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# Effect of feldspar as a K natural source on climbing snap bean yield under plastic house

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**Abstract**

Climate change impacts, sustainable food production and conserve the natural sources and energy create the drive forces to create new techniques in agricultural systems pay more consideration to the environmental.The study was conducted during two successive seasons 2012/2013 and 2013/2014 at Central Laboratory for Agriculture Climate plastic house (CLAC), Agriculture ResearchCenter (ARC), Dokki,Gizagovernorate, Egypt. The main objectives of the study were alternating the natural fertilizers instead of synthetic chemical fertilizers, maximize the yield production and qualitybeside conserve the environmental and energy. The investigation studied the effect of different three rates of feldspar fertilizer (100%, 125%, 150%) from recommended dose, twoforms of feldspar (granule and fine powder fertilizer)compared to standard potassium sulfate 100% combined withtwo cultivars (Alhamma and Moralida)in pots culture on productivity and podquality of climbing snap bean (*Phaseolus vulgarisL.*) in factorial experiment grown under unheated plastic house.

Vegetative growth (number of leaves, plant height, stem diameter and number of branches), chemical constituents of plant leaves (N, P and K), total yield per plantphysical quality of pods (pod diameter, pod length and pod weight), fibers (%) were recorded.

The obtained results indicated that increasing the rate of feldspar from 100 to 150 % had no positive effect on the yield. Otherwise, using bothK-Granulee feldspar and K-fine feldsparat 100%gave the highest total yield per plant.Snap bean *cv.*Moralida recorded higher total yield per plant (16% more) than *cv.* Al-Hamma under unheated plastic house. The use of natural feldspar was more efficient on different scales (environment, economic, energy and etc.) than K-chemical fertilizer to match sustainable production of snap bean under plastic house.

**Key words:** Snap bean, varieties, feldspar, K,plant growth, natural sources, yield and plastic house.

## Introduction

Organic farming has become increasingly popular in the world. This is mostly attributed to escalating consumer concerns over the impacts of pesticides and chemical fertilizers on human health as well as growing concerns over environmental pollution derived from modern agricultural practices, such as rising greenhouse gas emissions and water contaminations. Organic farming is considered a promising solution for reducing environmental burdens related to intensive agricultural management practices **(Nemecek *et al.*, 2011)** and is gaining interest worldwide due to its environmental benefits compared to conventional, intensive agriculture **(Sandhu *et al.*, 2010; Maeder *et al.*, 2002).**

Snap bean (*Phaseolus vulgaris L.*) is one of the most important pulses and fresh market crop in the world and it is also one of the most important legume crops in Egypt cultivated for local consumption as well as exportation especially during the period from December to May. However, it is highly sensitive to environmental conditions (climate, salinity, irrigation, fertilization etc…). It is an important source of proteins, calories, dietary fibers, minerals and vitamins for millions of people in both developing and developed countries worldwide. The acreage of snap bean in Egypt was 57873 fed. In 2012, and produced 251279 tons according to the Statistics of Ministry of Agriculture 2013.

The recent major problem facing the farmers is the high cost of chemical fertilizers. The alternative to depending on expensive imported fertilizers is to exploit indigenous resources such as K-bearing minerals. Making use of such minerals is meaningful in increasing crop yield and protecting ecological environment. The main source of K for plants growing under natural conditions comes from the weathering of K minerals (K feldspar, leucite, K-mica such as biotite, plogopite and glauconite and clays such as illite) and organic K-sources such as composts and plant residues. Potassium occurs in feldspars in very weathering resistant framework lattice positions **(Sanz-Scovino and Rowell, 1988).**

Potassium is one of the three essential elements viz., NPK, for the growth and reproduction of the plants and it plays many vital roles in its nutrition. The crop production in Egypt relies completely on imports to meets its annual requirement of potash fertilizers besides; the high cost of conventional, watersoluble K fertilizers constrains their use by most of the farmers in the country. In order to reduce the depended on imported potash, feldspar a potash mineral, contains 11.25 % $K_2$ O and therefore it could be a potential K-source for crop production **(Badr, 2006).**

Although the circulating water is certainly a major weathering agent, the possible role of the biochemical agents in the weathering ofrocks and minerals have received great interest, especially in soil environments **(Hinsinger *et al.,* 2001).**

Potassium is natural ore from Egypt mines;it's considered special ore, good quality, contain a group of useful micro elements for plant such as Zn - Bo – Fe- Cu and Mn.

This ore white in color and soft powder odorless, there are at potassium oxide formulation($K_2o$), with relative between 10 to 12% percentage and it's very important to plant according to its advantages as follows: accessed in flouring stability, increased fruit quality and quantity, helping to absorbing other nutrient elements, containing many important micro elements such as (Zn,Bo, Fe, Cu and Mn) as well as slow release to potassium element at long time that may increase the activity of this ore.

For sustainable agriculture production and mitigate GHG's emission need to support the use of natural sources of different nutrients. Has feldspar as a natural sources of K the ability to supply friendly environmental the K requirements of snap bean? Which rate? As well as the yield of different snap bean cultivars under unheated plastic house were create the main objectives of this study.

**Materials and Methods**

This experiment was conducted at Central Laboratory for Agricultural Climate (CLAC), Agriculture Research Centre, Dokki, Giza governorate, Egypt under plastic house conditions (9 x 20 x 3.5 m) during two successive seasons of 2012/2013 and 2013/2014.

**Plant materials:**

Seeds were obtained from SuezCanal Company for agricultural and commercial development. Two cultivarsAlhamma and Moralida were sown on 15th of Octoberin both cultivated seasons. Snap bean seeds were treated by Rhizobium inoculation (Microbin) to encourage both germination and microbial nodules. One seed was planted directly in each plastic pot.

**System materials:**

Plastic pots 8 L (25 cm diameter x 30 cm height) were used in open system of sand culture.Sand was primarily washed with diluted nitric acid to get rid from the undesirable salts, then with running tap water to wash nitric acid compounds from the sand. After sand was getting dry, it mixed with feldspar in different rates regarding to the treatments under the study and filled the pots in specific volume 8 L. Black polyethylene sheets were mulched the soil of unheated plastic house (9 x 60 x 3.5 m) before arranging the pots.

The pots were arranged in rows, the final plant spacing was 30 cm in the row, 60 cm between the rows and between the double rows was 70 cm.The chemical fertilizers were injected within irrigation drip system. Sub-miserable pump (110 watt) at water tank 120 L per each experimental plot was used to pump the fertigation via drippers 4 l/hr capacity. The fertigation was programmed to work 4 times / day and the duration of irrigation time depended upon the season. All the other agriculture practices of snap bean cultivation were in accordance with the standard recommendations for commercial growers by Agriculture Research center (ARC). Ministry of Agriculture, Egypt.

**The study treatments:**

The experiment was designed to study the effect of three factors on snap bean yield as follows:

1. Three rates of feldspar as a natural resource of K mixed with sand substrate calculated on the standard recommended of climbing snap bean program fertilization and the feldspar content of K as follows:
   a. 100 % of recommended = 53.6 g feldspar / plant (K-100%)
   b. 125 % of recommended = 67 g feldspar / plant (K-125%)
   c. 150 % of recommended = 80.4 g feldspar / plant (K-150%)
   d. The control(using potassium sulphate (50% $K_2O$) during plant growth periodaccording to the climbing snap bean program fertilization (80 units of $K_2O$ during season)
2. Two types of fertilizer forms:
   a. Granule feldspar
   b. Fine powder feldspar
3. Two cultivars of climbing snap bean
   a. Al-Hamma
   b. Moralida

**Table 1.** Chemical composition of feldspar.

| | | | | | |
|---|---|---|---|---|---|
| | **SiO2** | **TiO2** | **Al2O3** | **Fe2O3** | **MnO** |
| **Component %** | 68.23 | 0.04 | 16.25 | 0.40 | 0.02 |
| | **MgO** | **CaO** | **Na2O** | **K2O** | **P2O5** |
| | 0.03 | 0.47 | 3.25 | 10.12 | 0.02 |

**Measurements**

Number of leaves, plant height (cm), number of branches, stem diameter (mm), plant fresh and dry weight (g / plant) were determined after 120 days of sowing as vegetative growth characteristics of snap bean.

The quantity and quality of snap bean yield were estimated at the harvesting stages as total yield of green pods (g / plant), average pod weight (g), average pod length (cm), average pod diameter (mm) and fiber content (%)according to **A.O.A.C., (1990).**

For mineral analysis of leaves (N, P and K %) determinations toke place at the beginning ofblooming stage, Three samples of the snap bean leavesfrom each plot were dried at 70 ºC in an air forced oven for 48 h. Dried plants were digested in $H_2SO_4$ on a hot plate at approximately 270 ºC,The solution left to cool and diluted with redistilled water according to the method described by **Allen (1974).**N, P and K contents were determined in the acid digested solution by colorimetric method (ammonium molybdate) using spectrophotometer and flame photometer **Chapman and Pratt, (1961**). Total nitrogen was determined by Kjeldahl method according to the procedure described by **FAO (1980).** Phosphorus content was determined by using spectrophotometer according to **Watanabe and Olsen (1965).** Potassium content was determined photo-metrically using the Flame photometer as described by **Chapman and Pratt (1961)**.

**Statistical analysis:**

The treatments were arranged as a factorial experiment in randomized complete blocks designed with three replication.Analysis of the data was determined by computer, using SAS program for statistical analysis and the differences among means for all traits were tested for significance at 5 % levelaccording to the procedure described by**(Waller and Duncan 1969).**

**Results**

Data recorded in Table 2 show the effect of feldspar rates and forms on vegetative characteristics of snap bean cultivars (number of leaves, plant height,number of branches and plant fresh weight).

In both seasons, data showed that Alhamma gave the higher number of leaveswhileMoralida, recorded the higher values of plant height.

Concerning the effect of feldspar rates and forms, the differences among treatments were significant, the obtained results showed that the the control treatment gave the highest number of leaves, plant height and number of branches followed by using K-Granule at100%and 125% without significant differences between them,the lowest values were obtained by using K-Fine at 125% the same trend was similar for the the second season.

The interaction between cultivars, feldspar rates and the forms as presented in Table 2 showed that cv. Alhamma combined with both the control andK-Granulee100% as well as cv.Moralida combined with K-Granulee125% gave the highest number of leaves, plant height and number ofbranches,the lowest results illustrated by cv. Moralida combined with K-Fine 125%.Significant differences between treatments were true during both seasons.

**Table 2.** Effect of cultivars, feldspar rates and forms on number of leaves, plant heightand number of branches.

| | First season 2012/2013 | | | The second season 2013/2014 | | |
|---|---|---|---|---|---|---|
| Treatments | Alhamma | Moralida | Means | Alhamma | Moralida | Means |
| Number of leaves | | | | | | |
| K-Granule 100% | 184.6 ab | 166.6 c | 175.6 B | 195.7 a | 178.9 cd | 187.4 B |
| K-Fine 100% | 174.0 bc | 153.6 d | 163.8 D | 184.4 bc | 162.8 e | 173.7 E |
| K-Granule 125% | 156.6 d | 189.3 a | 173.0 BC | 168.4 e | 200.7 a | 184.5 BC |
| K-Fine 125% | 154.3 d | 145.6 e | 150.0 E | 163.6 e | 154.4 f | 159.0 F |
| K-Granule 150% | 177.6 b | 157.6 d | 167.6 CD | 188.3 b | 167.1 e | 177.7 DE |
| K-Fine 150% | 173.6 bc | 166.3 c | 170.0 BC | 184.1 bc | 176.3 d | 180.2 CD |
| The control | 188.6 a | 191.0 a | 189.8 A | 199.9 a | 202.5 a | 201.2 A |
| **Means** | 172.8 A | 167.2 B | | 183.5 A | 177.6 B | |
| plant height (cm) | | | | | | |
| K-Granule 100% | 2.85 bce | 3.09 b | 2.97 B | 3.17 bc | 3.42 b | 3.29 B |
| K-Fine 100% | 2.84 bce | 2.75 bce | 2.79 B | 3.04 bcd | 2.94 cd | 2.99 C |
| K-Granule 125% | 2.88 bce | 3.86 a | 3.37 A | 3.08 bcd | 4.13 a | 3.61 A |
| K-Fine 125% | 2.78 bce | 2.86 bce | 2.82 B | 2.97 cd | 3.06 bcd | 3.02 BC |
| K-Granule 150% | 2.55 e | 2.93 bc | 2.74 B | 2.73 d | 3.13 bc | 2.94 C |
| K-Fine 150% | 2.88 bce | 2.63 ce | 2.76 B | 3.08 bcd | 2.81 cd | 2.95 C |
| The control | 2.98 bc | 3.69 a | 3.34 A | 3.19 bc | 3.94 a | 3.57 A |
| Means | 2.83 B | 3.12 A | | 3.04 B | 3.35 A | |
| Number of branches | | | | | | |
| K-Granule 100% | 5.00 a | 4.00 ab | 4.50 AB | 5.30 a | 4.24 bcde | 4.77 B |
| K-Fine 100% | 4.00 ab | 4.33 ab | 4.16 AB | 4.24 bcde | 4.59 abc | 4.42 ABC |
| K-Granule 125% | 4.66 ab | 4.66 ab | 4.66 AB | 4.64 abc | 4.95 ab | 4.79 AB |
| K-Fine 125% | 4.00 ab | 4.33 ab | 4.16 AB | 4.05 bcde | 4.47 abcd | 4.26 BC |
| K-Granule 150% | 4.33 ab | 4.66 ab | 4.00AB | 4.59 abc | 3.69 de | 4.14 BC |
| K-Fine 150% | 4.00 ab | 4.51 b | 3.83 B | 3.99 cde | 3.50 e | 3.75 C |
| The control | 5.00 a | 4.66 ab | 4.83 A | 5.29 a | 4.95 ab | 5.12 A |
| Means | 4.42 A | 4.19 A | | 4.59 A | 4.34 A | |

Regarding to stem diameter, plant fresh weight and dry weight, no significant differences were observed between both cultivars in both two seasons.

Data recorded in Table 3 indicated that feldspar rates and forms had a positive significant effect on stem diameter, fresh weight and dry weigh. K-Granule 100% and the the control treatment recorded the highest results of stem diameter followed by the other treatments without significant differences between them; the same trend was similar for the the second season. The K-Granule 100%, K-Granule 125% and the the control gave the highest results of fresh weight. Otherwise, the lowest result observed by K-Fine 100%, K-Fine 125%,K-Granule 150% and K-Fine 150%, similar trends were obtained for the the second season. Concerning the dry weight data showed that using K-Fine 100% gave the highest values followed by the other treatments without significant differences between them, the same trend was similar for the the second season.

In both two seasons regarding the interaction effect between cultivars, fertilizer rates and fertilizer forms on stem diameter, fresh weight and dry weight. The highest results of stem diameter were noticed with using K- Granule100%, K-Granule125% andthe control with both cultivars. The lowest results obtained with K-Granule 150%, K-Fine 150% and K-Fine 125% with cv. Moralida. The same trend was observed in the second experimental season.

**Table 3.** Effect of feldspar rates, forms and cultivars on stem diameter,fresh weightanddry weight.

| Treatments | First season 2012/2013 Alhamma | Moralida | Means | The second season 2013/2014 Alhamma | Moralida | Means |
|---|---|---|---|---|---|---|
| | | | Stem diameter (cm) | | | |
| K-Granule 100% | 1.43 ab | 1.33 abc | 1.38 A | 1.44 a | 1.41 ab | 1.43 A |
| K-Fine 100% | 1.03 de | 1.06 de | 1.05 B | 1.09 cde | 1.04 cde | 1.07 BC |
| K-Granule 125% | 1.16 cd | 1.23 bcd | 1.20 B | 1.18 cd | 1.23 bc | 1.21 B |
| K-Fine 125% | 1.03 de | 1.06 de | 1.05 B | 0.97 e | 1.02 de | 0.99 C |
| K-Granule 150% | 1.16 cd | 1.06 de | 1.12 B | 1.17 bc | 1.13 cde | 1.15 B |
| K-Fine 150% | 1.16 cd | 0.90 e | 1.03 B | 1.24 cd | 0.95 e | 1.09 BC |
| The control | 1.46 a | 1.33 abc | 1.40 A | 1.55 a | 1.41 ab | 1.48 A |
| Means | 1.21 A | 1.14 A | | 1.24 A | 1.17 A | |
| | | | Fresh Weight (g) | | | |
| K-Granule 100% | 889.0 a | 759.0 bcd | 824.0 AB | 847.6 a | 805.5 bcd | 876.1 A |
| K-Fine 100% | 719.3 def | 757.6 bce | 738.5 BC | 762.5 de | 786.5 cd | 774.5 B |
| K-Granule 125% | 857.3 abc | 896.3 a | 876.8 A | 902.1 abc | 950.1 a | 926.1 A |
| K-Fine 125% | 714.3 def | 741.6 cdef | 728.0 C | 773.9 d | 786.2 cd | 780.0 B |
| K-Granule 150% | 736.3 cdf | 636.0 ef | 686.2 C | 780.5 d | 690.8 de | 735.7 B |
| K-Fine 150% | 716.0 def | 620.0 f | 668.0 C | 758.9 de | 643.9 e | 701.4 B |
| The control | 866.3 ab | 835.6 abcd | 851.0 A | 918.3 ab | 885.8 abcd | 902.1 A |
| Means | 785.5 A | 749.5 A | | 834.5 A | 792.5 A | |
| | | | Dry Weight (g) | | | |
| K-Granule 100% | 220.0 a | 200.3 a | 210.2 A | 235.4 a | 214.4 ab | 224.9 A |
| K-Fine 100% | 165.3 b | 177.0 ab | 171.2 B | 176.9 c | 189.4 bc | 183.1 B |
| K-Granule 125% | 180.6 ab | 170.0 b | 175.3 B | 195.5 bc | 199.2 bc | 197.3 B |
| K-Fine 125% | 171.6 ab | 188.0 ab | 179.8 B | 183.7 c | 201.2 bc | 192.4 B |
| K-Granule 150% | 172.0 ab | 186.6 ab | 179.3 B | 184.0 c | 199.7 bc | 191.9 B |
| K-Fine 150% | 170.7 ab | 178.6 ab | 174.7 B | 182.7 c | 191.2 bc | 186.9 B |
| The control | 185.0 ab | 188.3 ab | 186.6 B | 197.9 bc | 201.5 bc | 199.7 B |
| Means | 180.7 A | 184.1 A | | 193.7 A | 199.5 A | |

The obtained data in Table 4 presented the effect of cultivars, fertilizer rates and fertilizer forms ontotal yield per plant, pod length, pod diameter and pod weight.

Regarding the effect of the cultivars on total yield per plant data showed that cv. Moralida gave the highest total yield per plant than cv. Alhamma. According to pod length data said that no significant differences were observed between both cultivars. Otherwise regarding the pod diameter and pod weight cv. Alhamma gave the higher values than cv.Moralida.The same trend was similar inthe second experimental season.

Concerning the effect of fertilizer rates and fertilizer forms on total yield per plantdata indicated that there weren'tsignificant differences were observed between all treatments in both two seasons.Regarding to pod length and pod diameter results showed that using K-Granule 100%, K-Granule 125% and the The control gave the highest values, although using K-Fine 150% and K-Fine 125% gave the lowest results. The results indicated that using K-Granule 100% gave the highest values related to pod weight followed by all others treatments without significant differences between them. The same trend was observed in the second experimental season.

As for the interaction effect between cultivars, fertilizer rates and fertilizer forms data showed that using K-Granule 100%, K-Fine 100% and the the control with both cultivars gave the highest values regarding to total yield per plant, the lowest results were obtained with K-Fine 150% with both cultivars. The same trend was similar in the second experimental season. Concerning to pod length K-Granule 100% with both cultivars gave the highest results. On the other hand using K-Fine 125%, K-Fine 150% and the control with both cultivars gave the lowest results. The same trend was noticed in the second experimental season. Using K-Granule 100%, K-Fine 100% and the control with cv.Alhamma increased pod diameter although all treatments with cv.Moralida gave the lowest results. The same trend was observed in the the second experimental season. Regarding to pod weight data showed that using K-Granule 100% with cv.Alhamma gave the highest weight, the lowest weight obtained byusing K-Fine 150% with both cultivars. The same trend was observed in the second season.

**Table 4.** Effect of feldspar rates, forms and cultivars on total yield per plant, pod length, pod diameter and pod weight.

| | First season 2012/2013 | | | The second season 2013/2014 | | |
|---|---|---|---|---|---|---|
| **Treatments** | **Alhamma** | **Moralida** | **Means** | **Alhamma** | **Moralida** | **Means** |
| | | | Total yield (g/plant) | | | |
| K-Granule 100% | 1141 ab | 1183 a | 1161 A | 1184 bc | 1254 a | 1218 A |
| K-Fine 100% | 1066 bc | 1175 a | 1120 A | 1130 cd | 1236 ab | 1183 A |
| K-Granule 125% | 905 f | 1053 cd | 978 C | 959 fg | 1116 de | 1037 C |
| K-Fine 125% | 855 f | 1076 bc | 965 C | 906 g | 1141 cd | 1023 C |
| K-Granule 150% | 851 f | 1099 bc | 974 C | 909 fg | 1145 cd | 1026 C |
| K-Fine 150% | 772 g | 920 ef | 946 D | 819 h | 976 f | 997 D |
| The control | 991 de | 1119 abc | 1054 B | 1050 e | 1186 bc | 1117 B |
| Means | 940 B | 1089 A | | 993 B | 1150 A | |
| | | | Average pod length (cm) | | | |
| K-Granule 100% | 15.7 a | 15.5 ab | 15.6 A | 16.1 a | 15.9 ab | 16.0 A |
| K-Fine 100% | 15.2 c | 15.4 bc | 15.3 BC | 15.6 c | 15.9 ab | 15.8 BCD |
| K-Granule 125% | 15.4 bc | 15.6 ab | 15.5 AB | 15.8 abc | 16.0 a | 15.9 AB |
| K-Fine 125% | 15.2 c | 15.2 c | 15.2 C | 15.7 bc | 15.7 bc | 15.7 CD |
| K-Granule 150% | 15.6 ab | 15.2 c | 15.4 ABC | 16.1 a | 15.6 c | 15.9 AB |
| K-Fine 150% | 15.3 bc | 15.2 c | 15.2 C | 15.7 bc | 15.6 c | 15.6 D |
| The control | 15.4 bc | 15.4 bc | 15.4 ABC | 15.9 ab | 15.9 ab | 15.9 ABC |
| Means | 15.4 A | 15.3 A | | 15.8 A | 15.8 A | |
| | | | Average pod diameter (cm) | | | |
| K-Granule 100% | 0.836 a | 0.670 e | 0.753 A | 0.89 a | 0.72 e | 0.81 A |
| K-Fine 100% | 0.760 ab | 0.660 e | 0.710 BC | 0.81 ab | 0.71 e | 0.76 BC |
| K-Granule 125% | 0.750 bc | 0.686 e | 0.718 ABC | 0.80 bc | 0.73 e | 0.76 BC |
| K-Fine 125% | 0.746 bcd | 0.683 e | 0.715 BC | 0.79 bcd | 0.73 e | 0.76 BC |
| K-Granule 150% | 0.740 de | 0.683 e | 0.712 BC | 0.75 de | 0.73 e | 0.76 BC |
| K-Fine 150% | 0.700 de | 0.673 e | 0.686 C | 0.75 de | 0.72 e | 0.73 C |
| The control | 0.793 ab | 0.666 e | 0.730 AB | 0.85 ab | 0.71 e | 0.78 AB |
| Means | 0.761 A | 0.674 B | | 0.81 A | 0.72 B | |
| | | | Average pod weight (g) | | | |
| K-Granule 100% | 10.6 a | 8.4 ef | 9.5 A | 11.3 a | 8.9 e | 10.1 A |
| K-Fine 100% | 9.2 b | 8.6 cdef | 8.9 B | 9.8 b | 9.2 cd | 9.5 B |
| K-Granule 125% | 9.2 b | 9.0 bcd | 9.1 B | 9.8 b | 9.6 bcd | 9.7 B |
| K-Fine 125% | 9.1 bc | 8.5 def | 8.8 B | 9.7 bc | 9.0 d | 9.4 B |
| K-Granule 150% | 8.8 bcde | 8.8 bcde | 8.8 B | 9.4 bcd | 9.4 bcd | 9.4 B |
| K-Fine 150% | 8.2 f | 8.5 def | 8.3 C | 8.7 e | 9.1 d | 8.9 C |
| The control | 9.1 bc | 9.0 bcd | 9.0 B | 9.7 bc | 9.6 bcd | 9.6 B |
| Means | 9.2 A | 8.7 B | | 9.8 A | 9.3 B | |

The results in Table 5 illustrate the effect of cultivars, fertilizer rates and fertilizer forms on nitrogen, phosphorus, potassium and fibers.

Concerning the effect of the cultivars on nitrogen, phosphorus, potassium and fibers, data show that the highest N contents of snap beans leaves recorded by cv. Alhamma while cv. Moralida gave the lowest N content. Meanwhile, it was lucid, that phosphorus, potassium and fibers didn't show significant differences between both cultivars. In the second season it gave the same result.

Regarding the effect of fertilizer rates and fertilizer forms on nitrogen, phosphorus, potassium and fibers, it was obvious that using K-Granule 100% significantly increased N content in leaves, while using K-Fine 100%, K-Granule 125% and the control gave the lowest N content. Moreover it was noteworthy that using K-Granule100%, K-Fine 100%and the control gave the highest P content in leaves, meanwhile the lowest P content was observed with the others treatments. On the other, hand using K-Granule 100%, K-Granule 125% and the control significantly increased K content in leaves but using K-Granule 150% and K-Fine 150% gave the lowest K content. Concerning to fiber percentage data indicate that all treatments increased fiber except K-Granule 100% and K-Fine 150%.In the second season it gave the same result.

From data in Table 5 it's possibly discerned that, all fertilizer rates and forms with cv.Alhamma and the control increased N content. Meanwhile, the lowest N content was observed with K-Fine 100%, K-Granule 125%, K-Fine 125% and K-Fine 150% with cv. Moralida. In the the second season it gave the same result. According to P content, it was clear that using K-Granule 100%, K-Fine 100%, the controlwith cv.Alhamma, K-Fine 100% and the control with cv.Moralidagave the highest P content in leaves, while the lowest P content was observed with the others treatments. On the other hand using K-Granule 100% with cv.Alhamma,K-Fine 125% and K-Fine 125% with cv. Moralida.

As regards effect of fertilizer rates, forms and cultivars on K content in leaves, it's clear that using K-Fine 150% with both cultivars gave the lowest K content in leaves. Concerning to fiber percentage data indicate that K-Granule 125%, K-Fine 125%, the control with cv.Alhamma, K-Fine 100%, K-Fine 125%, K-Granule 150% and the control with cv. Moralida gave the highest fiber percentage in pods. Meanwhile, the lowest fiber percentage was observed with the others treatments. In the the second season it gave the same result.

**Table 5.**Effect of feldspar rates, forms and cultivars on nitrogen, phosphorus, potassium and fibers percentages.

| | First season 2012/2013 | | | The second season 2013/2014 | | |
|---|---|---|---|---|---|---|
| Treatments | Alhamma | Moralida | Means | Alhamma | Moralida | Means |
| | | | N (%) | | | |
| K-Granule 100% | 2.80 a | 2.77 abc | 2.78 A | 2.82 a | 2.79 abc | 2.80 A |
| K-Fine 100% | 2.80 a | 2.67 d | 2.73 B | 2.82 a | 2.69 d | 2.76 B |
| K-Granule 125% | 2.79 ab | 2.67 d | 2.73 B | 2.81 ab | 2.69 d | 2.76 B |
| K-Fine 125% | 2.79 ab | 2.72 cd | 2.75 AB | 2.80 ab | 2.74 cd | 2.78 AB |
| K-Granule 150% | 2.77 abc | 2.73 bc | 2.75 AB | 2.79 abc | 2.76 bc | 2.78AB |
| K-Fine 150% | 2.77 abc | 2.73 bcd | 2.75 AB | 2.79 abc | 2.75 bc | 2.77 AB |
| The control | 2.74 abc | 2.73 bcd | 2.73 B | 2.76 bc | 2.75 bc | 2.75 B |
| Means | 2.78 A | 2.72 B | | 2.80 A | 2.74 B | |
| | | | P (%) | | | |
| K-Granule 100% | 0.53 a | 0.50 bce | 0.52 A | 0.53 a | 0.50 bce | 0.52 A |
| K-Fine 100% | 0.51 abc | 0.51 abc | 0.51 A | 0.51 abc | 0.51 abc | 0.51 A |
| K-Granule 125% | 0.49 cef | 0.48 efg | 0.48 B | 0.49 cef | 0.48 efg | 0.49 B |
| K-Fine 125% | 0.49 cef | 0.48 efg | 0.48 B | 0.49 cef | 0.48 efg | 0.49 B |
| K-Granule 150% | 0.47 fg | 0.48 efg | 0.48 B | 0.48 fg | 0.48 efg | 0.48 B |
| K-Fine 150% | 0.46 g | 0.49 cef | 0.47 B | 0.46 g | 0.49 cef | 0.48 B |
| The control | 0.51 abc | 0.52 ab | 0.52 A | 0.51 abc | 0.52 ab | 0.52 A |
| Means | 0.49 A | 0.49 A | | 0.50 A | 0.50 A | |
| | | | K(%) | | | |
| K-Granule 100% | 2.70 ab | 2.55 d | 2.63 AB | 2.73 ab | 2.57 d | 2.65 AB |
| K-Fine 100% | 2.68 b | 2.50 f | 2.59 C | 2.70 b | 2.53 f | 2.61 C |
| K-Granule 125% | 2.54 de | 2.71 a | 2.62 AB | 2.56 de | 2.73 a | 2.65 AB |
| K-Fine 125% | 2.53 def | 2.70 ab | 2.61 B | 2.55 def | 2.72 ab | 2.64 B |
| K-Granule 150% | 2.55 d | 2.51 ef | 2.53 D | 2.57 d | 2.53 ef | 2.55 D |
| K-Fine 150% | 2.50 f | 2.54 de | 2.52 D | 2.53 f | 2.56 de | 2.54 D |
| The control | 2.64 c | 2.64 c | 2.64 A | 2.66 c | 2.66 c | 2.66 A |
| Means | 2.59 A | 2.59 A | | 2.61 A | 2.62 A | |
| | | | Fiber(%) | | | |
| K-Granule 100% | 8.92 e | 8.92 e | 8.92 B | 8.97 e | 8.97 e | 8.97 B |
| K-Fine 100% | 9.01 bcde | 9.21 abc | 9.11 A | 9.07 bcde | 9.27 abc | 9.17 A |
| K-Granule 125% | 9.13 abcd | 8.98 de | 9.05 AB | 9.19abcd | 9.03 de | 9.11 AB |
| K-Fine 125% | 9.24 a | 9.15 abcd | 9.19 A | 9.29 a | 9.20 abcd | 9.25 A |

| | | | | | | |
|---|---|---|---|---|---|---|
| K-Granule 150% | 9.00 cde | 9.22 ab | 9.11 A | 9.06 cde | 9.28 ab | 9.17 A |
| K-Fine 150% | 9.15 abcd | 9.30 a | 9.22 B | 9.20 abcd | 9.35 a | 9.28 B |
| The control | 9.25 a | 9.17 abcd | 9.21 A | 9.30 a | 9.22 abcd | 9.26 A |
| Means | 9.10 A | 9.13 A | | 9.16 A | 9.19 A | |

**Discussion**

The main source of K is sulphate form in Egypt, the need to investigate natural resources such K-bearing minerals to avoid the adverse effect of potassium sulphate on environment and to conserve energy through manufactureas well as mitigate the greenhouse gases(GHG's) and maximize the crop yield. **Xiao *et al.*, 2016** mentioned that the available potassium content was increased when K-feldspar was added into the soil. It is found to be an attemptable way of accelerating $CO_2$ fixation and improving the potassium content of soil.

The use of feldspar as a source of K instead of K sulphate form gave another advantage as slow release fertilizer. Slow release fertilizer can be more efficient source of nutrients than conventional fertilizers. However, slow release fertilizers contain one or more essential elements. These elements are released or made available to the plant over an extended period. The obtained results are concordant with those found by **Arora *et al.* (1991); Awad *et al.* (1993); Kuntala *et al.* (1996); Fatma Rizk (2002) and Fatma Rizk*et al.* (2002)**.

The obtained results proved that K-bearing mineral such feldspar could be substitute the potassium sulphate fertilizerin cultivating snap bean under plastic house condition. . The use of both forms of feldspar granular and fine gave the same effect. Increasing the rate of feldspar from 100% up to 150% of recommended doseled to decrease the snap bean yield, it could be explained by increasing the salinity, the other company element such as Na and Al that have negative impact on snap bean yield. Feldspar at 100 % satisfy snap bean nutrient requirement of K. The application of this element at adequate rate not only increases the yield, but also tends to stimulate its quality characters (**Aisha *et al.*, 2008**).

Increasing the rate of feldspar led to decrease the total N and P of snap bean leaves contents regarding to the antagonism impact among the nutrients.

For economic reasons, the approach of using feldspar as K-source instead of chemical fertilizers will be very beneficial for both the farmers as well as the national authorities who subsidize the high costs of chemical. The price of potassium sulfate is about 7000 LE /ton while K- feldspar rock about 600 to 800 LE/ton. It is well known that the excessive applications of chemical fertilizers have hazardous impact on environmental conditions since considerable proportions are usually lost through drainage which results in pollution of water channels (**Labib *et al.*, 2012**).

**Conclusion**

Under the need to conserve the natural resources, energy, mitigate the greenhouse gases (GHG's) and pollution, increase the sustainable production of food and adaptation climate change impacts, the use of feldspar in different forms (fine and granule) could contribute in satisfying the plant requirement of K.

The study conclusion recommended the use of feldspar in the rate of 100 % in both forms (fine and granule) as natural resource of K presented a good alternative for potassium sulfate as chemical fertilizer.Snap been cv. Moralida is recommended under greenhouse condition. The combined nutrients and elements effect of feldspar and salinity impacts on the nutrients requirements of snap bean need more research also the economic and environmental impacts.

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## "تأثير الفليسبار كمصدر طبيعى للبوتاسيوم على محصول الفاصوليا المداة تحت الصوب البلاستيكية"

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آثار تغير المناخ، والإنتاج الغذائى المستدام، والحفاظ على المصادر الطبيعية والطاقة خلق القوى الدافعة لخلق تقنيات جديدة فى النظم الزراعية للمزيد من الإهتمام بالبيئة.أجريت هده الدراسة خلال الموسمين التجريبين 2013/2012 و 2014/2013 فى المعمل المركزى للمناخ الزراعى،مركز البحوث الزراعية، مصر.

هدفت الدراسة لإحلال الأسمدة الطبيعية بدلا من الأسمدة الكيماوية الصناعية، معظمة الإنتاج والجودة والحفاظ على البيئة والطاقة.ويقوم البحث على دراسة تأثير ثلاثة معدلات من سماد الفليسبار(100%، 125%،150%) ،وصورتين للفليسبار (سماد محبب ، سماد ناعم) ومقارنة ذلك بسماد سلفات البوتاسيوم على إنتاج صنفين من الفاصوليا (الهاما، الموراليدا) فى الأصص الزراعية وتأثيرة على جودة قرون الفاصوليا المدادة النامية تحت الصوب البلاستيكية الغير مدفئة.

تم تسجيل لنمو الخضرى (عدد الأوراق، إرتفاع النبات،قطر الساق،عدد الأفرع)، وتقدير النيتروجين والبوتاسيوموالفوسفور بالأوراق،المحصول الكلى للنبات، صفات الجودة الفيزيائية للقرون (قطر القرن، طول القرن، وزن القرن).

تشير النتائج ان زيادة معدل الفليسبار من 100% الى 150% لا يؤدى لزيادة المحصول. من ناحية أخرى فأن إستخدام الفليسبار المحبب والناعم بمعدل 100% أعطى أعلى محصول كلى للنبات .سجل صنف الموراليدا زيادة 16% فى المحصول الكلى للنبات عن صنف الهاما تحت الصوب البلاستيكية الغير مدفئة. ان إستخدام الفليسبار الطبيعى له العديد من الفوائد (البيئية والاقتصادية وعلى الطاقة،......ألخ) مقارنة بالتسميد البوتاسى الكيماوى على انتاج الفاصوليا تحت الصوب البلاستيكية الغير مدفئة.