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Research Communication

Effect of tillage practices and phosphorus doses on the performance of mungbean (*Vigna radiata*) in semi-arid Kandahar region of Afghanistan

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ABSTRACT

A field experiment was conducted in Kandahar, Afghanistan during summer (June-August) season of 2017 to assess the impact of different tillage practices and phosphorus doses on yield and economics of mungbean [*Vigna radiata* (L.)]. Experiment consisted 12 treatment combinations of 3-tillage practices in main plots, viz., raised bed, zero tillage and conventional tillage and 4-phosphorus doses in sub-plots, viz. 0 (control), 40, 60 and 80 kg P_2O_5/ha. Research findings of the study showed that yield attributes, seed and stover yields, harvest index and economics of mungbean were not significantly influenced by different tillage practices. Application of P resulted significantly higher growth and yield parameters compared to absolute control. Application of 80 kg P_2O_5/ha gave the highest seed yield (0.98 t/ha) and 60 kg P_2O_5/ha gave the highest stover yield (3.92 t/ha). In terms of economics, the highest net returns (58,238 AFN/ha) was recorded with 80 kg P_2O_5/ha, and the B: C ratio was the highest (2.24) with 40 kg P_2O_5/ha.

Key words: Economics, Mungbean, Phosphorus levels, Tillage practices

Conservation agriculture (CA) practices are gaining more attention in recent years with the rising concerns of natural resource degradation, energy, water and labour crisis, instability in crop yields, high production costs, low water productivity, low nutrient-use efficiency and adverse effects of climate change (Parihar *et al.,* 2016). CA practices like zero tillage (ZT), raised bed planting and residue management have been found to be the potential resource conservation technologies (RCTs), which can play a vital role to save the scarce natural resources like land, labour, energy and water. To obtain a good seed bed in conventional tillage with repeated ploughings not only involve high expenditure but also consume more time, which more often delays the sowing of the crops resulting in low yields in intensive cropping system where turnaround time is very less. Recent studies have shown that permanent bed (PB) planting was suitable for enhancing crop productivity and reducing the production cost besides conserving the natural resources. It also allowed the maintenance of uniform permanent soil cover for increased infiltration and higher moisture conservation. Direct planting of crops in ZT and PB plots lead to favorable alterations in soil water stable aggregates and improved organic carbon content and soil physical properties (Parihar *et al.,* 2016). Mungbean is an important field crop in Afghanistan (Noorzai *et al.,* 2017) and is highly responsive to applied phosphatic fertilization. Phosphorus nutrition plays an important role in plant physiological processes. It is an essential constituent for nucleoprotein, phospholipids enzymes and other plant substances and is needed for energy storage. It is also essential in translocation of carbohydrates, crop maturation and root development. Phosphorus is concentrated in cells with high metabolic activity. Both biomass and grain yield increased with the increasing P levels under different tillage depths and the increase was more with more tillage depth (Amanullah *et al.,* 2016). To address the aforesaid issues, a field study was planned to assess the effect of contrasting tillage practices and phos-

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phorus application rates on yield attributes, yield and economics of mungbean in Kandahar region of the Afghanistan.

The experiment was conducted at the experimental farm of Afghanistan National Agricultural Science & Technology University, Kandahar, Afghanistan (31°30' N, 65°50' E and 1010 m above the mean-sea level) during summer season of 2017. The site has semi-arid climate characterized by very low precipitation and high variation between summer and winter temperatures with annual mean temperature18.5°C. Average monthly temperature in Kandahar was 26.8°C. Total annual average precipitation is 190.6 mm. The soil of experimental field was clayey in texture. 'NM-94' genotype of mungbean was used in the study, which was semi-erect in nature and had vigorous growth and tolerant to mungbean yellow mosaic virus. The experiment consisted of 12 treatment combinations with 3-tillage practices and crop establishment practices, viz., Raised bed (RB), Zero till flat (ZT) and Conventional tillage (CT) in main plots and 4 P doses in sub-plots, viz. absolute control, 40 kg P_2O_5/ha, 60 kg P_2O_5/ha, and 80 kg P_2O_5/ha, was laid out in a split-plot design and replicated thrice. The source of P_2O_5 was triple super phoshphate and was applied as basal.

Yield attributes recorded at harvest from ten competitive plants of an individual plot. The seed and straw yields were recorded from net plot and converted into grain yield kg/ha. The seed samples from each net plot were sun-dried and weighed. After sun drying the weight of straw was taken. Harvest index (%) was calculated as (seed yield / biological yield) × 100. The cost of cultivation was worked out using market price (AFN/ha) of the inputs. The net returns and benefit: cost ratio (B: C ratio) were calculated using cost of cultivation and price of the mungbean seeds (AFN 70/kg) and straw (AFN 5/kg). The data recorded for different parameters were analyzed with the help of analysis of Variance (ANOVA) technique (Gomez and Gomez, 1984) for split-plot design using SAS 9.3 Software (SAS Institute, Cary, NC).

Pods/plant, seeds/pod and 1,000-seed weight (g) did not differ significantly by different tillage practices but the highest value of pods/plant, seeds/pod was recorded in raised bed plots (Table 1). Successive levels of phosphorus up to 80 kg P_2O_5/ha significantly influenced the numbers of pods/plant and the numbers of seeds/plant over absolute control. But 1000-seed weight was not significantly affected by P_2O_5 doses (Table 1). This could be attributed to the improvement through adequate availability of nutrients and soil moisture which, in turn, favorably influenced number of physiological processes and buildup of food material. Tillage practices recorded statistically similar values for yields and harvest index, while the highest values of seed yield (0.92 t/ha), stover yield (3.06 t/ha) and biological yield (3.97 t/ha) were recorded in raised bed plots, but the higher value for harvest index was recorded with zero tillage. The highest seed yield (0.98 t/ha), stover yield (3.26 t/ha) and biological yield (4.24 t/ha) registered with 80 kg P_2O_5/ha, which were statistically at par to 60 kg P_2O_5/ha and 40 kg P_2O_5/ha (Table 1). Similarly, the highest harvest index (23.4%) exhibited with application of 60 kg P_2O_5/ha. The improvement in yield attributes and yields might have been resulted from favorable influence of phosphorus nutrition such as greater nutrient uptake, efficient partitioning of metabolites and adequate

Table 1. Effect of different tillage practices and phosphorus application doses on yield attributes, yield and economics of mungbean

Treatment	Pods/ plant	Seeds/ pod	1,000-seeds weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)	Cost of cultivation (× 10^3 AFN/ha)	Net returns (× 10^3 AFN/ha)	Benefit: cost ratio
Tillage practices										
RB	17.0	7.8	41.2	0.92	3.06	3.97	22.9	24.2	55.2	2.27
ZT	15.6	7.6	41.8	0.89	2.95	3.84	23.1	23.6	53.2	2.23
CT	15.7	7.4	42.0	0.85	3.05	3.90	21.8	25.5	49.3	1.92
SEm±	0.31	0.16	0.78	0.028	0.043	0.067	0.4	-	21.0	0.08
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	-	NS	NS
Phosphorus (kg P_2O_5/ha)										
0	13.7	7.1	41.0	0.71	2.72	3.43	20.7	21.3	41.9	1.97
40	15.8	7.5	41.5	0.90	3.02	3.92	23.0	24.1	54.0	2.24
60	17.0	7.7	41.9	0.94	3.08	4.02	23.4	25.5	55.9	2.19
80	17.9	8.1	42.3	0.98	3.26	4.24	23.2	26.9	58.2	2.16
SEm±	0.32	0.14	0.46	0.019	0.059	0.063	0.48	-	1.4	0.06
CD (P=0.05)	0.95	0.40	NS	0.058	0.177	0.189	1.44	-	4.2	0.20

RB, Raised bed; ZT, Zero tillage; CT, Conventional tillage; AFN, Afghani (currency of Afghanistan)

translocation and accumulation of photosynthates, thereby improving the growth and development of plants. These results are in conformity with the results of Ali (1993) and Yadav and Jakhar (2001).

The highest cost of cultivation (25,536 AFN/ha) was incurred with conventional tillage practice, followed by raised bed (24,236 AFN/ha) and zero tillage (23,636 AFN/ha). Among P fertilization the highest cost of cultivation was recorded with 80 kg P_2O_5/ha (26,906 AFN/ha), followed by 60 kg P_2O_5/ha (25,511 AFN/ha), 40 kg P_2O_5/ha (24,122 AFN/ha) and the lowest was recorded with control (21,338 AFN/ha). The net returns and B: C ratio did not differ significantly in different tillage practices (RB, ZT or CT), but raised bed planting had higher values for net returns and benefit: cost ratio. Further, the highest net returns (58,238 AFN/ha) was recorded with 80 kg P_2O_5/ha. With respect to B: C ratio, application of 40 kg P_2O_5/ha was superior most, followed by 60 kg P_2O_5/ha. The higher net returns and B: C ratio under raised bed planting was due to higher seed yield in raised bed planting system (Aquino, 1998). The fertility level of 80 kg P_2O_5/ha resulted in the highest net return. Similar results were also recorded by Ali (1993). Therefore, to get the maximum farm profitability from mungbean crop in Kandahar region of the Afghanistan, the crop can be sown with zero till raised bed along with application of optimum dose of phosphorus.

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