned by (Albayrak and Camas, 2006).

Effect of planting distance on yield and quality of fodder beet:

Root yield is a good indicator for plant ability in giving thicker roots and accumulating more dry matter which affects by plant spaces as shown in Table (2).Plants spacing had a significant effect on the growth above and under ground parts of fodder beet. Increasing distance between hills from 20 to 30 cm improved the plant performance which reflected by increasing the capability of plants to give higher productivity. But decreasing distance between hills from 30 to 20 cm led to increasing top and root yields significantly. It could be concluded that increasing planting distance induced more extension in the produced roots. This was due mainly to the increase in available area for that extension. These increases in top fresh and dry yields and root fresh and dry yields/fed at 20 cm between hills may be attributed to the increase of plant population compared with growing at 30 cm between hills. These results agree with those obtained by Ouda, Soheir (2005) and Nemeat Alla *et al.* (2007). Increasing distance between fodder beet plants caused a significant increase in crude protein and nitrogen free extract (NFE). While, no significant response was found with increasing planting distance in ash content (%), Ether extract (%) and TDN (%). The decrease in planting distance intended to produce much assimilating area per unit of soil. This in turn could result in more photosynthetic rates and dry matter formation and consequently increased as total soluble in roots. Since it considered as the sink of carbohydrate storage.

Table (2): Effect of foliar application N fertilization, hill spaces and their interactions on top and root DW/plant, top and root FWY (t/fed) and top and root DWY (t/fed).

Treatments	Top dry weight (kg)/plant		Root dry weight (kg)/plant		Top fresh yield (t/fad)		Root fresh yield (t/fad		Top dry yield (t/fad)		Root dry yield (t/fad	
	First	Second	First	Second	First	Second	First	Second	First	Second	First	Second
Foliar micronutrients												
F_0	0.039 [c]	0.038 [b]	0.235 [c]	0.249	3.676 [c]	3.438 [b]	28.884 [b]	26.775 [b]	0.842 [c]	0.792 [b]	5.338 [b]	4.991 [b]
F_1	0.045 [b]	0.042 [b]	0.274 [b]	0.258	4.071 [b]	3.785 [b]	30.518 [b]	29.846 [b]	0.969 [b]	0.877 [b]	5.689 [b]	5.334 [b]
F_2	0.059 [a]	0.054 [a]	0.308 [a]	0.292	4.831 [a]	4.424 [a]	34.046 [a]	34.966 [a]	1.219 [a]	1.100 [a]	6.437 [a]	6.129 [a]
F-test at 5%	*	*	*	Ns	*	*	*	*	*	*	*	*
N fertilization												
N1 (40 kg/fad)	0.043 [b]	0.041 [b]	0.262 [b]	0.247	3.865 [b]	3.561 [b]	29.949 [b]	28.761 [b]	0.901 [b]	0.820 [b]	5.561 [b]	5.098 [b]
N2(80 kg/fad	0.050 [a]	0.045 [ab]	0.273 [b]	0.262	4.102 [b]	3.788 [b]	30.416 [b]	30.310 [ab]	1.063 [a]	0.951 [a]	5.668 [b]	5.377 [b]
N3(120 kg/fad	0.051 [a]	0.048 [a]	0.300 [a]	0.291	4.612 [a]	4.297 [a]	33.088 [a]	32.216 [a]	1.066 [a]	0.998 [a]	6.236 [a]	5.979 [a]
F-test at 5%	*	*	*	Ns	*	*	*	*	*	*	*	*
Plant spaces												
20 cm	0.047	0.044	0.269	0.249	4.950	4.522	36.338	34.417	1.192	1.086	6.788	6.144
30 cm	0.049	0.045	0.287	0.284	3.436	3.243	25.960	26.460	0.828	0.760	4.855	4.825
F-test at 5%	Ns	Ns	*	*	*	*	*	*	*	*	*	*
Interactions												
F*N	Ns	*	*	Ns	Ns	Ns	*	Ns	Ns	*	Ns	Ns
F*S	*	Ns	Ns	Ns	Ns	Ns	Ns	Ns	*	Ns	Ns	Ns
N*S	Ns	Ns	*	Ns	*	Ns	Ns	Ns	*	Ns	*	*
F*N*S	*	*	Ns	Ns	Ns	Ns	Ns	Ns	**	**	**	**

F_0: (control) spray with tap water.
F_1 335 ppm Cu + 335 ppm Fe + 420 ppm Zn + 500 ppm Mn
F_2: 670 ppm Cu + 670 ppm Fe + 840 ppm Zn + 1000 ppm Mn

Table (3): Effect of foliar application, N fertilization, hill spaces and their interactions on Crude protein*(%), Crude fiber(%),ash(%),ether extract (%),nitrogen free extract (%) and total digestible nutrient (%).

Treatments	Crude protein (%)		Crude fiber (%)		Ash (%)		Ether Extract (%)		Nitrogen Free Extract (%)		TDN (%)	
	First	Second	First	Second	First	Second	First	Second	First	Second	First	Second
Foliar												
F_0	8.48 ^{c}	7.92 ^{c}	10.36 ^{c}	10.15 ^{c}	4.76 ^{c}	4.56 ^{c}	2.32 ^{c}	2.39 ^{c}	74.08 ^{a}	74.98 ^{a}	93.98 ^{a}	94.55 ^{a}
F_1	9.36 ^{b}	8.29 ^{b}	11.61 ^{a}	10.72 ^{a}	5.58 ^{b}	5.53 ^{b}	2.47 ^{b}	2.57 ^{b}	70.99 ^{b}	72.90 ^{b}	92.93 ^{ab}	93.63 ^{ab}
F_2	9.88 ^{a}	9.39 ^{a}	10.96 ^{b}	10.40 ^{b}	7.39 ^{a}	7.31 ^{a}	2.79 ^{a}	2.85 ^{a}	68.98 ^{c}	70.04 ^{c}	91.25 ^{b}	91.64 ^{b}
F-test at 5%	*	*	*	*	*	*	*	*	*	*	*	*
N fertilization												
N1(40 kg/fad	8.86 ^{c}	8.14 ^{b}	11.44 ^{a}	10.59 ^{a}	5.71 ^{b}	5.70 ^{b}	2.38 ^{c}	2.45 ^{c}	71.62 ^{a}	73.12 ^{a}	92.39	93.37
N2(80 kg/fad	9.14 ^{b}	8.27 ^{b}	10.86 ^{b}	10.27 ^{b}	5.77 ^{b}	5.61 ^{b}	2.48 ^{b}	2.59 ^{b}	71.75 ^{a}	73.25 ^{a}	92.85	93.57
N3(120 kg/fad	9.74 ^{a}	9.18 ^{a}	10.62 ^{b}	10.40 ^{ab}	6.24 ^{a}	6.09 ^{a}	2.72 ^{a}	2.77 ^{a}	70.68 ^{b}	71.55 ^{b}	92.93	92.86
F-test at 5%	*	*	*	*	*	*	*	*	*	*	Ns	Ns
Space Plant												
20 cm	9.12 ^{b}	8.34 ^{b}	11.08 ^{a}	10.36	5.79	5.75	2.50	2.56	71.72	72.99	93.08	93.36
30 cm	9.37 ^{a}	8.73 ^{a}	10.86 ^{b}	10.48	6.01	5.85	2.54	2.65	70.98	72.29	92.33	93.18
F-test at 5%	*	*	*	Ns	Ns	Ns	Ns	Ns	*	*	Ns	Ns
Interactions												
F*N	*	*	*	NS	*	*	*	*	*	**	Ns	*
F*S	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	*	Ns
N*S	Ns	Ns	Ns	Ns	*	NS	*	Ns	Ns	Ns	Ns	Ns
F*N*S	**	**	*	*	Ns	Ns	Ns	Ns	*	*	Ns	Ns

F_0: (control) spray with tap water.
F_1: 335 ppm Cu + 335 ppm Fe + 420 ppm Zn + 500 ppm Mn
F_2: 670 ppm Cu + 670 ppm Fe + 840 ppm Zn + 1000 ppm Mn

Effect of the interaction between nitrogen fertilization and planting distances on yield of fodder beet: The interaction between N levels and hill spaces had significant effects on root dry yield/fed in both seasons. The highest values of root dry yield (7.171 and 6.837 ton/fad) were significantly obtained from the application of 120 kg N/ fad and sowing fodder beet at 20 cm apart between hills, flowed by the interactions between 40 kg N/ fad and 20 cm and between 80 kg N/ fad and 20 cm apart between hills, in both seasons respectively, as shown in Table (4).

Effect of the interaction between nitrogen and micronutrients on protein content: The content of crude protein in root was significantly increased by increasing N levels from 40 to 120 kg N/fad and micronutrients from F0 to F2 in both seasons (Table 5). The highest crude protein (%) in root (10.72% and 10.73%) were obtained from the maximum dose of micronutrients with 120 kg N/fed in the first and second seasons respectively. While, the lowest crude protein (%) (8.11% and 7.74%) were taken from 40 kg N/fed without micronutrients in the first and second seasons, respectively.

Effect of the interaction between micronutrients, nitrogen fertilization and planting distances on yield and quality of fodder beet: It was evident from obtained data in Figures (1 & 2) that lower distance of 20 cm between plants showed the best one for producing highest root dry yield, top dry yield, Crude protein (%), crude fiber (%) and NFE(%) when micronutrients and nitrogen was applied by (670 ppm Cu & 670 ppm Fe +840 ppm Zn + 1000 ppm Mn) and 40 kg N/ fad. At every planting distance, the root dry yield and the top dry yield showed different responses at the different nitrogen levels but mostly there was a top trend of increasing dry yield of tops, roots and quality by lowering plant distance and increasing micronutrients in addition decreasing nitrogen rates (F2 x N1 x S1).

In could be noticed that crude protein (%) and crude fiber (%) affected significantly by application of micronutrients and nitrogen rates and planting distance (Fig. 2). The response between these traits was inversely i.e. when protein was increased fiber was decreased. The interaction between previous fertilizer treatments increased total carbohydrate at 20 cm planting distance (Fig.1).

Finally, it can be stated that sowing fodder beet at 20 cm between hills with the micronutrients (F2) and N1 (40 kg / fad) was the recommended treatment to improve productivity and quality of fodder beet under the condition of the new reclaimed soil.

Table (4): Root dry yield (ton/fed) of fodder beet as affected by the interaction between nitrogen fertilization and hill spaces.

	First season				Second season			
	N1(40 kg/fad)	N2(80 kg/fad)	N3(120 kg/fad	Average	N1(40 kg/fad	N2(80 kg/fad	N3(120 kg/fad	Average
20 cm	6.786	6.408	7.171	6.788	5.776	5.818	6.837	6.144
30 cm	4.337	4.928	5.301	4.855	4.419	4.935	5.121	4.825
average	5.561	5.668	6.236		5.098	5.377	5.979	
LSD 5%		0.473				1.050		

Table (5): Crude protein (%) of root fodder beet as affected by the interaction between nitrogen fertilization and foliar application.

Treatment	First season				Second season			
	N1(40 kg/fad	N2(80 kg/fad)	N3(120 kg/fad	Average	N1(40 kg/fad)	N2(80 kg/fad)	N3(120 kg/fad)	Average
F_0	8.11	8.50	8.85	8.48	7.74	7.85	8.16	**7.92**
F_1	9.02	9.41	9.64	9.36	8.01	8.19	8.66	**8.29**
F_2	9.43	9.50	10.72	9.88	8.68	8.78	10.73	**9.39**
average	8.85	9.14	9.74		8.14	8.27	9.18	
LSD 5%		0.455				0.404		

F_0: (control) spray with tap water.
F_1: 335 ppm Cu + 335 ppm Fe + 420 ppm Zn + 500 ppm Mn
F_2: 670 ppm Cu + 670 ppm Fe + 840 ppm Zn + 1000 ppm Mn

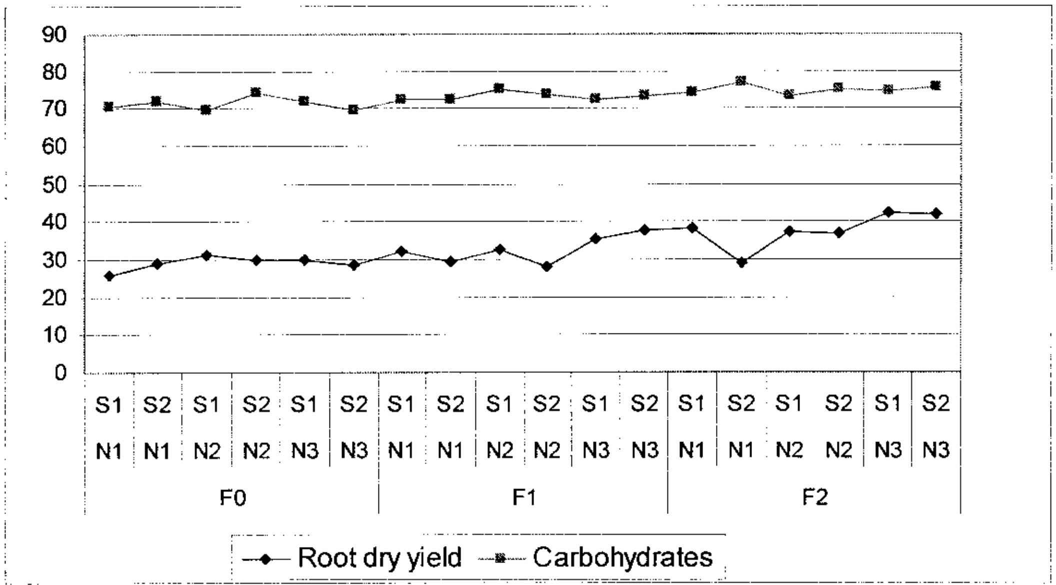

Fig. (1): Effect of foliar micronutrients, nitrogen rates and planting distances on root dry yield (ton/fed) and carbohydrates (%) for combined analysis

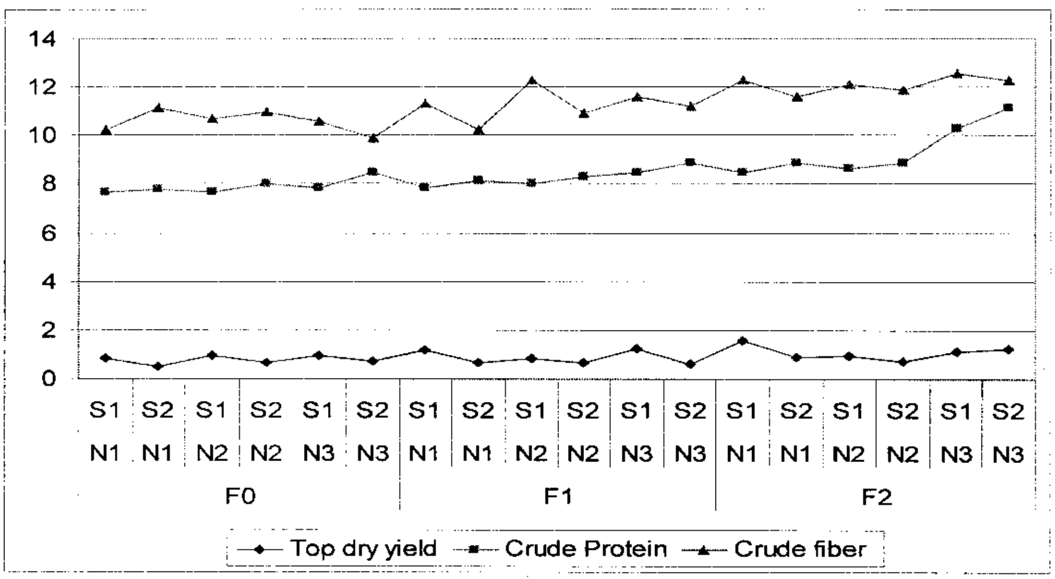

Fig. (2): Effect of foliar micronutrients, nitrogen levels and planting distances on combined some fodder beet traits

F_0: (control) spray with tap water, F_1 335 ppm Cu + 335 ppm Fe + 420 ppm Zn + 500 ppm Mn, F_2: 670 ppm Cu + 670 ppm Fe + 840 ppm Zn + 1000 ppm Mn, N_1: (40 kg/fad, N_2: (80 kg/fad, N_3: (120 kg/fad, S_1: 20 cm, S_2: 30 cm

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تاثير بعض المعاملات السمادية ومسافات الزراعة على انتاجية وجودة بنجر العلف تحت ظروف الاراضى حديثة الاستصلاح

محمد صبرى حمادة على يوسف
قسم المحاصيل- كلية الزراعة- جامعة قناة السويس- ٤١٥٢٢ الإسماعيلية- جمهورية مصر العربية

أجريت تجربتان حقليتان خلال الموسمين ٢٠٠٣/ ٢٠٠٤ و ٢٠٠٤/٢٠٠٥ بالمزرعة التجريبية بكلية الزراعة- جامعة قناة السويس- الإسماعيلية- مصر بهدف دراسة تأثير التغذية الورقية بثلاثة معدلات من النحاس والحديدووالزنك والمنجنيز (بدون عناصر - ٣٣٥ جزء/مليون نحاس +٣٣٥ جزء/مليون حديد +٤٢٠ جزء/مليون زنك +٥٠٠ جزء/مليون منجنيز - ٦٧٠ جزء/مليون نحاس +٦٧٠ جزء/مليون حديد +٨٤٠ جزء/مليون زنك +١٠٠٠ جزء/ مليون منجنيز) و الرش مرتين بعد ٤٥ ، ٦٠ يوما من الزراعة وذلك تحت ثلاثة مستويات من التسميد النتروجينى (٤٠ ، ٨٠ ، ١٢٠ كجم ن/فدان) عند زراعة نباتات بنجر العلف على مسافات ٢٠و٣٠ سم بين الجور.

أوضحت النتائج أن زيادة مستويات التسميد الارضى بالنيتروجين ومعدلات الرش بالعناصر الصغرى قد ادت الى زيادة محصول بنجر العلف ؛ كما ادت زيادة مسافة الزراعة من ٢٠ الى ٣٠ سم بين الجور الى زيادة وزن العرش والجذور للنبات ؛على حين ادى نقص المسافة بين النباتات من ٣٠ الى ٢٠سم الى زيادة محصول الفدان.وفيما يخص صفات جودة المحصول فلقد ادت زيادة كل من معدلات التسميد النيتروجينى وتركيز الرش العناصر الصغرى والمسافة بين النباتات الى زيادة معنوية فى نسبة البروتين الخام والرماد ومستخلص الايثير؛ على حين ادت زيادة التسميد النيتروجينى الى نقص معنوى فى نسبة الالياف الخام والمستخلص الخالى من النيتروجين.بينما ادت زيادة معدلات التسميد النيتروجينى والمسافة بين النباتات الى نقص غير معنوى للمواد المهضومة الكلية.