ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor, Vol. 44(4): 1521-1530, (2006)

FODDER BEET (*Beta vulgaris* L.) POTENTIALITIES AS AFFECTED BY NITROGEN AND POTASSIUM FERTILIZATION LEVELS

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ABSTRACT

Tow field experiments were carried out at Sers-Elliyan Field Crops Station at Minufiya Governorate (Middle Delta), Egypt during 2001-2002 and 2002-2003 seasons. This is to study the effect of four nitrogen levels (30, 45, 60 and 75 Kg N/fed..) and three potassium levels (25,50, and 75 Kg K2O/fed..) in split plot design on growth characters, yield and nutritive value of fodder beet Polyaurea variety. Results can be summarized as follows

The increase in nitrogen (N) levels significantly increased roots width and length, fresh and dry forage yields of top, root and total yield as well. Also, it increased crud protein and digestible protein contents of top, root and its mean in the two growing seasons.

Increasing potassium (K) fertilizer level up to 75 Kg K_2O/fed. significantly increased the roots length and width, tops, roots and total fresh and dry forage yields, crude protein and digestible protein percentages (top, root and its mean) in the two growing seasons.

The interaction effect of N x K was found to be significant on root and total yield of fodder beet in the two seasons. This result indicated that such variables were all related in influencing forage yield of fodder beet. Wereas, this interaction effect was not significant on roots width and length and top yield indicated that each of those fertilizers act independently on this studied characters.

It could be concluded that the application of 75 Kg N/fed.. and 75 Kg K_2O gave the highest productivity and quality of fodder beet at Middle Delta.

INTRODUCTION

Fodder beet (*Beta vulgaris* L.) is considered as one of the highest productive forage crops and becomes mature at the end of winter season forage crops as berssem clover. So, it could be kept for use as a fresh fodder during the early summer season till the beginning of the next summer forage crops.

Also, it should be noted that fodder beet is an ideal fodder for high performance dairy caows due to its high nutritive value

Great attention in the last few years have been devoted for increasing the fodder beet cultivated area due to the inadequate green forage production for the demand of animal consumption in the early summer where shortage of green and succulent forage used to be during this period of time.

Fertilization with the major elements as nitrogen and potassium are among the main important cultural practices for increasing and improving forage yields. Potassium improves many physiological growth stimulus through many of the crucial enzymatic process within the plant and control the transport of sugars and the other products of photosynthesis from leaves to the storage organs of the plants.

Meanwhile, it is well known fact that nitrogen element plays an essential role as important as that of carbon, hydrogen and oxygen which all together form more than 90 % of the dry matter content of the plants. Nitrogen proved to be the most yield-limiting nutrient factor. Many investigations proved that fodder beet yield are greatly influenced by the applied levels of nitrogen fertilizers (Ramadan, 1988; Abdel-Aal, 1990; Kamel *et al*, 1990; Geweifel and Aly, 1996 and Abd El-Gawad *et al*, 1997).

Adequate potassium quantities are thus vital for full fodder yield and also for many aspects of product quality (Stumpe *et al*, 1989; Sobhy *et al*, 1992; El-Khawaga and Zeiton, 1993; Geweifel and Aly, 1996; Abd El-Gawad *et al*, 1997 and El-Shafei 1997).

This investigation aimed to find out the optimum levels of nitrogen and potassium fertilization levels which produce the highest fodder beet yield/fed.. and of high quality characteristics.

MATERIALS AND METHODS

Two field experiments were carried out at Sers Elliyan Field Crops Research Station at Minufiya Governorate (Middle Delta), Egypt during 2001-2002 and 2002-2003 seasons to study the effect of twelve treatments representing the combinations between four levels of nitrogen (30, 45, 60 and 75 Kg N/fed..) and three levels of potassium (25, 50 and 75 Kg K_2O/fed..) on growth characters, yield and quality of fodder beet Polyaurea variety.

Experimental design was split plot with four replicates. The main plots were randomly devoted to the three potassium levels and the sup-plots were for the four nitrogen levels. Calcium superphosphate fertilizer (15.5 % P_2O_5) at a rate of 150 Kg/fed.. was applied during soil preparation. Whereas, potassium levels were applied at two equal doses, the first dose during the land preparation and the second one a month later after thinning. While, nitrogen levels were applied at the two equal doses after thinning and a month later. Fertilization treatments were applied in a similar mannar during each of the two growing seasons.

The techniques adapted for soil physical and chemical analysis were done for particle size distribution and the soil chemical composition according to Piper, 1950 and Jackson, 1973, respectively.

Table (1): Physical and chemical analysis of the exprimental soil plots.

Parameters	First season 2001-2002	Second season 2002-2003
Physical properties:		
Coars sand %	01.80	01.65
Fine sand %	52.72	55.35
Silt %	27.50	30.00
Clay %	18.00	13.00
Textare class	Sandy loam	Sandy loam
Chemical analysis:		
pH	007.60	007.40
Ec mm/cm at 25 C	000.67	000.50
Available nutrient	001.60	001.13
N	031.50	033.70
pH	014.61	013.81
K	713.70	709.80
ESP	007.10	006.63

Fodder beet seeds at a rate of 3 Kg/fed.. were sown on October 28th and 1st November in the two successive seasons. The other cultural practices were done as recommended for growing fodder beet.

At harvesting, roots width (RW) and length (RL) by (cm) were recorded from five guarded plants, which randomly uprooted from each plot. Fresh forage yield in ton/fed. (tops, roots and total) was estimated by multiplying the fresh forage fodder by dry matter percentage.

Chemical analysis was determined on dry matter basis for leaves and roots. Each randomly selected sample was chopped into thin slices, then thoroughly mixed and 200-gram was oven dried at 70 C° up to constant weight. The dried sample was used to determine the crude protein (CP %) using the modified micro-Kjeldahl methods as described by Peach and Tracey (1956). Digestible protein (DP %) was estimated according to Bredon *et al*, (1963) where: DP % = 0.9596 CP - 3.55. Data were statistically analyzed according to the procedure of Snedecor and Cochran (1982). Means were compared using Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

I- Growth characters:

Data in Table (2) show the effect of nitrogen (N) and potassium (K) fertilization levels on the root lengths (RL) and root width (RW) of fodder beet cv. Polyaurea. Concerning nitrogen levels, data revealed that increasing nitrogen levels significantly increased roots length and width in the two growing seasons. In addition, increasing nitrogen fertilizer application from 30 to 75 Kg N/fed. resulted in increasing percentage of root width by 11 % and 10.99 % in the 1st and 2nd seasons, respectively, where increasing percentage of root length was 13.89 %

and 13.91 % in the subsequaent two seasons. These results are in accordance with those obtained by Abdel-Aal, (1990), Kamel *et al*, (1990) and Abd El-Gawad *et al*, (1997).

Data in Table (2) showed that root length and width were significantly affected by increasing potassium up to the highest used level (75 Kg K_2O/fed..) in the two growing seasons. These results are in agreement with those obtained by Stump *et al*, (1989), Abdel-Aal, (1990) and El-Shafei (1997).

The interaction between levels of nitrogen and potassium fertilizers levels was found to be insignificant for root length and width. This result was in agreement with those obtained by Abdel-Aal (1990).

Table (2): Growth parameters of fodder beet as affected by N and K fertilization levels in the two growing seasons.

K_2O_5 levels (Kg /fed)	Nitrogen levels (Kg/fed)	First season (2001/2002)		Second season (2002/2003)	
		RL	RW	RL	RW
25	30	40.98	42.69	34.83	35.01
	45	42.37	44.31	36.01	36.33
	60	44.35	45.68	37.7	37.64
	75	46.87	47.54	39.84	39.98
Mean		43.64 C	45.06 C	37.10 C	36.95 C
50	30	44.80	45.93	35.53	38.12
	45	46.33	47.83	39.84	39.20
	60	48.48	48.90	41.69	40..59
	75	50.94	50.89	43.81	42.24
Mean		47.64 B	49.24 B	40.97 B	40.04 B
75	30	49.00	49.33	41.85	41.44
	45	50.66	50.71	43.26	42.60
	60	53.03	52.54	45.29	44.13
	75	55.71	54.68	47.58	45.93
Mean		52.10 A	51.82 A	44.50 A	43.52 A
Over all K levels	30	44.93 c	45.98 c	38.40 c	38.19 c
	45	46.45 c	47.42 c	39.70 c	39.38 c
	60	48.62 b	49.04 b	41.56 b	40.73 b
	75	51.17 a	51.04 a	43.74 a	42.39 a
Interaction		N.S.	N.S.	N.S.	N.S.

II- Fresh forage yield (ton/fed..):

Data presented in Table (3) show that the application of nitrogen fertilizer revealed that increasing nitrogen levels produce significant increase in top, root and total fresh forage yield of fodder beet in the two seasons. In addition, increasing nitrogen fertilizer application from 30 to 75 Kg N/fed. increased percentage of total fresh yield by 34.02 and 33.91 % in the two growing seasons, respectively. The beneficial effect of nitrogen on fresh fodder yield may be due to the important role of nitrogen as an essential element in building up plant tissues. These results are in agreement with those obtained by Ramadan, (1988), Kamel *et al.* (1990) and Abd El-Gawad *et al.* (1997)

The application of potassium significantly increased the values of top, root and total fresh forage yield up to the highest level (75 Kg K_2O/fed..) in the two growing seasons as showed in Table (3). This positive effect of potassium on fodder beet may be due to the important role of potassium in the function of enzymes needed for vital processes and its beneficial effect in the translocation of carbohydrate to the storage organs of fodder beet (Roots). These results were similar to what was obtained by Stumpe *et al* (1989), Sobhy *et al.* (1992), Geweifel and Aly. (1996) and El-Shafei. (1997)

Table (3): Fresh forage yield of tops, roots and total yields of fodder beet as affected by nitrogen and potassium fertilization levels in the two growing seasons.

K_2O_5 levels (Kg /fed)	Nitrogen levels (Kg/fed)	First season (2001/2002)			Second season (2002/2003)		
		........................(ton / fed)........................					
		Tops	Root	Total	Tops	Root	Total
25	30	5.79	095.62 j	101.41	4.11	081.28	085.39
	45	6.77	105.72 I	112.49	4.81	089.86	094.67
	60	7.62	116.10 k	123.72	5.41	098.69	104.10
	75	8.42	127.49 g	135.91	5.98	108.37	114.35
Mean		**7.15 c**	**111.23c**	**118.35**	**5.08**	**94.55**	**99.63**
50	30	7.68	118.08 h	125.76	6.3	98.01	104.31
	45	8.98	130.57fg	139.55	7.37	108.37	115.73
	60	10.11	143.21 e	153.32	8.29	118.86	127.15
	75	11.17	156.97 c	168.14	9.16	130.29	139.45
Mean		**9.49 B**	**137.21 B**	**146.69**	**7.78**	**113.88**	**121.66**
75	30	9.98	134.51 f	144.49	8.38	107.61	115.99
	45	11.68	148.12 b	159.8	9.81	118.54	128.35
	60	13.15	162.86	176.01	11.05	130.24	141.34
	75	14.52	178.70 a	193.26	12.2	142.99	155.19
Mean		**12.33**	**156.10 A**	**168.43**	**10.36**	**124.86**	**135.22**
Over all K levels	30	7.82	116.97	123.89	6.36	95.63	101.89
	45	9.14	128.14	137.28	7.33	105.59	112.92
	60	10.29	140.72	151.01	8.25	115.95	124.4
	75	11.37	154.4	165.77	9.11	127.22	136.33
Interaction		**N.S.**	**sig ***	**sig ***	**N.S.**	**sig ***	**sig ***

The interaction effect between the levels of nitrogen and potassium fertilizers was found to be insignificant for top yield in the two growing seasons, indicating that each fertilizer act independently for its effect of top fresh yield of fodder beet. Whereas, there was significant interaction effect for N x P was noticed on root and total fresh yield in the two growing seasons (Table 3).

However, it could be noticed that total yield/fed.. reached its peak by the application of 75 Kg N/fed.. + 75 Kg K_2O/fed.. in the two growing seasons. Along the sameline Abdel-Aal in 1990 found that maximum root yield of fodder beet was produced by appling 90 Kg N/fed.. and 72 Kg K_2O/fed..

III- Dry forage yield (ton/fed.):

Data in Table (4) presented the effect of nitrogen and potassium levels and their interaction on dry yield of top, root and total yield of fodder beet in the two growing seasons.

Table (4): Dry forage yield of fodder beet as affected by N and K fertilization levels in the two successive seasons.

K_2O_5 levels (Kg /fed)	N levels (Kg/fed)	First season (2001/2002)			Second season (2002/2003)		
		........................(ton / fed)...............					
		Tops	Root	Total	Tops	Root	Total
25	30	0.75	10.08 I	10.83 I	0.53	08.63 h	09.16 j
	45	1.81	10.55 h	11.36 h	0.57	09.26 g	09.83 I
	60	0.81	12.75 g	13.56 g	0.58	10.92 f	11.52 h
	75	0.80	15.14 e	15.94 e	0.57	12.91 d	13.48 e
Mean		**0.79 C**	**12.13 C**	**12.92 C**	**0.56 C**	**10.43 C**	**10.99 C**
50	30	1.02	12.91 g	13.93 g	0.87	11.16 f	12.03 g
	45	1.11	13.45 f	14.95 f	0.95	11.73 e	12.68 e
	60	1.12	16.25 c	17.36 c	0.97	14.03 c	15.00 c
	75	1.11	19.41 b	20.53 b	0.97	16.70 b	17.67 b
Mean		**1.09 B**	**15.53 B**	**16.62 B**	**0.94 B**	**13.41 B**	**14.53 B**
75	30	1.31	12.20 e	16.51 d	1.15	13.15 d	14.30 d
	45	1.43	15.89 d	17.32 c	1.26	13.81 c	15.07 c
	60	1.43	19.05 b	20.49 b	1.29	16.44 b	17.73 b
	75	1.43	22.82 a	24.26 a	1.29	19.85 a	20.87 a
Mean		**1.40 A**	**18.24 A**	**19.64 A**	**1.25 A**	**15.74 A**	**16.99 A**
Over all K levels	30	1.03 a	12.37 d	13.40 d	0.85 a	10.98 d	11.83 d
	45	1.12 a	13.33 c	14.45 c	0.93 a	11.62 c	12.53 c
	60	1.12 a	16.02 b	17.14 b	0.95 a	13.80 b	14.75 b
	75	1.11 a	19.12 a	20.23 a	0.94 a	16.40 a	17.30 a
Interaction		**N.S.**	**sig ***	**sig ***	**N.S.**	**sig ***	**sig ***

Results indicated that increasing the level of nitrogen application from 30 up to 75 Kg N/fed.. was accompanied by a significant increase in total dry fodder beet yield. The total dry yield was increased from 13.40 to 20.23 and from 11.83 to 17.34 ton/fed.. as nitrogen level increased from 30 to 75 Kg N/fed.. in the first and the second seasons, respectively. These results are in harmony with those obtained by Geweifel and Aly (1996) and Abd El-Gawad *et al*, (1997)

Data in Table (4) revealed that dry top, root and total yields were significantly affected by the applied potassium fertilization levels. The optimum potassium level was 75 Kg K_2O/fed.. which produced total fodder yield of 19.64 and 16.99 (ton/fed..) with an increase of 52.01 and 54.60 % over the control (25

Kg K_2O/fed) in the first and second season respectively Such results could be attributed to the role of potassium in the important physiological process in plant such as carbohydrate metabolism and its translocation (Devlin and Witham, 1986) These results are proved what was obtained by Stumpe *et al.* (1989), El-Khawaga and Zeiton (1993) and El-Shafei (1997)

Mean values of top, root and total dry yield were not significantly affected by the interaction effect of nitrogen and potassium levels for top yield, while it was significantly affective for root and total yields (ton/fed) in the two seasons Nevertheless, it could be noticed that the total dry yield/fed reached its peak of 20.23 and 17.34 ton/fed by the application of 75 Kg N/fed + 75 Kg K_2O/fed in the first and the second seasons respectively These results confirmed what was results obtained by Stumpe *et al.* (1989) and Abdel-Aal (1990)

IV- Quality characteristics:

Results of crude protein and digestible protein percentages of fodder beet as affected by nitrogen and potassium levels in the tow growing seasons are presented in Table (5)

Applying N fertilizer level up to 75 Kg N/fed showed marked increase in crude protein content of roots, tops and their means by 13.59, 11.24 and 12.23 % compared with the lowest level of N (30 Kg N/fed) in the first season. Similar trend was also observed in the second season, and such result was in agreement with that was obtained by Kamel *et al.* (1990)

Data in Table (5) indicated that increasing K level from 25 to 75 Kg K_2O/fed increased root crude protein content from 9.93 to 11.80 % in the first season being 9.99 to 11.74 in the second season Also, crude protein content of top increased from 13.58 to 15.88 % and from 13.56 to 16.07 % in each of the two sucsessive seasons The corresponding increase in crude protein was 17.68 % and 18.93 %. These results are in accordance with those obtained by El-Khawaga and Zeiton, (1993), Geweifel and Aly (1996) and El- Shafei, (1997).

Increasing nitrogen levels from 30 to 75 Kg N/fed increased root, top and digestible protein content by 21.32, 15.19 and 17.57 % in the first season with a similar trend in the second season

Data in Table (5) indicated that the application of potassium increased digestible protein content up to 75 Kg K_2O/fed. Increased K level from 25 to 50 and 75 Kg K_2O/fed. showed a substantial marked increase in digestible protein by 17.46 and 7.16 % in the first season. Similar trend was noticed in the second season. Similar effect was previousley recorded in Egypt by Ali *et al.* (1984) and El-Shafei (1997).

The effect of N and K levels on digestible protein content was in paralled to crude protein content as shown in Table (5) This may due to their highly positive correlation as reported by Miaki, (1968) These results agree with those obtained by Kamel *et al.* (1990) and El-Shafei, (1997)

Table (5): Crude protein (CP) and digestible protein (DP) percentage of fodder beet as affected by nitrogen and potassium fertilization levels in the two growing seasons.

K_2O levels (Kg/fed)	N. levels (Kg/fed)	First season (2001/2002)						Second season (2002/2003)					
		CP (%)			DP (%)			CP (%)			DP (%)		
		Root	Tops	Mean	Root	Tops	Mean	Root	Tops	Mean	Root	Tops	Mean
25	30	9.37	12.83	11.10	5.44	8.76	7.10	9.32	12.76	11.04	5.39	8.69	7.04
	45	9.65	13.34	11.50	5.71	9.25	7.48	9.71	13.29	11.50	5.77	9.20	7.49
	60	10.09	13.87	11.98	6.13	9.76	7.95	10.21	13.91	12.06	6.25	9.80	8.03
	75	10.62	14.26	12.44	6.64	10.13	8.39	10.72	14.29	12.51	6.74	10.16	8.45
Mean		**9.93**	**13.58**	**11.76**	**5.98**	**9.48**	**7.73**	**9.99**	**13.56**	**11.78**	**6.04**	**9.46**	**7.75**
50	30	10.49	14.36	12.43	6.52	10.23	8.38	10.48	14.34	12.41	6.51	10.21	8.36
	45	10.81	14.94	12.88	6.82	10.79	8.81	10.91	14.93	12.92	6.92	10.78	8.85
	60	11.30	15.53	13.42	7.29	11.35	9.32	11.48	15.63	13.56	7.47	11.45	9.46
	75	11.89	15.97	13.93	7.86	11.77	9.81	12.05	16.06	14.06	8.01	11.86	9.94
Mean		**11.12**	**15.20**	**13.17**	**7.12**	**11.04**	**9.08**	**11.23**	**15.24**	**13.24**	**7.23**	**11.08**	**9.16**
75	30	11.03	15.00	13.02	7.03	10.84	8.94	10.95	15.57	13.26	6.96	11.39	9.18
	45	11.53	15.61	13.57	7.51	11.43	9.49	11.40	15.60	13.90	7.39	11.42	9.41
	60	12.05	16.22	14.14	8.01	12.01	10.01	12.00	16.33	14.17	7.97	12.12	10.05
	75	12.60	16.68	14.64	8.54	12.46	10.50	12.59	16.78	14.69	8.53	12.55	10.54
Mean		**11.80**	**15.88**	**13.84**	**7.77**	**11.69**	**9.73**	**11.74**	**16.07**	**14.01**	**7.71**	**11.87**	**9.79**
Over all K levels	30	10.30	14.06	12.18	6.33	9.94	8.14	10.25	14.22	12.24	6.29	10.10	8.19
	45	10.66	14.63	12.65	6.68	10.49	8.59	10.67	14.61	12.77	6.69	10.47	8.58
	60	11.15	15.21	13.18	7.14	11.04	9.09	11.23	15.29	13.26	7.23	11.12	9.18
	75	11.70	15.64	13.67	7.68	11.45	9.57	11.79	15.71	13.75	7.76	11.52	9.64
Interaction		**10.95**	**14.89**	**12.92**	**6.96**	**10.73**	**8.85**	**10.99**	**14.96**	**12.01**	**6.99**	**10.80**	**8.90**

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دراسات على التسميد الأزوتى والبوتاسى فى بنجر العلف

أحمد سيد أحمد عبد الشافى، عبد العزيز حسن فهمى، محمود محمد محمد طراد
قسم بحوث محاصيل العلف - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية

أجريت تلك الدراسة فى تجربتين أقيمتا بمحطة بحوث المحاصيل الحقلية بسرس الليان، مركز البحوث الزراعية، محافظة المنوفية. لدراسة تأثير أربع معدلات من التسميد الأزوتى وهى: ٣٠، ٤٥، ٦٠، ٧٥ كجم أزوت/فدان وكذا ثلاث مستويات من التسميد البوتاسى وهى: ٢٥، ٥٠، ٧٥ كجم بو٢أ/فدان، خلال موسمين متتاليين هما ٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣م على صفات النمو والمحصول وكذا جودة محصول بنجر العلف لصنف بولى ايريا. وكانت أهم النتائج المتحصل عليها كما يلى:

أدت زيادة معدلات التسميد الأزوتى إلى زيادة معنوية فى طول وقطر الجذر وكذا المحصول الأخضر والجاف، وزيادة محتوى البروتين الخام والمهضوم لبنجر العلف صنف بولى ايريا.

كما أدت زيادة مستويات التسميد البوتاسى إلى حدوث زيادة معنوية فى كـل من الصفات التالية: طول وقطر الجذر، المحصول الأخضر والجاف، محتوى البروتين الخام والمهضوم لبنجر العلف صنف بولى ايريا.

كما أوضحت النتائج وجود تأثير تفاعل معنوى بين التسميد الأزوتى والتسميد البوتاسى على كل من محصول الجذور والمحصول الكلى، بينما لم يكن التفاعل معنوياً للصفات التالية: طول وقطر الجذر، ومحصول العرش.

وتشير النتائج إلى أن التسميد بعنصرى الأزوت بمعدل ٧٥ كجم /الفـدان + ٧٥ كجم من البوتاسيوم أنتج أعلى محصول جاف كلى جذور وعرش من بنجر العلف والذى كان ٢٠,٢٣ ، ١٧,٣٠ طن/فدان لموسم الزراعة الأول والثانى على التوالى.