International Journal of Advanced Biotechnology and Research (IJBR)
ISSN 0976-2612, Online ISSN 2278–599X,
Vol-8, Issue-3, 2017, pp2209-2215
http://www.bipublication.com

Research Article

The Effect of Minerals Fertilizers and Arbuscular mycorrhizal Fungi on the Growth Characteristics and Yield of Beans

Mahshad Hamidi[1], Parisa Alizadeh[2]* and Shahram Baghban[3]

[1, 2] Department of soil science, [3] Department of Horticulture,
Marand Branch, Islamic Azad University, Marand, Iran
*Corresponding author email: P_alizadeh@marandiau.ac.ir

ABSTRACT

Arbuscular mycorrhizal fungi and mineral fertilizers may decrease the deleterious effects of copper on plants and improve its growth. The goal of the present study was to evaluate the effect of inoculation with the fungus Rhizophagus clarus and the addition of mineral fertilizer on beans growth and yield. For this purpose, to determine the appropriate type and amount of mineral fertilizers to create some bean appropriate qualitative and quantitative characteristics. Common bean is an important cash crop and protein source for farmers in many parts of Ethiopia. However, its production is limited by phosphorus fertilizer. Therefore, field experiment was evaluated in the wet soil of to investigate the responses of common bean to different levels of phosphorus fertilizer and its effect on growth, dry matter yield and yield component of the crop. Five phosphorus rates (0, 10, 20, 30 and 40kg ha-1) were used as treatments. Sampling at the end of the growing season to determine the amount of phosphate, dry matter, chlorophyll, and protein content were performed throughout the plant. Analysis of variance showed that the phosphate fertilizer and Arbuscular mycorrhizal fungi are desirable in terms of other features and is recommended for beans yield and growth.

Keywords*:* phosphorus, arbuscular mycorrhizal fungi, Mineral fertilizers, beans

1. INTRODUCTION

Beans and vegetables consumed is important that fertilizer use has a significant impact on productivity growth and its bulk. Improper application of Phosphorus fertilizers causes the waste of money and energy in addition to farmers, a sensitive crop to lodging and disease, a rare product, the quality of the product with the right look and market-friendly, Phosphate accumulation in plant tissues and effects, subsequent to follow in man and animals [1]. Phosphate accumulation occurs when the increase in Phosphate plant more plants of bean it. Phosphate-Phosphorus storage undigested, especially in the leaves accumulate. And the start of the rally when the process stops protein. This research aims to provide the type and amount of fertilizer Phosphorus, hat making quantitative and qualitative characteristics appropriate to the level of Phosphates in bean allowed, dry matter, chlorophyll, protein and plant height is formed. The majority of vegetable crops are potential host plants of arbuscular mycorrhizal fungi (AMF). AMF can improve the nutrient and water supply, induce tolerance of environmental stress and resistance to root diseases and nematodes of their host plants. Therefore, inoculation of vegetable crops with AMF can be profitable and commercial inoculation products are available [2]. According to Koch et al. [3] also garlic (Allium sativum) cv. Frankon plants inoculated with AMF had higher fresh and dry weights than plants in non-inoculated plots. Tomato (S. lycopersicum) yield and fruit number tended to increase after inoculation with AMF (Glomus mosseae, G. intraradices) [4, 5]. Conversa et al. [6] found that the effect of mycorrhization on the growth of tomato was evident from the second month of cultivation when the fastest increase of the plant leaf area index was registered. Several investigations proved that AM mycorrhiza improved the nutrient supply of diverse vegetable crops. This impact of AMF on the host plants was controlled by the genotypes of host and fungus and also by the inoculation method. In [7] they mentioned that the factors were cropping systems including a) common bean (Phaseolus vulgaris L.) sole cropping (40 plants m−2), b) dill (Anethum graveolens L.) sole cropping at different densities (25, 50 and 75 plants m−2) and c) the additive intercropping of dill + common bean (25 + 40, 50 + 40 and 75 + 40 plants m−2). Santana et al. [8] proposed a method to evaluate the effect of inoculation with Rhizophagus clarus and addition of grape-bagasse vermicompost on phytoremediation by C. ensiformis of a sandy soil with high Cu concentration.

2. MATERIALS AND METHODS

A greenhouse experiment as factorial in a randomized complete block design with four replications. Treatments consisted of four Phosphorus levels (0 and 10 and 20 and 30 and 40 Kg.ha-1) and four sources of fertilizer. Soil samples, 0 to 30 cm depth, were collected from representative spots of the entire experimental field by using diagonal sampling method before planting and the composite sample was obtained. The soil was air dried and made fine by using mortar and pestle. Lactuca Sativa L. three-liter pots were planted with 20% viability. Foliar fertilizer was applied in two stages 0 and 4. At the end of the growing season, leaf samples to determine the concentration of Phosphate (colorimetric method after resuscitation) and determination of chlorophyll (chlorophyll meter by hand), plant height, protein content (measured by total Phosphorus) and dry matter done [9, 10].

2.1. Soil Analysis

The physical and chemical properties of the soil before sowing were presented in (Table 1). The soil texture of experimental was clay loam. The pH value the experimental soil was 7.3 slightly basic. The electrical conductivity (Ec) was 4.46 µs/cm. The soil moisture content of experimental of soil was 10.49.

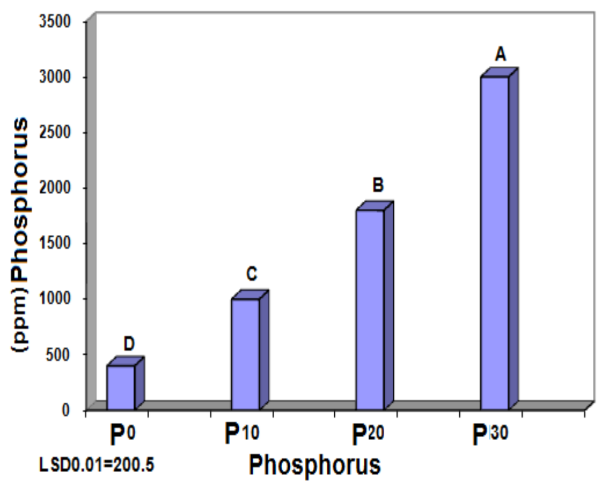
Table 1. Physical and chemical properties of the top soil (0-30 cm) used in the field experimental site in Arba Minch Research farm field

Soil Depth (cm)	Physical properties of soil		Chemical properties of soil	
	Textural class	Moisture Content	PH	Conductivity
0-30	Clay loam	11	7.4	4.34

3. RESULTS

3.1 The accumulation of Phosphate:

As shown in Figures 1 and 2, the effects of the sources and amounts of P value on Phosphate concentration was significant on the level of 0%. The highest Phosphate fertilizers with slow release fertilizer solution and the lowest Come on bean leaves has been made. Limit for Phosphate by taking 20 $Kg.ha^{-1}$ of Scu application has been made.



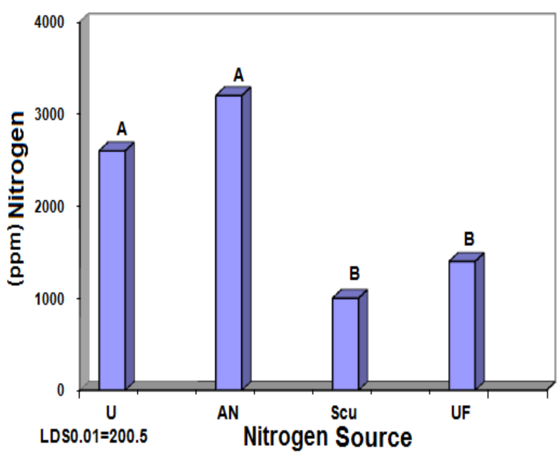


Figure 1. Effect of Phosphorus rates on Phosphate levels in bean

Figure 2. Effect of Nitrogen Sources on Nitrogen levels in bean

Scu fertilizer, slow release fertilizer in the fertilizer makes gradually taken root and plant in sufficient time and energy to provide sugar and energy will be needed to attract and Nitrate reduction. The presence of sulfur, Phosphorus fertilizer major role in reducing Phosphate accumulation in plants and increases the activity of the enzyme Phosphate reductase [11]. Also, due to the presence of sulfur acid, iron, copper, manganese and zinc mineralization which absorb increases and the reduction of Phosphate in the plant due to the more active the enzyme Phosphate reductase increases [12] and its accumulation in plant tissues prevented.

3.2 Dry matter percent

Based on Figure 3, the main effect of amounts and sources of Phosphorus on bean leaf dry matter content was significant at the 5% level. With increasing Phosphorus rates increased dry matter but would mean a significant difference between levels of N_{200} and N_{300} fertilizer does not show. With increasing levels of N, production of photosynthesis such as glucose, sucrose and ascorbic acid as well as amino acids and proteins resulting in increased plant dry matter increases [13]. According to Figure 4 also significant differences between urea and ammonium Phosphate fertilizer sources and Scu been achieved.

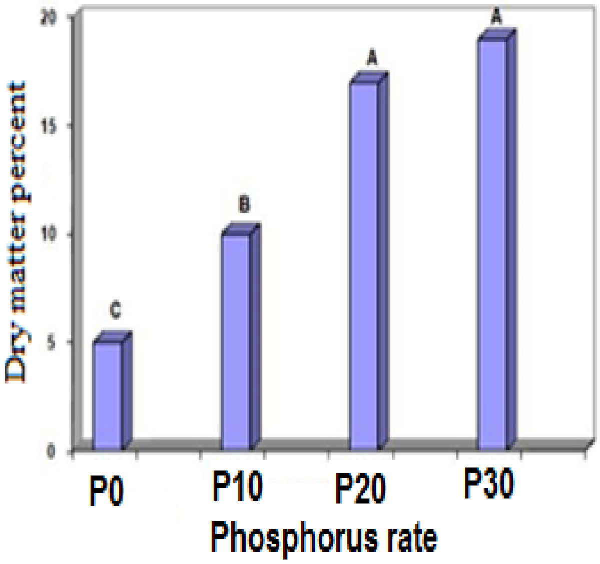


Figure 3. Effect of Phosphorus rates on dry matter

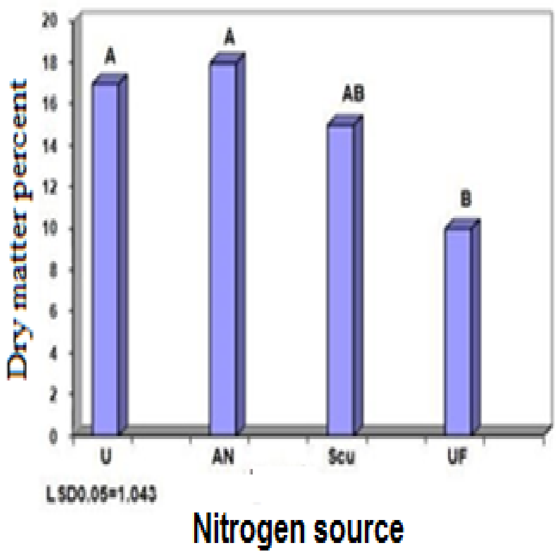


Figure 4. Effect of Nitrogen sources on dry matter bean

3.3 Chlorophyll index

The effects of significant amounts and sources of N on chlorophyll content. The maximum chlorophyll index at the level of 300N fertilizer and fertilizer among fertilizer sources Scu has been made. (Figures 5 and 6) The amount of Phosphorus absorbed by the plant and consequently the amount of Phosphorus is participating in the building of more chlorophyll content more will be measured and greener leaf color will be seen.

The highest chlorophyll content in manure Scu may be due to the importance and positive sulfur Phosphorus and chlorophyll is increased so that Bottril et al., [14] as well as the role of sulfur, Phosphorus and chlorophyll content of the plants is emphasized and has shown that low levels of Phosphorus and sulfur decreased chlorophyll than other elements of the plant.

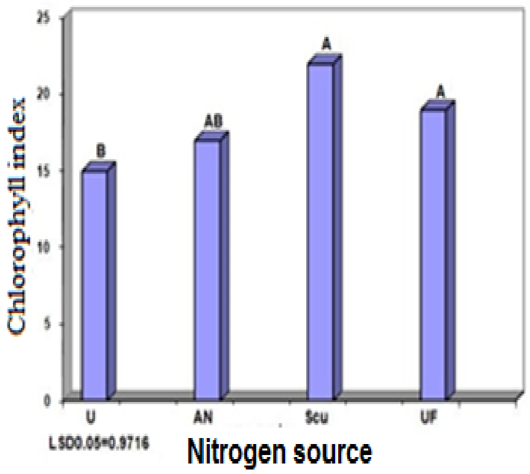


Figure 6. The effect of Nitrogen sources on chlorophyll index

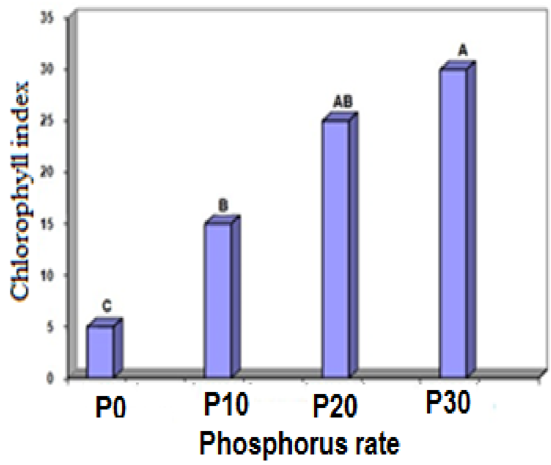


Figure 5. The effect of Phosphorus fertilizer on chlorophyll index

3.4 Protein percent

With protein content increased with increasing Phosphorus rates, but the results indicated a significant difference between 200N and 300N. When Phosphorus fertilizer will increase as a result of ammonium Phosphate and protein will be more and more plants. Takebe et al., [13] Increase protein production in plants as a result of Phosphorus application and its combination with sucrose and glucose and producing materials such as amino acids and proteins knows.

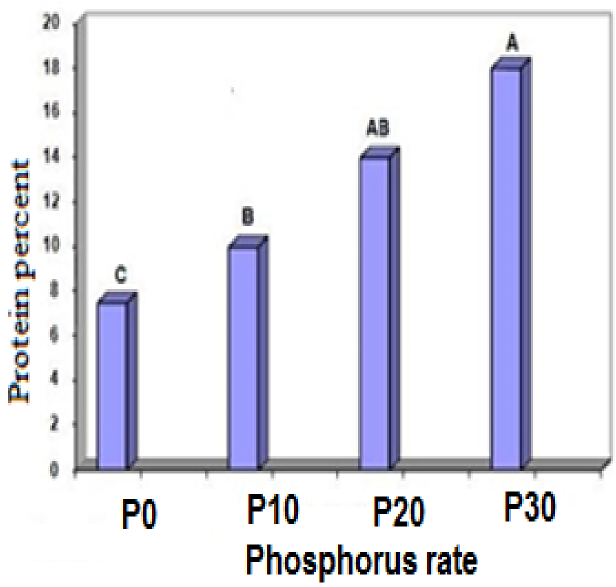


Figure 7. Effect of Phosphorus rates on protein percentage

3.5 Plant height

With increasing Phosphorus levels have been observed a significant increase in plant length. In the research the effects of Phosphorus fertilizer plant longest and the least soluble fertilizer with urea has been made but the difference was not significant with Scu. Given the important role of Phosphorus in rapid cell growth and division during plant increased with increasing Phosphorus levels forward. The high solubility of urea plant and is quickly absorbed and more rapid effects Meyer will grow bean tissue cells division. Kilemm [15] Showed that the availability of Phosphorus in the root zone, elongation increase the aerial parts of the plant. Generally, taking 200 $KgN.ha^{-1}$ of Scu fertilizer allowed the creation of Phosphate accumulation, in terms of other features, including dry matter, chlorophyll and plant during the optimum and are recommended.

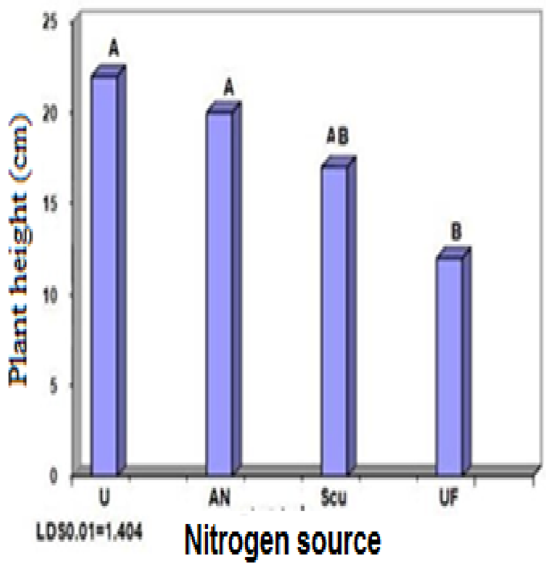


Figure 8. Effect of Nitrogen Sources on the plant height

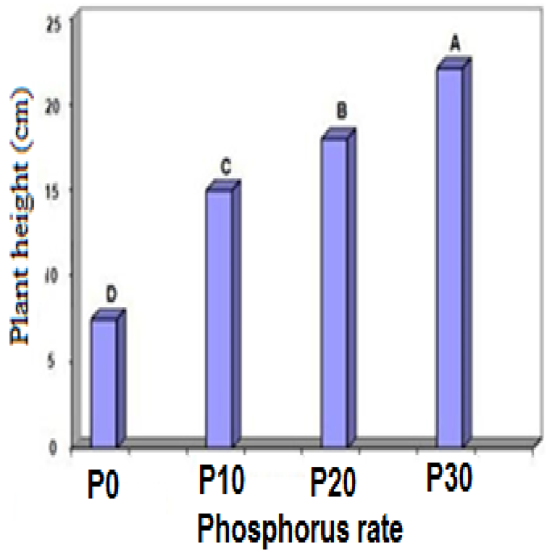


Figure 9. Effect of Phosphorus fertilizer on the plant height

3.6 phosphorus fertilizer effects

Effect of different rates of phosphorus fertilizer on plant height, leaf area and number of branchesper plant are presented in table 2. As indicated in Table 2, application of P fertilizer has no significant effect on plant height. The high plant height was recorded on application rate of 20 kg P ha-1. Moreover, application of 30 kg P ha-1 has revealed high plant height, next to P 20 kg ha-1. On the other hand, there was no significant difference between means of applied P fertilizer rates.

Table 2. Effect of different rates of phosphorus fertilizer on growth, dry matter yield and yield component of common bean

Phosphorous rate kg/ha	Normalized Planet height	Normalized Leaf area	Number of branches/plant	Normalized Pods/plant	Normalized Seeds/pod
0	1	1	2.33	1	1
10	1.06	1.4	4	1.2	1.6
20	1.4	2.1	5.67	1.9	1.9
30	1.3	1.75	5	1.6	1.8
40	0.9	0.93	3.58	1.2	1.3
CV (%)	20	19.766	24	21.4	13.19
LSD (%)	NS	31.45	1.84	14.04	1.2

3.7 Arbuscular mycorrhizal fungi effects

In the next stage to evaluate the effects of AFM on beans growth and productivity, Half of the plants from all treatments were inoculated with arbuscular mycorrhizal fungus (WAMF), and the other half were not inoculated (WOAMF). Results presented in figure (10) demonstrate the differences between vermicompost levels within each inoculation treatment.

Root and shoot dry weight increased with increasing levels of vermicompost addition to the soil.

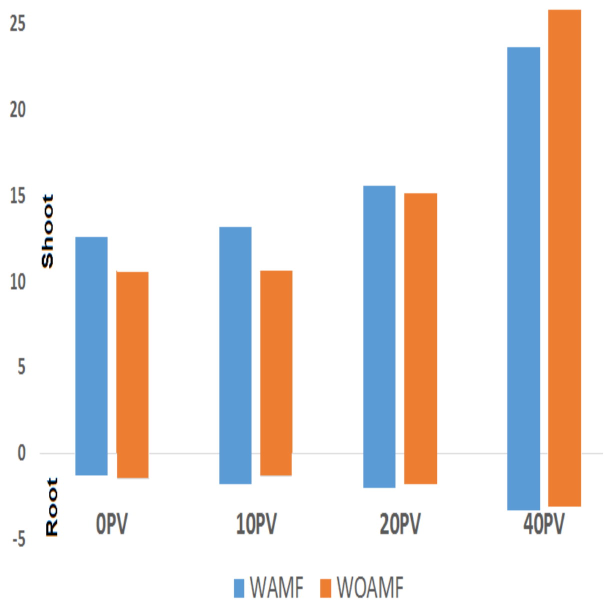


Figure 10. Shoot and root dry weight of C. ensiformis plants with AMF and without AMF

4. CONCLUSION

Using of the correct level of fertilizer is vital to achieve maximum yield of common bean crop. The present paper was initiated to assess the influence of different levels of phosphorus on growth, dry matter yield and yield component of common bean. Combination of AMF inoculation with applications of other biofertilizers or biopesticides turned out to be an especially promising future strategy for the cultivation of vegetable crops. Development of well-defined methods for the selection of suitable commercial products or on-farm production of AMF inoculates and inoculation methods is the lasting future challenge for the practical application of AMF in horticultural systems. In addition effects of Arbuscular mycorrhizal fungi are examined on root and shoot efficiency. Finally, evaluation of results demonstrated that the phosphate fertilizer and Arbuscular mycorrhizal fungi are main materials in terms of other features and is recommended for beans yield and growth.

REFERENCE

1- An, L.Y., Pan, Y.H., Wang, Z.B., Zhu, C., 2011. Heavy metal absorption status of five plant species in monoculture and intercropping. Plant Soil 345, 237–245.
2- Baum C., El-Tohamy W., Gruda N., 2015, Increasing the productivity and product quality of vegetable crops using arbuscular mycorrhizal fungi: A review Scientia Horticulturae 187, 131–141.
3- Koch, M., Tanami, Z., Bodani, H., Wininger, S., Kapulnik, Y., 1997. Field application of vesicular–arbuscular mycorrhizal fungi improved garlic yield in disinfected soil. Mycorrhiza 7, 47–50.
4- Makus, D.J., 2004. Mycorrhizal inoculation of tomato and onion transplant improves earliness. Acta Hortic. 631, 175–281.
5- Elahi, F.E., Aminuzzaman, F.M., Mridha, M.A., Begum, B., Harun, A.K., 2010. AMF inoculation reduced arsenic toxicity and increased growth, nutrient uptake and chlorophyll content of tomato grown in arsenic amended soil. Adv. Environ. Biol. 4, 194–200.
6- Conversa, G., Lazzizera, C., Bonasia, A., Elia, A., 2013. Yield and phosphorus uptake of a processing tomato crop grown at different phosphorus levels in a calcareous soil as affected by mycorrhizal inoculation under field conditions. Biol. Fertil. Soils 49, 691–703.
7- Weisan W., Zehtab-Salmasi S., Raei Y., Sohrabi Y., Ghassemi-Golezani K., 2016, Can arbuscular mycorrhizal fungi improve competitive ability of dill + common bean intercrops against weeds? J. Agronomy 75, 60–71.
8- Santana N., Ferreira P., Soriani H., Brunetto G., Nicoloso F., Antoniolli Z., Jacques R., 2015, Interaction between arbuscular mycorrhizal fungi and vermicompost on copper phytoremediation in a sandy soil, Applied Soil Ecology 96, 172–182.
9- Emami A., Leaf analysis method, Technical issue, 982, Soil and water research institute, Tehran, Iran, 2000, (in Persian)
10- Müller, A., George, E., Gabriel-Neumann, E., 2013. The symbiotic recapture of nitrogen from dead mycorrhizal and non-mycorrhizal roots of tomato plants. Plant Soil 364, 341–355.
11- Englstad OP, 1972. Mineral nutrition of plants-Principles and perspectives. Wiley. New York.

12- Gabal MR, 1980. Studies on the response of paprika varieties to Phosphorus level and forms under different environmental conditions. Ph.D. Thesis.Budapest. Hungary.
13- Takebe M, Ishihara T, Matsuna K, Fojimoto J and Yoneyama T, 1995. Effect of Phosphorus application on the content of Sugars, ascorbic acid, Phosphate and oxalic acid in Spinach and Komatsuna. Jap. J. Soil Sci plant Nutr. 66:238-246.
14- Bottril DE, Possigham JV and Kriedemann PE, 1970. The effect of nutrient deficiencies on photosynthesis and respiration on spinach. Plant Soil 33: 424-438.
15- Kilemm K, 1966. Der Einfluss der N-Form auf die Ertragsbildungb verschiedener kulturpflanzen. Bodenkultur 17, 265-284.