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The Influence of Slow Release Fertilizer on Bean Plants (*Phaseolus Vulgaris* L.) Grown in Sandy Soils

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Abstract: Bean plants (*Phaseolus vulgaris* L.) were grown under sandy soil conditions in the experimental station of the National Research Center in Nubaria region. The experiments aimed to investigate the effects of different levels of slow release fertilizer (Ensyabine: a slow release N fertilizer contains 40% of N) on vegetative growth, yield, quality of pods and physiological responses of snap bean plants. Five levels of Ensyabine were applied (30, 60, 90, 120 and 150 kg/Feddan). Several measurements were recorded to investigate the effects of these levels including vegetative growth measurements, yield, and pod quality, N, P and K contents of leaves and protein content of pods. The results indicated that increasing levels of slow release fertilizer significantly improved vegetative growth and yield of bean plants. The highest level of Ensyabine had significantly higher growth and yield compared to control plants that received the conventional nitrogen application of ammonium sulfate. Chemical analysis of leaves showed that the high levels of treatments significantly increased N content and protein content of pods. The low levels of Ensyabine had lower effects than the control treatment especially the levels: 30 and 60 Kg/Feddan. Further effects of the treatments on growth, yield and chemical analysis of leaves and pods are explained.

Key words: Snap bean, Slow release, Nitrogen, Fertilizer, Quality.

INTRODUCTION

Cultivation of snap bean plants (*Phaseolus vulgaris L.*) in Egypt is markedly important for local market and it has a great importance for exportation. However, supplying bean plants with nitrogen is essential to obtain high growth and yield especially under sandy soil conditions as sandy soils have poor fertility especially with the nitrogen. Moreover, rationalizing the amounts of N application has a great economical impact for the farmer to minimize the expenses of chemical fertilizers as well as an environmental impact as the excess of chemical fertilizers such as nitrogen fertilizers may pollute the underground water. Research on slow release fertilizers revealed that using such fertilizers increased application efficiency of fertilizer application. For example, Volterrani *et al.* (1999) indicated that the use of slow release nitrogen fertilizers made it possible to reduce nitrogen leaching. Also, Hegde (1997) used slow release fertilizers for some solanaceous vegetable crops and found that the use of slow release N fertilizers was very effective in increasing nutrient use efficiency, crop productivity and reducing nutrient losses. The use of slow release fertilizers especially N fertilizers has been tested for different vegetable crops including lettuce (Hartrath, 1986), potato (Prugar and Hadacova, 1996), tomato (Hegda, 1997; Montemurro, 2005), cabbage (Juang, 1987), artichoke (El-Fattah, *et al*., 1998) and zuccini (Martinetti and Paganini, 2006). Moreover, slow release N fertilizers were also used for some leguminous crops such as faba bean (El-Gindy *et al*., 2000), soy bean (Kaushal *et al*., 2006; Zhang *et al*., 2002; Mo *et al*., 1991). However, little is known about the effects of slow release N fertilizers on snap bean plants especially under new reclaimed lands (sandy soil) and also about the effects on pods quality. The present study aimed to explore the efficiency of slow release N fertilizer on growth, productivity and quality of pods of snap bean plants grown under sandy soil conditions.

MATERIALS AND METHODS

Snap bean (*Phaseolus vulgaris* L.) plants were cultivated under sandy soil conditions at the experimental station of the National Research Center in Nubaria region during two successive seasons 2007 and 2008. The chemical and physical properties of the soil are presented in Table (1). Seeds of snap bean cv. Bronco were

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sown in the second week of February at both seasons. Seeds were sown in hills 5-7 cm apart on two side ridges. Different levels of Ensyabine (a slow release N fertilizer produced under supervision of the Ministry of Agriculture in Egypt and this product contains 40% of N mainly as urea formaldehyde) were applied at the rates of 30, 60, 90, 120 and 150 kg/Feddan. Control plants were received the normal recommended nitrogen fertilizer (ammonium sulfate at the rate of 300 kg/Feddan=4200m^2). The amounts of Ensyabine were added one time during the preparation of the soil and mixed with it. The amounts of ammonium sulfate applied to control plants were divided and added at different intervals: during soil preparation, after 15 from the first application, during flowering and during fruit set.

The following measurements were recorded:

1- Plant growth and yield measurements: plant height, number of leaves, and plant fresh weight) were recorded 60 days after sowing. Total number and weight of pods were recorded as well as pod length and diameter.

2- Chemical measurements: including nitrogen and potassium contents of leaves (according to FAO, 1980), phosphorus content of leaves (according to Troug and Meyer, 1939) and protein content (according to Piper, 1947).

Table 1: Physical and chemical properties of the experimental soil.

Physical properties							
Sand		Clay	Silt	Texture		F.C. %	W.P. %
90.08		9.26	0.66	Sandy		16.57	5.25
Chemical analysis							
E.C. M/moh.	P.H.	Meq./L.					
		Ca	Mg	Na	K	HCO_3	Cl
1.7	8.2	7.02	0.527	0.982	0.31	1.3	0.566

Statistical Analysis:

The design of the experiments was established as complete randomized block design with 4 replicates. Analysis of variance was calculated according to Snedecor and Cochran (1967). Least significant difference (L.S.D.) at 5% was used to compare between means.

RESULTS AND DISCUSSION

Effects of Slow Release Fertilizer on Vegetative Growth, Yield and Pod Characters:

The effects of different levels of slow release N fertilizer (Ensyabine) on growth and yield of snap bean plants are shown in Table (2). Generally, The results revealed that increasing the level of slow release fertilizer resulted in an increase in vegetative growth characters including: plant height, number of leaves and fresh weight of plants especially at the highest level (150 kg/Feddan). The highest level of Ensyabine gave significantly higher growth and yield than control plants which received the conventional level of N as ammonium sulfate. The low levels of Ensyabine (30 and 60 kg/Feddan) gave the lowest growth. The trend was obvious concerning the yield and productivity of bean plants including number of pods, pods fresh weight, pod length and pod diameter. Slow release N fertilizer significantly increased these parameters and the effects were more obvious at the high levels (120 and 150 kg/Feddan) than the other levels of slow release fertilizer at both seasons. Although the level of 120 kg/Feddan of Ensyabine gave high growth and yield of bean plants, control plants still had higher yield than this level. The level of 150kg/Feddan of Ensyabine had the highest growth and yield compared to other treatments. Slow release N fertilizer (Ensyabine) regularly provided bean plants with N requirement at all stages of growth and development and that helped bean plants to obtain higher growth and yield than the conventional application of nitrogen. The application of Slow release N fertilizer such as Ensyabine provided an efficient way of supplying plants with nitrogen especially under sandy soil conditions which are characterized with poor fertility, low water holding capacity and easily leaching of nutrients from the soil. El-Gindy *et al*. (2000) found that using slow release fertilizers in new reclaimed soil (sandy soils) with modern irrigation methods increased water use efficiency by increasing crop production per unit of applied water and improved faba bean growth, mineral content and seed yield. Moreover, other investigators indicated that different crops responded positively to the application of slow release fertilizers including bean (Garcia, *et al*., 1999), tomato (Montemurro, 2005; Hegde, 1997), soybean (Kaushal *et al*., 2006; Mo *et al*., 1991), lettuce (Krieg, 1978), artichoke (El-Fattah, 1998) and Zuccini (Martinetti and Paganini, 2006).

Table 2: Effects of different levels of slow release fertilizer on growth, pods characters and yield of snap bean plants.

Treatment	Plant height (cm)	Number of leaves	Number of pods/plant	Pods fresh weight/plant	Pod length (cm)	Pod diameter (cm)	Plant fresh weight (g)
			1st season				
Ensyabine (30 kg/Feddan)	14.33 d	4.67 c	5.33 f	15.8 f	9.33 d	0.63 c	46 e
Ensyabine (60 kg/Feddan)	17.33 c	5 c	7.67 e	24.23 e	10 c	0.7 bc	70.06 d
Ensyabine (90 kg/Feddan)	20.67 b	6.33 b	10.33 d	33.17 d	10.67 b	0.73 b	74.67 d
Ensyabine (120 kg/Feddan)	22 a	6.67 b	12.65 c	55.93 c	11 b	0.77 b	93.86 c
Ensyabine (150 kg/Feddan)	23 a	8.00 a	16.67 a	74.2 a	13 a	0.87 a	107.33 a
Control	18.66 b	7.00 b	14.67 b	59.9 b	11.16 b	0.73 b	99.46 b
L.S.D. at 5%	2.45	0.73	1.45	3.83	0.63	0.09	5.00
			2nd season				
Ensyabine (30 kg/Feddan)	15.67 d	4.6 d	4.33 e	14.71 f	7.92 d	0.6 d	51.26 e
Ensyabine (60 kg/Feddan)	17 c	5.54 cd	7.33 d	27.5 e	9.67 c	0.64 d	75.93 d
Ensyabine (90 kg/Feddan)	19.5 b	6.1 c	9.67 c	30.84 d	10.96 b	0.76 c	80.06 d
Ensyabine (120 kg/Feddan)	20 b	6.21 c	11 c	37.2 c	11.25 b	0.84 b	92.6 c
Ensyabine (150 kg/Feddan)	24.13 a	10.33 a	17.67 a	68.46 a	12.67 a	0.9 a	112.13 a
Control	21.3 b	8.87 b	13.7 b	58.96 b	11.33 b	0.81 bc	102.6 b
L.S.D. at 5%	1.78	1.19	1.68	2.52	1.04	0.05	4.59

Effects of Slow Release Fertilizer on Chemical Analysis of Leaves and Protein Content of Pods:

Table (3) shows that increasing levels of slow release N fertilizer (Ensyabine) resulted in an increment of nitrogen content of leaves and also an increment of protein content of pods. The effects on P and K content of leaves were not significant at both seasons. The high level of Ensyabine (150 kg/Feddan) significantly increased the nitrogen content of leaves and protein content of pods, indicating that this level had positive effects on the quality and nutritional value of pods compared to control plants. It seems that the application of slow release N fertilizer can provide bean pants with its requirement of nitrogen all over the growing season which help improving protein content of pods and absorption of N from the soil as indicated by high nitrogen content of leaves. The improvement of vegetable quality in response to slow release fertilizer application was studied by other investigators such as Mo *et al*. (1991) who found that applying slow release urea increased soybean yield, amino acid content and chlorophyll content compared to ordinary urea. Also, Zhang *et al*. (2002) indicated that slow release fertilizers increased dry matter accumulation of soybean and stated that it can also increase the absorption of some nutrients. Moreover, both soybean growth and N accumulation increased by the application of slow release fertilizers (Kaushal *et al*., 2006). Hartrah (1986) found that slow release fertilizers prevented excessive NO_3 level in lettuce and leaching of N from the soil.

Table 3: Effects of different levels of slow release fertilizer on N, P, K contents of leaves and protein content of pods.

Treatment	N%	P%	K%	Protein %
		1st season		
Ensyabine (30 kg/Feddan)	2.14 e	0.27	2.30	13.53 f
Ensyabine (60 kg/Feddan)	2.54 d	0.29	2.30	14.64 e
Ensyabine (90 kg/Feddan)	3.12 b	0.26	2.31	17.76 d
Ensyabine (120 kg/Feddan)	2.75 c	0.26	2.32	18.14 c
Ensyabine (150 kg/Feddan)	3.36 a	0.28	2.33	18.93 a
Control	3.11 b	0.27	2.32	18.46 b
L.S.D. at 5%	0.021	N.S.	N.S.	0.034
		2nd season		
Ensyabine (30 kg/Feddan)	2.37 f	0.32	2.25	12.47 e
Ensyabine (60 kg/Feddan)	2.62 e	0.30	2.28	13.56 d
Ensyabine (90 kg/Feddan)	2.77 d	0.32	2.26	15.35 c
Ensyabine (120 kg/Feddan)	2.84 c	0.29	2.33	15.49 c
Ensyabine (150 kg/Feddan)	3.66 a	0.31	2.31	18.24 a
Control	3.17 b	0.33	2.29	16.36 b
L.S.D. at 5%	0.024	N.S.	N.S.	0.423

The present study suggests the possibility of using slow release N fertilizer such as Ensyabine to maximize growth, yield and quality of bean plants grown under new-reclaimed lands (sandy soils). This approach also provides an efficient way of applying nitrogen to such soils to increase the efficiency of N application and to minimize leaching as well as to prevent environmental pollution by the excess of nitrogen in the soil.

REFERENCES

El-Fattah, M.A.A., M.E. Sorial, M.A. El-Shal and A.A. Omer, 1998. Some attempts to change the production pattern of globe artichoke to meet the export requirements. 1. Effects of soil conditioner and slow release fertilizer application on growth, chemical composition, earliness, productivity and yield pattern of globe artichoke (*Cynara scolymus* L.). Annals of Agricultural Science, Moshtohor, 36(2): 777-799.

El-Gindy, A.M., M.H. Mahmoud and A.H. El-Guibali, 2000. Effect of irrigation methods, various fertilizer sources and rates on Faba bean plants and residual effect on subsequent corn. Annals of Agricultural Science Cairo, 1: 157-173.

FAO., 1980. Soils and Plant Analysis. Soils Bulletin, 38(2): 250.

Garcia, G.T, C. Piloto, R. Martinez, G.A. Lopez, A. Hernandez, M.I. Balbin Arias and P. Leon, 1999. Fertilization of *Phaseolus vulgaris* L. with oligomers from urea-furfual resin. Revista Chapingo Serie Ingenieria Agropecuaria, 2(1): 53-59.

Hartrath, H., 1986. Nitrogen should be released slowly. Gemuse, 22(8): 332-334.

Hegde, D.M., 1997. Nutrient requirements of solanaceous vegetable crops. Extension Bulletin ASPAC, Food and Fertilizer Technology Center, 441: 9.

Juang, T.C., 1987. Verticulture in vegetable production. FFTC/ASPAC Book Series, 36: 71-87.

Kaushal, T., M. Onda, S. Ito, A. Yamazaki, H. Fujikake, N. Ohtake, K. Sueyoshi, Y. Takahashi and T. Ohyama, 2006. Effect of deep placement of slow-release fertilizer (lime nitrogen) applied at different rates on growth, N2 fixation and yield of Soya bean (*Glycine max* [L.] Merr.). Journal of Agronomy and Crop Science, 192(6): 417-426.

Krieg, K.H., 1978. Supply of slow release fertilizers to vegetables under plastic. Gemuse, 14(2): 46-48.

Martinetti, L and F. Paganini, 2006. Effect of organic and mineral fertilization on yield and quality of zucchini. Acta Horticulturae, (700): 125-128.

Mo, H., X.C. Zhao and F.S. Wang, 1991. Effect of slow-release urea on increasing soyabean yield. Soybean Science, 10(4): 335-338.

Montemurro, F., 2005. Alternative N fertilization on crops typical of the south. Informatore Agrario, 61(10): 55-57.

Piper, C.S., 1947. Soil and plant analysis, 293:296. The Univ. of Adelaiada, Adelaiada.

Prugar, J. and V. Hadacova, 1996. The effect of form and technique of nitrogen fertilizer application on nitrate content in vegetables and potatoes. Zahradnictvi, 23(4): 141-149.

Snedecor, G.W. and W.G. Cochran, 1967. Statistical methods (6th Ed.) Iowa State Univ. Press, Ames, Iowa, USA.

Troug, E. and A.A. Meyer, 1939. Improvement in denigess, calorimetric method for phosphorus and arsenic. Indian Engineering Annual. Ed., 136-139.

Volterrani, M., M. Gaetani, N. Grossi, G. Pardini, S. Miele and S. Magni, 1999. The use of organic fertilizers on turf. Dynamics of nitrogen uptake and losses. Rivista di Agronomia, 33(1): 34-39.

Zhang, Q.Y., P. Zhao, X.B. Liu, J. Jin, G. Wang and M. Osaki, 2002. Effect of controlled release fertilizer on yield in soybean plant. Soybean Science, 21(3): 191-194.