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Study the Effect of Animal Manure, Nitrogen and Phosphorus on Growth, Yield and Yield Components Traits of Mungbean

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ABSTRACT

The field experiment was conducted to assess the effect of different fertilizers sources such as animal manure (AM), Nitrogen (N) and Phosphorus (P) fertilizers on growth, yield and yield components of Mungbean (*Vigna radiate* L.) during 2019 The applied levels of mentioned sources were (0, 30 ton ha^{1}), (0, 25 & 50 N kg ha^{-1}) and 0, 50 & 70 P kg ha^{-1}) respectively. The experiment was laid out at the research farm of, Badghis University in factorial split-plot design (SPD) with 3 replications. Each replication consisted of (18) plots with (2m x 2m) size. Animal manure was applied to the main plots while, N and P fertilizers were applied to the subplots of the experiment. The results revealed that, animal manure significantly affected all characteristics of Mungbean except total dry matter, yield, and harvest index. The Interactive effect of nitrogen and phosphorus fertilizers was found significant for all characteristics of Mungbean, while the interactive effect of AM x N and AM x P was found non-significant for recorded parameters.

Keywords- Animal Manure, Nitrogen, Phosphorus, Mungbean, growth, yield.

I. INTRODUCTION

Mungbean (*Vigna radiate* L.) is a valuable pulse in which the grain is full of phosphorus and protein 25% (Fadaei *et al*., 2017). Due to its high protein content, wide cultivation area, ability to fix atmospheric nitrogen in the soil, palatability, and high digestibility, mungbean has significant importance, especially in Afghanistan. It is cultivated in Helmand, Kandahar, Nangarhar, Baghlan, Takhar, Kapisa, Badghis, and other regions. Although Afghanistan's climate is suitable for mungbean cultivation, its yield is much lower than the global average. The average yield of mungbean in Afghanistan ranges from 1000 to 1200 kg per hectare. The reasons for the low yield of mungbean in Afghanistan include the absence of high-yielding varieties, improper use of chemical fertilizers, inadequate application of animal manures, and poor pest and disease management ((Jalali *et al*., 2017).

Nitrogen is one of the essential elements for crop production, and its absence in the soil leads to a significant reduction in plant growth. Nitrogen is one of the essential elements for most legumes as it is an important component of proteins (Mainul *et al*., 2014). Proper management of nutrients, especially high nitrogen content, can increase the yield and quality of mungbean (Aslam *et al*., 2010). Phosphorus is one of the most important essential elements for plant growth after nitrogen. Phosphorus plays a vital role in photosynthesis, metabolism, energy storage and transfer, root growth, meristem division, glandular secretion, and nitrogen fixation (Jalali *et al*., 2017). Using organic fertilizers alone instead of chemical fertilizers is not enough and effective. A combination of both can increase yields and improve soil structure (Gawai and Pawer, 2006). When using animal manure, only 30% of nitrogen, a portion of phosphorus and potassium, is available for the current plant, and the remaining is supplied for the next plant (Sharma and Vyas, 2001). The use of animal and chemical fertilizers alone or in combination improves the

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physical and chemical soil's characteristics and creates a suitable environment for soil microorganisms, which plays a crucial role in increasing soil productivity (Kumar *et al*., 2011). Therefore, the yield and quality of mungbean can be increased by appropriate management of nutrients. It is necessary to determine the appropriate amounts of chemical and animal manure to increase mungbean yield. Thus, the main aim of this study was to find the best and most economical combination of animal and chemical fertilizers to obtain maximum mungbean yield.

Mungbean is a valuable pulse which grain is full of phosphorus and it has 25% protein. This plant has an important agricultural place in Afghanistan due to its huge cultivation area, nitrogen fixation, delicious taste, and high digestion capability. The yield of mungbean is very low compared to the worldwide average yield and one of the reasons is ineffective management of nutrients by the farmers.

II. MATERIALS AND METHODS

The experiment was conducted in 2019 at the research farm of Badghis Higher Education Institution, in sandy clay loam soil, using a split-plot design with three replications. The main plots consisted of two levels of animal manure (M0=0, M1=30 tons/ha), and the subplots were factorial with three levels of nitrogen fertilizer (N0=0, N1=25, N2=50 kg/ha) and three levels of phosphorus fertilizer (P0=0, P1=50, P2=75 kg/ha). During the sowing process, the application of both organic manure and synthetic chemical fertilizers was employed. A local variety of mungbean was selected and the distance between rows was fixed at 20 cm, and between plant to plant was 10 cm. Yield and yield components (plant height, number of pods per plant, number of seeds per pod, thousand-seed weight, grain yield, total dry matter weight, and harvest index) were measured at the end of the harvesting season in August 2019. Data were analyzed using SAS 9.1 software (Institute INC, USA).

III. RESULT & DISCUSSION

Nutrient management, especially the use of chemical fertilizers, is an important factor that affects crop yield. The use of organic fertilizers such as bio fertilizers and animal manure also leads to increased organic matter, improved soil structure, and increased yield in grain crops (Mohammadi *et al*., 2007; Courtney and Mullen, 2008). The results of the analysis of variance in this study showed that the effect of animal manure was not significant in the case of total dry matter weight (TDM), yield, and harvest index (HI), but was found significant in the case of other characteristics. However, the utilization of nitrogen and phosphorus fertilizers exhibited a substantial impact on various yield parameters including the pod count per plant, seed count per pod, the weight of 1000 seeds, TDM, HI, and grain yield. Furthermore, the interaction effects of animal manure with nitrogen and phosphorus fertilizers were not significant on any of the studied traits (Tab.l)

Table 1: Variance analysis of the effect of animal manure, nitrogen and phosphorus on mungbean yield

S.O.V	Df	Plant Height (cm)	No. of Pod plant^{-1}	No. of Seed pod^{-1}	1000 Seeds weight (g)	TDM (g)	Yield (g)	HI (%)
Block	2	18.66 **	27.28 **	12.24 **	12.25 **	40.84 **	35.23 **	6.13 **
M	1	13.46 **	47.29 **	13.58 **	10.02 **	3.95 ns	0.02 ns	1.05 ns
Error	2							
N	2	131.81 **	89.42 **	32.17 **	12.17 **	8.22 **	79.06 **	48.00 **
P	2	2.40 ns	44.97 **	4.21 *	52.96 **	12.10 **	48.24 **	20.75 **
N*P	4	0.36 ns	4.4 **	0.60 ns	1.72 ns	1.92 ns	1.10 ns	1.70 ns
AM*N	2	14.51 **	4.45 *	2.30 ns	2.17 ns	0.25 ns	1.06 ns	0.54 ns
AM*P	2	0.35 ns	0.26 ns	0.11 ns	1.28 ns	2.50 ns	0.15 ns	1.29 ns
AM*N*P	4	0.46 ns	2.32 ns	0.57 ns	2.06 ns	1.85 ns	0.13 ns	0.44 ns
Error	32							
**Significant at the 1% probability level *Significant at the 5% probability level and ns is not significant								

According to the comparison of means in the table 2., it can be observed that the effects of using or not using animal manure on the studied traits were different. The highest plant height, maximum number of pods plant^{-1}, number of seeds pod^{-1}, 1000 seed weight, total dry matter, harvest index, and highest grain yield

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were obtained with the use of 30 tons ha^{-1} of animal manure. The use of nitrogen had positive effects on the studied traits, with the highest values obtained with the application of 50 kg per hectare of nitrogen, and the lowest values obtained in the control treatment without nitrogen. Additionally, the use of phosphorus had desirable effects on Mungbean growth, with the application of the highest level (75 kg P ha^{-1}) of phosphorus resulted in the highest recorded values, and the lowest values obtained in the control treatment (without phosphorus) (Table 2g). The optimization of nutrient management exhibited a significant impact on the performance and yield index of mungbean, with the highest yield (10794 kg/ha) and yield index (29.53) obtained in the treatment with 75 kg of phosphorus. However, increasing nitrogen fertilizer from 25 to 50 kg did not have a significant impact on the yield and yield index of mungbean, due to its ability to fix atmospheric nitrogen as a legume. These results are consistent with previous studies by Sadeghipour (2012), Malik *et al.* (2003), and Bismillah Khan *et al*. (2003). The manipulation of nutrient management exerted a noteworthy influence on the cumulative dry matter weight of Mungbean, with the highest amount obtained in the treatment with 75 kg of phosphorus (3650 kg/ha) followed by the treatment with 50 kg of phosphorus (3649 kg/ha). The use of animal manure did not show a significant effect on the cumulative dry matter weight of Mungbean, with the lowest amount obtained in the control treatment (3480 kg/ha) due to nutrient stress, which led to a reduction in cell division and enlargement of chambers, ultimately resulting in a decrease in carbohydrate synthesis (Sultana *et al*., 2009).

Table 2: Comparison of the average effect of animal manure, nitrogen and phosphorus on Mungbean yield

Treatment Main Effects	Plant Height (cm)	No. of Pod $plant^{-1}$	No. of seed pod^{-1}	1000 Seed weight (g)	TDM ($g\ m^{-2}$)	Yield ($g\ m^{-2}$)	HI (%)
AM_0	28.70 b	30.28 b	6.93 b	32.19 b	353.89 a	100.04 a	28.21 a
AM_{30}	29.85 a	32.91 a	7.39 a	32.77 a	360.15 a	100.26 a	27.77 a
LSD $_{\%5}$	0.64	0.78	0.25	0.37	6.41	2.96	0.88
N_0	26.17 c	28.04 c	6.59 c	31.86 b	348.00 b	87.39 b	25.05 b
N_{25}	29.28 b	32.78 b	7.10 b	32.67 a	361.89 a	104.89 a	28.97 a
N_{50}	32.39 a	33.97 a	7.79 a	32.91 a	361.17 a	108.17 a	29.94 a
LSD $_{\%5}$	0.78	0.96	0.31	0.46	7.85	3.62	1.08
P_0	29.33 ab	29.64 c	6.96 b	31.40 c	346.56 b	90.72 c	26.16 c
P_{50}	28.83 b	31.12 b	7.13 ab	32.34 b	359.44 a	101.78 b	28.27 b
P_{75}	29.67 a	34.02 a	7.39 a	33.69 a	365.06 a	107.94 a	29.53 a
LSD $_{\%5}$	0.78	0.96	0.31	0.46	7.85	3.62	1.08

* In each column and for each factor, the averages with at least one common letter based on the LSD test do not have a significant difference at the five percent level.

IV. CONCLUSION

The study revealed that the manipulation of nutrient management exerts a significant influence on the growth and yield outcomes of mungbean, with animal manure, nitrogen, and phosphorus fertilizers having varying effects on different traits. The results suggest that excessive nitrogen fertilizer application may not be necessary for mungbean cultivation, due to its ability to fix atmospheric nitrogen as a legume while phosphorus may be a more limiting nutrient. The interaction effects of animal manure, nitrogen, and phosphorus fertilizers were not significant for any of the studied traits. Therefore, further research is needed to determine optimal nutrient management for mungbean, considering lower amounts of nitrogen (<25 kg) and higher amounts of phosphorus (>75 kg).

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