Egypt J. Agron. **Vol. 27**, No. 1, pp. 51 - 57 (2005)

Yield and Chemical Composition of Fababean as Affected by Methods of K- Application in Newly Cultivated Soil

M.H.M. Afifi and Manal F. Mohamed
Field Crops Department, National Research Centre, Cairo, Egypt.

TWO FIELD experiments were carried out in newly cultivated sandy soil at Al-Nagah Village, Regions, Badre center, Behaira Governorate in two winter seasons of 2002/2003 and 2003/2004 to study the effect of K fertilization either soil or foliar application on the yield and its components and seed chemical composition of faba bean (Giza 461).

The main results were

1- Plant height, number of branches LAI and total plant dry matter of faba bean were significantly affected by the potassium treatments.
2- The largest increase was obtained from the combination of foliar + high soil K application.
3- The treatments of potassium significantly increased number of pods, seed yield/plant, 100 seed weight, biological yield kg/fed. seed yield kg/fed, N and K % and protein yield kg/fed. in seeds compared to untreated plants.

Keywords : Faba bean, Yield, Yield components, Chemical composition, K-Fertilization .

Faba bean (*Vicia faba* L.) has potential as a source of nutrition for Egyptian human feed, and as a N_2 – fixing legume can also play an essential role in enhancing soil fertility. Increasing faba bean production and improving its quality is a major target to meet the demand of the increasing Egyptian population since faba bean constitutes a major part of the diet of Egyptian people, especially in the diet of low income. It is a cheap source of protein, high caloric and nutritive value.

This could be achieved by using new cultivars as well as by improving cultural practices such as good fertilizer. Mineral nutrient deficiencies are major constraints limiting legume nitrogen fixation and yield. Potassium deficiency does not seem to affect directly N concentration in the leguminous plants, but it can seriously inhibit N_2 – fixation by reducing plant growth (Andrew, 1976). The highest K rate of (120 kg K_2O / ha) increased number of seeds / pod, 100 seed weight, seed yield / plant and seed yield / ha (Nowak *et al.*, 1996).

The soil of the South El –Tahrir sector is sandy in texture which have a very low water holding capacity and high nutrient leaching losses and very poor in available K content. The use of foliar fertilization with potassium K may offer the

opportunity of correcting these deficiencies more quickly and efficiently, especially when soil application of K may not be effective. Loue (1979) supported that foliar fertilization with K will be applied when soil physical condition are unsuitable or K soil content is very low and not enough to face the requirements of plants. The main objective of the present study was to determine the effect of low and high soil applied K and combination with foliar applied K on yield, yield components and chemical composition of faba bean seeds.

Material and Methods

Two field experiments were carried out at El-Nagah Village, South El-Tahrir Province, El-Behaira Governorate, Egypt during two successive winter seasons of 2002 / 2003 and 2003 / 2004 to study the response of faba bean (*Vicia faba* L.) plants (var. 461) to application methods levels of potassium fertilizer in newly reclaimed sandy soil. Sowing date was on the third week of November in both seasons. The soil of the experimental field was sandy in texture. The experimental design was a complete plot design with four replications. The plot size was ($12m^2$ = 1/350 fed.). It contained 3 ridges 60cm. apart. Three seeds were sown / hill at 10cm hills space, and then thinned to 2plants/hill. Each plot received 30 kg P_2O_5/fed. as single calcium super phosphate (15.5 % P_2O_5) before sowing and 30 kg nitrogen /fed. as ammonium nitrate (33.5 % N) as soil application 35 days after sowing (Table1).

TABLE 1. Analysis of the experimental soil according to the methods given by Jackson (1971).

Sand %	Silt %	Clay %	O.M. %	pH	Ec ds/cm	$CaCO_3$ %	Total N(ppm)	K mg/100g soil.
93.8	5.3	0.9	0.9	7.80	0.30	3.1	5.6	73

Six treatments of potassium were used:

1- Control (without soil or foliar application of K).
2- Low soil application of K*(48 kg K_2O / fed.).
3- High soil application of K (96 kg K_2O / fed.).
4- Foliar application of K ($4cm^3$/L. potassium solution 37.5% K).
5- Low soil application of K and foliar application with ($4cm^3$ /L. potassium solution 37.5% K).
6- High soil application of K and foliar application ($4cm^3$ /L. potassium solution37.5% K).

The soil treatments were applied 30 days after sowing, while the foliar treatments were applied twice at early flowering stage and pods development using 400 L of solution / fed.

Characters studied

Yield and its components

At harvest, random samples of ten guarded plants from each plot were taken to estimate the following characters:

1- plant height (cm) .
2- Number of branches / plant.
3-Dry weight / plant (g).
4- Number of pods / plant.
5- Seed yield / plant (g).
6- 100 seed weight (g).
7- Leaf area index (LAI).

Other plants from each experimental plot were harvested to determine:

9- Seed yield/ fed. (g).
10- Straw yield /fed. (g).
11- Harvest index (%).

Chemical analysis

The Nitrogen % in seeds was determined by using colorimetric method according to (Yeun & Follard, 1952). Protein yield / fed. Was calculated by multiplying N % × 6.25 × seed yield / fed.as mentioned by Tripathi *et al.* (1971) and potassium was determined as K % in seeds by using the flame photometric method.

The data of the two experiments were subjected to statistical analysis according to (Snedecor & Cochran, 1967). The combined analysis was conducted for the data of the two seasons according to Cochran & Cox (1968). The least significant difference (LSD) was used to compare the means.

Results and Discussion

Yield components

Table 2 shows that plant height, number of branches plant, LAI, total plant dry matter, seed yield / plant and 100- seed weight of faba bean were significantly affected by tested potassium treatments. High soil K application (96 kg K_2O / fed) surpassed the low soil K application (48 kg K_2O/fed.) by (14.6, 14.8, 31.5, 0.05 and 0.06 %) for plant height , number of branches / plant number of pods / plant, LAI and total plant dry weight, respectively. On the other hand, the largest increase was obtained from the combination of foliar + high soil K application (6). These results mean that K soil content is not fairly enough to face the requirements of faba bean. Krauss (2000), reported that this pivotal role K is irrespective to crop type and regions where the crop is cultivated.

The increase in the above mentioned characters due to the basal and foliar application of K might be its important role in photosynthesis and its possible role in plant metabolism involved activation of large group of enzymes. The increase in 100 seed weight especially, when plants were treated by combination of foliar + high soil K (6).

Ahmed & Zeidan (2001) in this concern found that combined soil K + foliar K gave the highest significant effect on dry matter of peanut plants. Bastawisy & Sorial

Characters studied

Yield and its components

At harvest, random samples of ten guarded plants from each plot were taken to estimate the following characters:

1- plant height (cm) .
2- Number of branches / plant.
3-Dry weight / plant (g).
4- Number of pods / plant.
5- Seed yield / plant (g).
6- 100 seed weight (g).
7- Leaf area index (LAI).

Other plants from each experimental plot were harvested to determine:

9- Seed yield/ fed. (g).
10- Straw yield /fed. (g).
11- Harvest index (%).

Chemical analysis

The Nitrogen % in seeds was determined by using colorimetric method according to (Yeun & Follard, 1952). Protein yield / fed. Was calculated by multiplying N % × 6.25 × seed yield / fed.as mentioned by Tripathi *et al.* (1971) and potassium was determined as K % in seeds by using the flame photometric method.

The data of the two experiments were subjected to statistical analysis according to (Snedecor & Cochran, 1967). The combined analysis was conducted for the data of the two seasons according to Cochran & Cox (1968). The least significant difference (LSD) was used to compare the means.

Results and Discussion

Yield components

Table 2 shows that plant height, number of branches plant, LAI, total plant dry matter, seed yield / plant and 100- seed weight of faba bean were significantly affected by tested potassium treatments. High soil K application (96 kg K_2O / fed) surpassed the low soil K application (48 kg K_2O/fed.) by (14.6, 14.8, 31.5, 0.05 and 0.06 %) for plant height , number of branches / plant number of pods / plant, LAI and total plant dry weight, respectively. On the other hand, the largest increase was obtained from the combination of foliar + high soil K application (6). These results mean that K soil content is not fairly enough to face the requirements of faba bean. Krauss (2000), reported that this pivotal role K is irrespective to crop type and regions where the crop is cultivated.

The increase in the above mentioned characters due to the basal and foliar application of K might be its important role in photosynthesis and its possible role in plant metabolism involved activation of large group of enzymes. The increase in 100 seed weight especially, when plants were treated by combination of foliar + high soil K (6).

Ahmed & Zeidan (2001) in this concern found that combined soil K + foliar K gave the highest significant effect on dry matter of peanut plants. Bastawisy & Sorial

(1998) indicated that the most vegetative characters of faba bean plants were significantly increased by spraying plants with KNO_3.Similar results were found by Jackson (1971); Garica & Hanway (1976) and Loue (1979).

TABLE 2. Effect of K- fertilization on yield components of faba bean (Average of two seasons).

Treatments	Plant height (cm)	Number of branches / plant	Number of pods/plant	Leaf area index (LAI)	Dry weight / plant (g)	Seed yield/plant (g)	100-seed weight (g)
1	62.0	2.63	12.5	1.60	23.6	18.9	58.3
2	70.5	2.70	14.6	1.90	26.7	26.1	61.5
3	80.8	3.10	19.2	2.00	28.4	28.3	62.7
4	66.5	2.70	13.2	1.95	25.8	25.4	61.9
5	82.8	3.30	22.8	2.30	30.5	30.9	65.9
6	87.5	3.60	26.7	2.40	33.5	32.3	66.5
LSD (5 %)	9.36	0.69	2.69	0.11	0.67	1.7	6.56

Six treatments of potassium were used:

1- Control (with out soil or foliar application of K).
2- Low soil application of K*(48 kg K_2O/fed.).
3- High soil application of K(96 kg K_2O/fed).
4- Foliar application of K (4cm^3/L. potassium solution 37.5% K).
5- Low soil application of K and foliar application with (4cm^3 /L. potassium solution 37.5% K).
6- High soil application of K and foliar application (4cm^3 /L. potassium solution 37.5% K).

Yield and chemical composition of seeds

Data presented in Table 3 showed that all K treatments significantly increased seed and straw yields / fed. (N and K%in the seed) and protein yield / fed. increased compared to the untreated plants. The foliar application and high soil application gave the highest increased due to the physiological fact that potassium is involved in plant metabolism as well as large number of enzymes that are activated by K. In this respect, Fawzi *et al.* (1983); Dahdouh (1999); Ahmed & Zeidan (2001) and Khalifa *et al.* (2002) found that K application caused a significant increase in straw yield in peanut over the control. The yield increase of faba bean through soil application or soil + foliar application may be due to:(i) the induction of nutrient absorption by root system, (ii) increase the plant internal

translocation capacity and hence (iii) the transport of nutrients essential to metabolism in active areas. Secer (1978) and Baier & Baierova (1999) showed that K increased the mobilization of protein stored in leaves and Stem. Walker *et al.* (1982) found that application of K improved the N % and helped in the translocation of N whatever was available to plant. Pettigrew & Meredith (1997) showed that potassium fertilization significantly increased the K concentration in all parts of cotton plant.

TABLE 3. Effect of K fertilization on yield and chemical composition of faba bean seeds (average of two seasons.).

Treatments	Seed yield (kg/fed.)	Straw yield (kg/fed.)	Harvest index %	Seeds N %	Seeds K %	Protein yield kg/fed.
1	770.0	780.0	0.50	2.70	1.43	130
2	1240.0	1365.0	0.48	3.80	2.53	295
3	1333.0	1399.0	0.49	3.92	2.60	327
4	1139.0	1177.0	0.49	3.50	1.90	249
5	1448.0	1467.0	0.50	4.16	2.85	376
6	1534.5	1700.0	0.47	4.90	3.50	470
L.S.D. (5%)	67.53	118.8	N.S.	0.21	0.99	124

Six treatments of potassium were used:

1- Control (with out soil or foliar application of K).
2- Low soil application of K*(48 kg K_2O / fed.).
3- High soil application of K (96 kg K_2O / fed).
4- Foliar application of K ($4cm^3$ /L. potassium solution 37.5% K).
5- Low soil application of K and foliar application with ($4cm^3$ /L. potassium solution 37.5% K).
6- High soil application of K and foliar application ($4cm^3$ /L. potassium solution 37.5% K).

References

Ahmed, M.K.A. and Zeidan, M.S. (2001) Yield and quality of two peanut cultivars (*Arachis hypogeal* L.) as affected by methods of potassium application. *Egypt. J. Appl. Sci.* **16** (7) , 114 .

Andrew, C.S. (1976) *"Nutritional Constraints on Legume – Symbiosis in Tropical Agriculture"* J.M.Vincent ; A.S.Whitley and J. Bose (Ed), pp. 253–274, Coll. Trop. Agric. Misc. Publ., 145,Univ. of Hawaii .

Baier, J. and Baierova, V. (1999) Influence of foliar fertilizers on nutrient uptake through root. *Proc. of the 2nd International Brown and Lillian Workshop on Foliar Fertilization*, April 4 – 10, pp. 123-128, Bangkok, Thailand.

Bastawisy, M.H. and Sorial Mervet, E. (1998) Physiological role of spraying some mineral nutrients on the growth, flowering abscission, endogenous auxin and yield of faba bean. *Zagazig J. Agric. Res.* **25** (2), 271.

Cochran, W.G. and Cox, G.M. (1968) *"Experimental Design"*, 2nd ed., John Wiley and Sons, Inc., New York, (1946), U.S.A.

Dahdouh, S.M.M. (1999) Effect of K-fertilization, spray of calcium chelate on peanut (*Arachis hypogeal* L.) in a newly reclaimed soil. *Zagazig J. Agric. Res.* **26** (2), 457.

Fawzi, A.F.A.; Firgany, A.H.; Rezk, A.L. and Kishk, M.A. (1983) Response of (*Vicia faba* L.) bean to K and micronutrient fertilizers. *Egypt. J. Bot.* **26** (1-3), 113.

Garcia, R. and Hanway, J.J. (1976) Foliar fertilization of soybean during the seed filling period. *Agron. J.* **68** , 653.

Jackson, M.L. (1971) *"Soil Chemical Analysis"*, pp.183-190, Prentice Hall Engle Wood Cliffs, N.J., USA.

Khalifa, K.I.; Shetata, A.M. and Soliman, M.S.M. (2002) Influence of phosphorus and potassium on growth and yield of maize. *Egypt. J. Appl. Sci.* **17** (7), 143.

Krauss, A. (2000) *Presented at the Regional IPI Workshop on Potassium and Phosphorus Fertilization Effect on Soil and Crops.* 23-24 October, 2000 Dotnuva-Akademija, Lithuania Potassium, integral part for sustained soil fertility.

Loue (1979) The interaction of potassium with other growth factors growth. *Proc. Int. Work Shop Role of K in Crop Production*, Cairo 20-22 Nov.

Nowak, G.A.; Weirzgowska, J. and Klasa, A. (1996) Effect of potassium fertilizer application on field bean yield and soil properties. *Acta – Academiae Agriculturae,* 63, 107.

Pettigrew, W.T. and Meredith, W.R. (1997) Dry matter production, fertilization. *J. Plant Nutri.* **20** (4-5), 531.

Secer, M. (1978) Effect of potassium on nitrogen metabolization and grain protein formation inspiring wheat. Kali-Briefe (Buntehof) YEUN nutrient uptake and growth of cotton as affected by potassium **14,** 386.

Snedecor, G.W. and Cochran, W.G. (1967) *"Statistical Methods"*, 6th ed., The Iowa State Univ., Press Iowa, U.S.A.

Tripathi, R.D.; Srivasttava,G.P.; Misra,M.S. and Pandey, S.C., (1971) Protein Content in some varieties of legumes. *The Allah Abad Farmer* **16**, 291.

Walker, M.E.; Gainer, T.P. and Joun, R.J. (1982) Foliar application of potassium effects on yield, quality, nutrient uptake and vegetative characteristics of flora Brown and Lillian under peanuts. *Peanut Sci.* **9,** 53.

Yeun,, S. and Follard, A.F. (1952) The determination of nitrogen in agricultural materials by Nessler reagent. *J. Sci. Food Agric.* 3, 442.

(*Received* 27/12/2004;
accepted 12/7/2005)

تأثيرطرق إضافة البوتاسيوم على المحصول والمكونات الكيميائية في الفول البلدي بالأراضي الجديدة

محمد حسن محمد عفيفي و منال فهمي محمد
قسم بحوث المحاصيل الحقلية – المركز القومى للبحوث –القاهرة– مصر.

أجريت تجربتان حقليتان فى أراضى رملية حديثة الاستزراع بقرية النجاح التابعة لمركز بدر محافظة البحيرة خلال موسمى الزراعة الشتوية ٢٠٠٢/٢٠٠٣،٢٠٠٣/٢٠٠٤ لدراسة تأثير التسميد البوتاسي بمعدلات مختلفة (٤٨، ٩٦ كجم بو٢ا/ فدان) وبطرق اضافة مختلفة (اضافة ارضية ، ورقية) وذلك على المحصول ومكوناته ومحتوى البذور من العناصر الغذائية فى الفول البلدى (صنف جيزة ٤٦١) فى الأراضى الحديثة الاستزراع .
ويمكن ان نلخص أهم النتائج المتحصل عليها كما يلى :--

١. أدت المعاملة بالبوتاسيوم سواء اضافة ارضية او ورقية إلى زيادة معنوية فى ارتفاع النبات وعدد الفروع/ نبات ودليل مساحة الأوراق والوزن الجاف الكلى / نبات مقارنة بالنباتات الغير معاملة .
٢. اعطت المعاملة بالرش + الإضافة الأرضية العالية للبوتاسيوم أفضل النتائج بالمقارنة بالإضافة الأرضية فقط .
٣. أعطت الاضافة العالية للبوتاسيوم فى التربة مع الرش الورقى زيادة معنوية واضحة فى عدد القرون / نبات ومحصول البذور والبروتين / فدان ومحتوى البذور من النيتروجين والبوتاسيوم بالمقارنة بالنباتات الغير معاملة .
٤. أظهر البحث وجود استجابة واضحة لإضافة عنصر البوتاسيوم للاراضى الحد بتة لوجود نقص ملحوظ فى مثل هذه الأرضى وينصح كذلك بالرش بنفس العنصر فى الفول البلدى .