



Effects of Crop Establishment Methods and Phosphorus Fertilization on Growth and Yield of Mungbean (*Vigna radiata* L. Wilczek.) in Kandahar Region of Afghanistan

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ABSTRACT: A field experiment was conducted entitled “Effect of methods of crop establishment and phosphorus fertilization on mungbean (*Vigna radiata* L. Wilczek) during (August-October) of 2017 at Research Farm of Afghanistan National Agriculture Science and Technology University (ANASTU), Kandahar, Afghanistan. The experiment was laid out in a split plot design with seven treatment combinations, i.e. main plots as three crop establishment methods (Flatbed broadcast planting, raised bed planting and Flatbed row sowing) and four phosphorus application rates (0,45,60 and 75 kg P₂O₅). The experimental findings indicated that the growth attributes, plant height (cm) (41.9), number of branch plant⁻¹ (4.8), dry matter accumulation(g/m²) (481.5), root dry weight (g) plant⁻¹ (1.53), leaf area index (3.56) and yield, i.e. grain yield (1,424 t/ha), stover yield (4,203 t/ha), biological yield (5,627 t/ha) and harvest index (24.8%) were significantly enhanced due to raised bed plating method along with application of 75 kg P₂O₅, whereas the minimum growth attributes and yield was obtained in the plots cultivated as flatbed broadcast planting method with no phosphorus application level.

KEYWORDS: Mungbean, Growth, Crop, Phosphorous, Yield.

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INTRODUCTION

Mungbean is botanically known as *Vigna radiata* L. Wilczek. It is an important pulse crop worldwide. It is widely cultivated across the semi-arid to sub humid low land tropical and sub-tropical regions. Mungbean is believed to be originated in south and south-east Asia (India, Myanmar, Thailand). It is an annual crop with erect and highly branched stem which grows about 60 to 75 cm tall. It is an excellent and inexpensive source of vegetable protein and ranks high among the different pulse crops, grown in the world. Mature seeds are rich in proteins, and cooked seeds form a valuable constituent of diet of considerable number of people in country.

The seed of mungbean contains 51% carbohydrate, 26% protein, 10% moisture, 3% mineral and 3% vitamins (Kaul, 1982) and can easily be cooked. It constitutes an essential supplement in cereal based diet of human beings. The biological value of human diet improves greatly, when wheat or rice is combined with mungbean because of the complementary relationship of the essential amino acids. Mungbean is particularly rich in leucine, phenylalanine, lysine, valine, isoleucine, etc. In addition to being an important source of human food and animal feed. Apart from seed purpose mungbean is also used as green-manuring crop.

Generally, *Vigna radiata* is sown in warm region of Afghanistan like Kunduz, Helmand, Kandahar, Nangarhar, Parwan, Baghlan, Laghman, Takhar, Kapisa, etc. (Noorzaie, 2017). To maintain the level of pulses consumption in a balanced diet the Government of Afghanistan has to spend huge amount of foreign currency for importing pulses every year. Therefore, it is necessary to put efforts to improve and enhance production of mungbean in the country.

Therefore a field experiment conducted on the title of “**Effect of methods of crop establishment and phosphorus fertilization on mungbean (*Vigna radiata*,L) in Kandahar Region of Afghanistan**”.

MATERIAL AND METHODS:

The experiment was conducted to study the effect of methods of crop establishment methods and phosphorus fertilization on mungbean during August, 2017 to October, 2017 in *summer* season at the Experimental Farm of Afghanistan National Agricultural Science & Technology University (ANASTU), Kandahar (Afghanistan), situated in southern part of the country having semi-arid climate.

The soil of the experimental field was sandy clay loam in texture with pH 7.23 and Electric Conductivity 0.15 (EC Mater). The content of $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ (mg kg^{-1}), and available P (kg ha^{-1}) were 32.2, 36.2 and 23.0 respectively (by LaMotte Soil Test Kit). The experiment was laid out in split plot design (SPD) combined with three replications. The experimental treatments were of three crop establishment methods (i. Flatbed broad cast planting ii. Raised Bed Planting iii. Flatbed Row Sowing) and four levels of phosphorous treatments such as 0 (T1), 45 (T2), 60 (T3) and 75 (T4) kg ha^{-1} was worked out with a mungbean variety (NM-94). The planting methods were allocated to main plots and phosphorus levels to subplots. however, 150 kg ha^{-1} DAP (Diammonium-Phosphate) fertilizer was used on the sowing time to all plots equally, thus absolute control plots were not presented in the experiment. Basal application comprised of recommended dose of N and potash for mungbean while phosphorus was applied as per treatments. N was supplied through urea and DAP, while P_2O_5 and K_2O were supplied through DAP and potassium sulfate, respectively. Application of potassium sulphate as a source of potash also supplied sulphur @ 12.75 kg ha^{-1} .

The plant spacing was 30 cm \times 15 cm, which accommodated 7 rows/plot and 80 plants/row, while using seed @ 25 kg ha^{-1} . One border row from both the sides of each plot as well as one sample row from one side of the plot was discarded, besides, 20 cm crop rows from other two sides as border effect in the row/line sowing, while, to reduce the border effect a 25 cm crop was discarded from all borders in case of flatbed broadcast planting. The net plot size was 1.8 m \times 3.6 m *i.e.* 6.48 m^2 in case of raised bed planting along with flatbed row sowing; and 2.65 m \times 3.5 m *i.e.* 9.27 m^2 in case of flatbed broadcast planting.

RESULTS AND DISCUSSION:

Growth attributes and yield

The effect of different crop establishment methods and phosphorus application levels on Plant height (cm), Number of Branches plant⁻¹, Dry matter accumulation (g) plant⁻¹, Root dry weight (g), Leaf area index (LAI), grain yield, stover yield, biological yield and harvest index of *mungbean* plant was studied under semi-arid conditions of Kandahar during summer season of 2017. The result obtained are presented and discussed as follow:



Plant height (cm)

The data presented in table-1 on growth attributes of mungbean crop during experimentation period, were significantly affected due to different crop establishment methods and phosphorus application rates. Raised bed planting and flatbed row sowing methods resulted significantly higher plant height over flatbed broadcast planting method at all the growth stages (except 30 DAS). Same variations in growth attributes due to methods of crop establishment has been reported by Jat and Ahlawat *et al.* (2001), Ahmad *et al.* (2012) and Girase *et al.* (2016). Similarly, effect of 60 kg P₂O₅ ha⁻¹ was significant on plant height over control at all the growth stages (14.9 cm, 38.2 and 40.6 cm at 30 DAS, 60 DAS and at harvest). Enhancement of plant height with application of 75kg P₂O₅ ha⁻¹ was significantly higher over control and 45kg P₂O₅ ha⁻¹ at all the growth periods except 30 DAS. 60 kg P₂O₅ ha⁻¹ was found at par to 75kg P₂O₅ ha⁻¹. Gajera *et al.* (2014) and Kumar *et al.* (2012) also reported that application of phosphorus significantly affects the plant height of mungbean plant.

Number of Branches plant⁻¹

Different Crop establishment methods significant affects number of branches plant⁻¹ of mungbean, which was observed at all the growth stages (Table-1). The highest number of branches plant⁻¹ were found in raised bed planting method at all the growth stages, whereas the lowest number of branches plant⁻¹ were observed in flatbed broadcast planting method. Jat and Ahlawat (2001), and Shete *et al.* (2010), also observed result similar to the present findings. Application of phosphorus also had positive effect on numbers of branches plant⁻¹ of mungbean. The highest numbers of branches plant⁻¹ were resulted with application of 75kg P₂O₅ ha⁻¹ which remained statistically at par to 60 kg P₂O₅ ha⁻¹ at all the growth stages except 30 DAS. Ali *et al.* (1993), Shukla and Dixit (1996) also observed the effects of P₂O₅ ha⁻¹ on mungbean plant at different growth stages.

Dry matter accumulation (g) plant⁻¹

The dry matter accumulation (g) plant⁻¹ of mungbean was markedly affected by various crop establishment methods at all the growth stages (Table-1). Raised bed planting method and flatbed row sowing showed in significantly higher dry matter accumulation (g) plant⁻¹ at all the growth stages over flatbed broadcast planting method. The similar experiment results were observed by Shete *et al.* (2010), Jat and Ahlawat (2001). The dry matter accumulation (g) plant⁻¹ of mungbean was significantly influenced by different levels of phosphorus at all the growth stages except 30 DAS. The maximum dry matter accumulation (g) plant⁻¹ was obtained in 75 kg P₂O₅ ha⁻¹ at all the growth stages (466.3 g, 521.3 g at 60 DAS and at harvest respectively) except 30 DAS and it remained at par to 60kg P₂O₅ ha⁻¹. The lowest dry matter accumulation plant⁻¹ was resulted in the plots not treated with P₂O₅ ha⁻¹. Similarly, Owla *et al.* (2007) and Gajera *et al.* (2014) reported the positive effect of phosphorus on mungbean dry matter accumulation.

Root dry weight (g)

The highest root dry weight plant⁻¹ was produced in raised bed planting method (0.75 g, 0.38 g, 1.53 g, at 30 DAS, 60 DAS and at harvest respectively), but the lowest root dry weight plant⁻¹ was observed in flatbed broadcast crop establishment method. Flatbed row sowing showed the best result on root dry weight plant⁻¹ of mungbean as compared to raised bed planting method, but raised bed planting method was statistically better. Different phosphorus levels remarkably improved root dry weight plant⁻¹ of mungbean at all the growth stages. Application of 45 kg P₂O₅ ha⁻¹ had significant effect on root dry weight plant⁻¹ over control at 30 DAS and at harvest. Significantly maximum root dry weight plant⁻¹ observed in the plots treated with 75 kg P₂O₅ ha⁻¹ (0.80 g, 0.34 g, 1.61 g, at 30 DAS, 60 DAS and at harvest respectively). The minimum root dry weight plant⁻¹ was recorded in the plots treated with no phosphorus level at all the growth stages (Table-1). Shete *et al.* (2010) and Girase *et al.* (2016) also observed similar results.

Leaf area index (LAI)

Maximum leaf area index of munbean was recorded in raised and flatbed, and it was significantly improved over flatbed broadcast planting method at all the growth stages (Table-1). Different phosphorus levels had positively increased leaf area index of munbean at various stages of crop growth. Maximum leaf area index (3.67 at 60 DAS respectively) was found in the plots treated with 75 kg P₂O₅ ha⁻¹. The same results were recorded by Jat and Ahlawat (2001), Amanullah *et al.* (2012).



Grain yield

Grain yield of mungbean significantly improved due to various crop establishment methods. The remarkably higher grain yield was recorded in raised bed planting method and was at par with flatbed row sowing method, whereas the minimum grain yield was recorded in flatbed broadcast planting method (Table-1). Rasheed *et al.* (2003), Shaikh *et al.* (1994), Majid *et al.* (1986) and Amin *et al.* (2006) also found similar results. Application of different phosphorus levels also significantly raised the grain yield. Application of 75 kg P₂O₅ ha⁻¹ resulted significantly maximum grain yield of mungbean over control and 45 kg P₂O₅ ha⁻¹ respectively, whereas, application of 60 kg P₂O₅ ha⁻¹ was at par to 75 kg P₂O₅ ha⁻¹. Prasad *et al.* (2014) and Jahish *et al.*, (2017) also found 60 kg P₂O₅ ha⁻¹ as optimum dose for better grain yield of mungbean.

Stover yield

Due to various crop establishment methods, higher stover yield was recorded in raised bed planting method. The lowest stover yield was obtained in flatbed broadcast planting method. Flatbed row sowing showed the best influence with stover yield at all the growth and yield attributes (Table-1). The same results were observed by Leyenaar and Hunter. (1977) and Rasheed *et al.* (2003). Application of different phosphorus levels had positive effect on the stover yield of mungbean. Maximum stover yield of mungbean was recorded in plots treated 75 kg P₂O₅ ha⁻¹ where the minimum stover yield was observed in control plots, 60 kg P₂O₅ ha⁻¹ was found at par to 75 kg P₂O₅ ha⁻¹. Khan *et al.* (2002) found the similar results.

Biological yield (t ha⁻¹)

The biological yield was meaningfully affected by different crop establishment methods. Raised bed planting method produced maximum biological yield. Various phosphorus levels resulted in positive effect on biological yield. Increase in phosphorus rates significantly improved the biological yield up to 75 kg P₂O₅ ha⁻¹. The higher biological yield was recorded with application of 75 kg P₂O₅ ha⁻¹ while the lowest biological yield was obtained in control plots respectively (Table-1). Amanullah *et al.* (2012) reported that 60 kg P₂O₅ ha⁻¹ in mungbean was resulted in higher biological yield.

Harvest index

The data presented in the table shows that, raised bed planting method recorded better harvest index of mungbean. The minimum harvest index was observed in flatbed broadcast planting method. Flatbed row sowing was at par with raised bed planting method, but raised bed planting method was numerically superior than flatbed row sowing method respectively. Identical observation was recorded by Rasheed *et al.* (2003), Bakht *et al.* (2006) and Jehan *et al.* (2011). Different rates of phosphorus also remarkably increase the harvest index. Addition of 60 kg P₂O₅ ha⁻¹ (25.3 %) resulted in highest harvest index. Tahir *et al.* (2015), Sardar (2002) and Parvez *et al.* (2013) also observed the same records from their experiments.



Treatment	Plant height			Number of branch plant ⁻¹			Dry matter accumulation (g/m ²)			Root dry weight (g) plant ⁻¹			Leaf area index (LAI)		Gram yield (kg ha ⁻¹)	Drove yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS				
Crop Establishment																		
Flatbed broadcast planting	14.1	36.2	38.2	1.6	3.3	3.7	22.9	380.0	435.5	0.54	0.33	0.92	0.35	3.17	1,137	3,824	4,961	22.4
Raised Bed Planting	14.2	38.1	41.9	2.4	4.0	4.8	26.1	414.7	481.5	0.75	0.38	1.53	0.48	3.56	1,424	4,203	5,627	24.8
Flatbed Row Sowing	15.4	36.2	40.0	1.8	3.5	4.1	23.5	379.5	454.0	0.68	0.31	1.37	0.53	3.49	1,305	4,053	5,358	23.9
SEm±	0.07	0.92	1.30	0.12	0.17	0.04	0.39	6.92	9.77	0.04	0.05	0.07	0.008	0.09	20.6	89.6	125.8	0.98
CD (P=0.05)	0.28	3.67	5.21	0.41	0.40	0.26	1.57	27.91	NS	NS	0.02	0.32	0.03	NS	83.5	353.9	493.1	1.01
Phosphorus Rates																		
Control	13.7	34.9	38.8	1.6	3.1	3.8	18.6	261.0	331.7	0.50	0.32	0.96	0.20	2.98	774	3,177	3,951	19.4
45 kg P ₂ O ₅ /ha	14.3	36.2	39.9	1.9	3.5	4.2	25.5	387.0	463.0	0.62	0.31	1.04	0.46	3.38	1,296	4,006	5,303	24.4
60 kg P ₂ O ₅ /ha	14.9	38.2	40.6	2.1	3.8	4.3	26.0	451.3	512.0	0.72	0.31	1.44	0.37	3.57	1,523	4,436	5,960	25.3
75 kg P ₂ O ₅ /ha	16.3	39.3	41.3	2.2	3.9	4.6	26.4	466.3	521.3	0.80	0.34	1.61	0.32	3.67	1,562	4,486	6,048	25.0
SEm±	0.09	1.18	1.28	0.22	0.19	0.16	0.18	13.95	14.71	0.04	0.01	0.14	0.006	0.06	24.3	82.3	114.6	0.38
CD (P=0.05)	0.26	3.54	3.89	NS	0.57	0.38	0.56	41.83	44.86	0.12	0.01	0.40	0.02	0.19	72.6	247.9	341.6	1.12

Table-1



Conclusion

1. Raised bed planting method along with flatbed row sowing method of mungbean was superior in terms of growth, yield and economics than flatbed broadcast planting method.

2. Significantly highest grain yield, gross returns, net returns and benefit: cost ratio of mungbean was recorded with 75 kg P₂O₅ ha⁻¹. For almost all the parameters 60 kg P₂O₅ ha⁻¹ remained statistically at par to 75 kg P₂O₅ ha⁻¹.

3. Interaction effect between methods of crop establishment and phosphorus levels was non-significant.

According to the findings of the study, raised bed planting method along with flatbed row sowing method and application of 60 kg P₂O₅ ha⁻¹ can be recommended for mungbean, higher productivity and profitability.

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