

Influence of Different Land Configuration And Phosphorus Fertilizer Application On Growth And Yields Of Black-Eyed Bean

Feroz Babazoi^{✉1}, Omran Abdul Hadi² & Said Alem Alemyar³

¹Department of Agronomy, Faculty of Agriculture, Helmand University, Helmand, Afghanistan

²³Department of Agronomy, Faculty of Agriculture, Al-beroni University, Kapisa, Afghanistan

[✉]E-mail: ferozbabazoi2019@gmail.com (corresponding author)

ABSTRACT

A field experiment was carried out in Nawa-i-Barakzai District of Helmand province, Afghanistan, during the spring season (April, 30–August, 5) of 2025, to study the influence of different land configuration and phosphorus fertilizer application on growth parameters and yields performance of black-eyed bean (*Vigna unguiculata* L.) in Nawa-i-Barakzai District, Helmand province, arid region of Afghanistan. The treatments consisted of three land configuration treatments, viz. broadcast, line sown and raised bed planting method, allocated to main plots and four levels of phosphorus fertilization, viz. 0, 20, 40 and 60 kg P₂O₅/ha, in subplots. The experiment was conducted in a three-time replicated split plot. The result revealed that different land configuration significantly influenced growth parameters like plant height, leaf area, leaf area index, dry matter accumulation above-ground/plant, root dry weight/plant, number of nodules/plant at maximum flowering stage and tape root length/plant at maximum flowering stage. Numerically higher values for these parameters were observed under the raised bed planting method. Furthermore the , raised bed planting method significantly recorded the highest plant height (53.5 cm), leaf area (494.0 cm²), leaf area index (1.77), dry matter accumulation above-ground (41.4 g)/plant, root dry weight (2470.8 mg)/plant, number of nodules (2.39)/plant at maximum flowering stage and tape root length (25.0 cm) at maximum flowering stage. These improvements ultimately led to significantly higher yield attributes, seed yield and stover yield. Similarly higher seed and stover yields were also associated with the raised bed planting method. Among the phosphorus fertilizer application levels, application of 60 kg P₂O₅/ha, resulted in the highest values of all growth parameters, which led to significantly higher yield attributes, seed yield (2.18 t/ha) and stover yield (6.10 t/ha) compared to all other phosphorus levels.

ARTICLE INFO

Article history:

Received: January 11, 2026

Revised: February 2, 2026

Accepted: March 5, 2026

Published: March 31, 2026

Keywords:

Black-eyed bean; Different Land Configuration; Growth Parameters; Phosphorus Fertilizer Application; Yields

To cite this article: Babazoi, F., Hadi, O. A., & Fida, N. (2026) Influence of Different Land Configuration And Phosphorus Fertilizer Application On Growth And Yields Of Black-Eyed Bean. *Journal of Natural Science Review*, 4(1), 271-280. <https://doi.org/10.62810/jnsr.v4i1.398>

Link to this article: <https://kujnsr.com/JNSR/article/view/398>



Copyright © 2026 Author(s). This work is licensed under a Creative Commons Attribution-Non Commercial 4.0 International License.

INTRODUCTION

Black-eyed bean is one of the most important pulse crops of Afghanistan, ranking third after mung bean and black gram. It is grown as spring and summer crop after the harvesting of the

first crop which is either wheat or legumes. Black eyed bean is grown throughout the Afghanistan in different ecological zones. Herat, Farah, Kandahar, Nangarhar, Parwan, Kapisa and Kanduz, are the provinces where black-eyed bean is extensively cultivated.

However, the yield of black-eyed bean in Afghanistan is far below the biological potential of the existing black-eyed bean cultivars for want of appropriate production technologies like improved seed, different land configurations (broadcast, line sown and raised bed planting method), proper nutrient management, irrigation management, weed-control measures. Among the different agro-management practices, proper phosphorus management, and different land configurations (broadcast, line sown and raised bed planting method) are of prime significance to realize optimum yield potential of black-eyed bean, As the crop is highly responsive to both planting methods and phosphorus application rates.

This highly responsive of black-eyed bean to different land configurations (broadcast, line sown and raised bed planting method) might be attributed to better root growth due to better aeration and good soil air movement, might have also increased microbial activity with optimum moisture and nutrient availability for its growth (Shinde *et al.*, 2013). Joshi *et al.* (2018) reported the raised bed method of planting was significantly recorded higher growth parameters, seed yield (0.92 t/ha) and stover yield (1.99 t/ha) than line sown. Similarly, Pal *et al.* (2015) concluded growth parameters *viz.*, plant height, and dry matter accumulation, yields *viz.*, seed and stover yield found superior in raised bed followed by line sown and broadcast methods, respectively. Kumar and Singh (2014) reported significantly higher values of growth parameters *viz.*, plant height and dry matter accumulation/plant, and yields were higher under raised bed planting as compared to line sown methods. However, Shashikumar *et al.* (2013) concluded significantly higher seed yield (2.14 t/ha) was ascribed to raised bed planting method over other sowing methods which were significantly higher in growth parameters and yields.

Karimvand *et al.* (2013) reported that the effect of planting methods on all morphological traits was significant and the highest morphological traits were associated with raised bed planting method. Laleeta *et al.* (2017) concluded that among the phosphorus tested, the application of 120 kg P/ha resulted in the highest growth parameters, yield parameters, yield and quality of cowpea. Similarly, Singh *et al.* (2011) reported application of 60 kg P₂O₅/ha could be recommended for higher yield of cowpea (1.40 t/ha) relative to 0 kg P₂O₅/ha that yielded (1.0 t/ha). Similarly, Karikari *et al.* (2015) concluded the highest seed yield (1.68 t/ha) and (1.47 t/ha) for major and minor seasons, was significantly produced with application of 60 kg P₂O₅/ha.

These results indicate that response of black-eyed bean to different phosphorus levels is location specific. However, no research has been conducted on black-eyed bean with respect to its growth and yield performance response to different land configuration and phosphorus fertilizer application rates in Afghanistan. Hence the current investigation was carried out to evaluate the influence of different land configuration and phosphorus fertilizer application on

the growth and yield performance of black-eyed bean in Nawa-i-Barakzai District, Helmand province, arid region of Afghanistan.

METHODS AND MATERIALS

A field experiment was carried out during the spring season (April, 30–August, 5) of 2025, in Nawa-i-Barakzai District of Helmand province, Afghanistan (31°34' N, 64°21' E and 787 m above mean sea-level). The Soil of the experiment field was sandy clay boam, with pH 8.30. the climate of Afghanistan is semi-arid to subtropical with extreme cold and hot conditions. The hottest month is July, with the a mean maximum temperature of 31.9 °C, whereas the mean minimum temperature of the coldest month, January, falls in the range of 5.1 °C. the average monthly temperature of Helmand hovers around 26.8 °C, which is a moderate range. The average annual relative humidity is 38% and average monthly relative humidity ranges from 23% in June to 59% in February. Average normal annual rainfall of Helmand is about 190.6 mm. The experiment consisted of combinations of three different land configurations (broadcast, line sown and raised bed planting method) assigned to main plots and four levels of phosphorus fertilizer application (0, 20, 40, and 60 kg P₂O₅/ha) assigned to the rsub-plots. Ther treatments were arranged in a split-plot design with three repliations.

Seeds of black-eyed bean var. 'Cheshm Bulbuli' were sown manually on 30 April 2025 in broadcast (no-row arrangement), raised bed planting and line sown keeping line to line distance of 30 cm and plant-to-plant distance of 10 cm as per crop establishment method treatments, using a seed rate of 25 kg/ha for each crop establishment method. Two seeds/hill in raised bed planting and line sown were planted manually. In broadcast method, seeds were uniformly spread on a well-prepared field and buried in to soil with planking, later 1 plant/hill was maintained after thinning. Recommended doses of N was applied after preparation of a good seedbed as basal.

Weeding was done twice, 30 and 50 days after sowing (DAS) to keep the crop free from weeds. At the early growth stage (after 16 days of germination), the plants were attacked by army worms, which were removed by spraying crop with Cypermethrine @ 1.5 l/ha twice at 7 days' interval. The data on various yield-contributing characters and yield were recorded at harvesting of crop using standard procedures. Gross returns, net returns, and benefit: cost ratio were calculated on basis of prevailing market prices of inputs and produce. All data were analysed statistically by using analysis of variance technique for a split-plot design. Critical differences were worked out at 5% probability level.

FINDINGS

Plant height (cm), leaf area (cm²), leaf area index, above-ground dry matter accumulation (g)/plant root dry weight (mg)/plant, number of root nodules/plant at maximum flowering stage and tape root length (cm)/plant at maximum flowering stage were significantly influenced by different crop establishment methods (Table 1). The raised bed planting method resulted in significantly higher values for all parameters compared to the other methods. It recorded highest plant height (53.5 cm), leaf area (494.0 cm²), leaf area index (1.77), dry matter accumulation (41.4 g)/plant above-ground, root dry weight (2470.8 mg)/plant, root nodules (2.39)/plant at maximum flowering stage and tape root length (25.0 cm)/plant at maximum flowering stage followed by line sown plant height (49.4 cm), leaf area (482.7 cm²), leaf area index (1.58), dry matter accumulation (38.1 g)/plant above-ground, root dry weight (2244.2 mg)/plant, root nodules (1.94)/plant at maximum flowering stage and tape root length (22.5 cm)/plant at maximum flowering stage and broadcast methods plant height (47.8 cm), leaf area (466.5 cm²), leaf area index (1.44), dry matter accumulation (34.0 g)/plant above-ground, root dry weight (1921.7 mg)/plant, root nodules (0.97)/plant at maximum flowering stage and tape root length (20.9 cm)/plant at maximum flowering stage, respectively.

Application of different phosphorus levels affected significantly growth and yields performance of black-eyed bean. Among phosphorus levels, the highest plant height (55.1 cm), leaf area (512.8 cm²), leaf area index (1.76), dry matter accumulation (42.3 g)/plant above-ground, root dry weight (2510.0 mg)/plant, root nodules (2.96)/plant at maximum flowering stage and tape root length (24.3 cm)/plant at maximum flowering stage were significantly recorded with application of 60 kg P₂O₅/ha which was significantly better than 20 kg P₂O₅/ha and 40 kg P₂O₅/ha. The lowest values of growth parameters and yields were recorded in control.

Raised bed planting method significantly increased seed yield 11.4 and 35.5 % higher compared to line sown and broadcast methods, respectively (Table 1). Higher seed yield (2.18 t/ha) significantly was recorded with application of 60 kg P₂O₅/ha, being 7.9, 27.5 and 62.7 % higher than 40, 20 kg P₂O₅/ha and control respectively. Raised bed planting method significantly recorded 9.3 and 16.7 % higher stover yield than line sown and broadcast methods respectively. Among phosphorus levels, the highest stover yield was recorded with application of 60 kg P₂O₅/ha, which was 7.2 and 20.8 % higher than 20 and 40 kg P₂O₅/ha and the rest of the phosphorus fertilizer application levels (Table 1).

Interaction

Interaction effect, between different land configurations and phosphorus fertilizer application levels were significant on stover yield (t/ha). Application of 60 kg P₂O₅/ha, in raised bed planting, line sown and broadcast methods produced significantly the most stover yield (6.41, 6.08 and 5.80 t/ha), than 40 kg P₂O₅/ha which in turn increased significantly stover yield by 13.09%,

12.89% and 11.96% compared to 20 kg P₂O₅/ha. In control, raised bed planting method recorded significantly the maximum stover yield (5.00 t/ha) than line sown method which in turn recorded significantly higher stover yield (4.18 t/ha) than broadcast method (Table 2).

Different land configurations (broadcast, line sown and raised bed planting method) at same phosphorus fertilizer application levels affected significantly the stover yield (t/ha). Raised bed planting method with all applied levels of phosphorus (60, 40 and 20 kg P₂O₅/ha), increased significantly the stover yield by 5.42 and 10.51%, 7.73 and 16.98%, and 7.53 and 15.81% more compared to line sown and broadcast methods, respectively. Raised bed planting method with no phosphorus application significantly recorded the highest stover yield (5.00 t/ha) than line sown method which in turn also produced significantly the higher stover yield (4.18 t/ha) than broadcast method (Table 1).

Table 2. Influence of different land configuration and phosphorus fertilizer application on growth parameters and yields performance of black-eyed bean

Treatment	Plant height (cm)	Leaf area (cm ²)	Leaf area index	DMA (g)/plant A-ground	Root dry weight (mg)/plant	Root nodules/plant	Tape root length (cm)	Seed yield (t/ha)	Stover yield (t/ha)
Crop establishment methods									
Broadcast	47.8	466.5	1.44	34.0	1921.7	0.97	20.9	1.52	4.92
Line sown	49.4	482.7	1.58	38.1	2244.2	1.94	22.5	1.85	5.25
Raised bed planting	53.5	494.0	1.77	41.4	2470.8	2.39	25.0	2.06	5.74
SEm±	0.43	0.84	0.005	0.28	9.10	0.009	0.12	0.01	0.02
CD (P=0.05)	1.19	3.33	0.022	1.10	36.70	0.035	0.47	0.02	0.06
Phosphorus level (kg P₂O₅/ha)									
0	45.0	435.8	1.39	32.6	1921.1	0.81	21.2	1.34	4.38
20	49.3	473.7	1.54	37.0	2098.9	1.18	22.4	1.71	5.05
40	51.6	502.0	1.69	39.3	2318.9	2.11	23.3	2.02	5.69
60	55.1	512.8	1.76	42.3	2510.0	2.96	24.3	2.18	6.10
SEm±	0.19	0.84	0.013	0.28	10.56	0.008	0.13	0.01	0.01
CD (P=0.05)	0.40	2.48	0.040	0.84	31.62	0.024	0.39	0.02	0.04

Table 2. Interaction effect between different land configuration and phosphorus fertilizer application on stover yield (t/ha) of black-eyed bean

Treatment	Phosphorus level (kg P ₂ O ₅ /ha)				
	0	20	40	60	Mean
Crop establishment methods (CEM)					
Broadcast	3.95	4.68	5.24	5.80	4.92
Line sown	4.18	5.04	5.69	6.08	5.25
Raised bed planting	5.00	5.42	6.13	6.41	5.74
Mean	4.38	5.05	5.69	6.10	
		SEm±		CD (P=0.05)	
Main plot effect (crop establishment methods, CEM)		0.016		0.064	
Sub-plot effect (phosphorus levels)		0.013		0.040	
P levels at same CE method		0.032		0.079	
CE methods at same P level		0.026		0.087	

DISCUSSION

The raised bed planting method significantly recorded the highest plant height (53.5 cm), leaf area (494.0 cm²), leaf area index (1.77), dry matter accumulation (41.4 g)/plant above-ground, root dry weight (2470.8 mg)/plant, root nodules (2.39)/plant at maximum flowering stage and tape root length (25.0 cm)/plant at maximum flowering stage followed by line sown plant height (49.4 cm), leaf area (482.7 cm²), leaf area index (1.58), dry matter accumulation (38.1 g)/plant above-ground, root dry weight (2244.2 mg)/plant, root nodules (1.94)/plant at maximum flowering stage and tape root length (22.5 cm)/plant at maximum flowering stage and broadcast methods plant height (47.8 cm), leaf area (466.5 cm²), leaf area index (1.44), dry matter accumulation (34.0 g)/plant above-ground, root dry weight (1921.7 mg)/plant, root nodules (0.97)/plant at maximum flowering stage and tape root length (20.9 cm)/plant at maximum flowering stage, respectively. This superior performance under the raised bed method may be attributed to improved soil moisture regimes and better root proliferation, which likely enhanced drainage, nutrient availability, soil aeration, and the soil environment. These conditions may have promoted nitrogen fixation by nodule bacteria leading to improved growth and yield development. These results are in close conformity with those of Pal *et al.* (2015) and Joshi *et al.* (2018).

Among phosphorus levels, the highest plant height (55.1 cm), leaf area (512.8 cm²), leaf area index (1.76), dry matter accumulation (42.3 g)/plant above-ground, root dry weight (2510.0 mg)/plant, root nodules (2.96)/plant at maximum flowering stage and tape root length (24.3 cm)/plant at maximum flowering stage were significantly recorded with application of 60 kg P₂O₅/ha which was significantly better than 20 kg P₂O₅/ha and 40 kg P₂O₅/ha. The lowest values of growth parameters and yields were recorded in control. These results are in agreement with the finding of Jha *et al.* (2014) and Laleeta *et al.* (2017) and who reported phosphorus fertilizer had a significant ($p < 0.05$) effect on the entire growth parameters and yields of black-eyed bean.

Raised bed planting method significantly increased seed yield 11.4 and 35.5 % higher compared to line sown and broadcast methods, respectively. These findings are in consonance with the results of Sodavadiya *et al.* (2017) and Joshi *et al.* (2018) who reported that raised bed planting method was found significantly superior over line sown and broadcast methods with higher value of seed yield (0.95 t/ha) and (0.92 t/ha). Significantly higher seed yield (2.18 t/ha) was recorded with application of 60 kg P₂O₅/ha, being 7.9, 27.5 and 62.7 % higher than 40, 20 kg P₂O₅/ha and control respectively. Better source and sink development, and congenial micro-environment under raised bed planting method and with higher phosphorus fertilizer application levels resulted in better translocation of not only reserved but also concurrent photosynthates for filling the sink to its capacity for higher seed yield compared to other treatments. These results are in agreement with finds of Karikari *et al.* (2015) and Laleeta *et al.* (2017). Raised bed planting method significantly recorded 9.3 and 16.7 % higher stover yield than line sown and broadcast methods respectively. These results

are in close conformity with the finding of Pal *et al.* (2015), Sodavadiya *et al.* (2017) and Joshi *et al.* (2018) who reported that raised bed planting method significantly recorded the higher stover yield than line sown method. Among phosphorus levels, the highest stover yield was recorded with application of 60 kg P₂O₅/ha, which was 7.2 and 20.8 % higher than 20 and 40 kg P₂O₅/ha and the rest of the phosphorus fertilizer application levels. These findings corroborate the results of Jha *et al.* (2014).

Interaction effect, between different land configurations and phosphorus fertilizer application levels were significant on stover yield (t/ha). Application of 60 kg P₂O₅/ha, in raised bed planting, line sown and broadcast methods produced significantly the most stover yield (6.41, 6.08 and 5.80 t/ha), than 40 kg P₂O₅/ha which in turn increased significantly stover yield by 13.09%, 12.89% and 11.96% compared to 20 kg P₂O₅/ha. In control, raised bed planting method recorded significantly the maximum stover yield (5.00 t/ha) than line sown method which in turn recorded significantly higher stover yield (4.18 t/ha) than broadcast method.

Different land configurations (broadcast, line sown and raised bed planting method) at same phosphorus fertilizer application levels affected significantly the stover yield (t/ha). Raised bed planting method with all applied levels of phosphorus (60, 40 and 20 kg P₂O₅/ha), increased significantly the stover yield by 5.42 and 10.51%, 7.73 and 16.98%, and 7.53 and 15.81% more compared to line sown and broadcast methods, respectively. Raised bed planting method with no phosphorus application significantly recorded the highest stover yield (5.00 t/ha) than line sown method which in turn also produced significantly the higher stover yield (4.18 t/ha) than broadcast method. These results are in close conformity with the finding of Sodavadiya *et al.* (2017) who reported that the crop grown on raised bed, gets good drainage and aeration at all the critical growth stages. This might be the probable reason for higher stover yield.

CONCLUSION

From the above study, it could be concluded that in the arid regions of Afghanistan black-eyed bean can be successfully grown by planting on the raised bed and application of 60 kg P₂O₅/ha could be done for higher growth parameters and yields performance.

AUTHORS CONTRIBUTIONS

Omran Abdul Hadi conceptualized and supervised the study. Babazoi Feroz investigated and analyzed data. Said Alem Alemyar wrote the manuscript with input from all authors. All authors reviewed and approved the final version.

ACKNOWLEDGEMENTS

I thank so much the participants who gave their time to the trial.

FUNDING INFORMATION

No funding is available for the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

REFERENCES

- Jha, A.K., Shrivastava, A., & Raghuvansi, N.S. (2014). Effect of different phosphorus levels on growth, fodder yield and economics of various cowpea genotypes under Kymore plateau and Satpura hills zone of Madhya Pradesh. *International Journal of Agricultural Sciences*, 10(1), 409–411. [Link](#)
- Joshi, J.R., Patel, V.M., Barad, H.L., Macwan, S.M., & Ehsas, J. (2018). Effect of land configuration and fertilizer management practices on growth, yield and yield attributes and economics of summer cowpea (*Vigna unguiculata* L.) under South Gujarat Condition. *International Journal of Current Microbiology and Applied Sciences*, 7(1), 1148–1155. <https://doi.org/10.20546/ijcmas.2018.701.139>
- Karikari, B., Arkorful, E., & Addy, S. (2015). Nodulation and yield response of cowpea to phosphorus fertilizer application in Ghana. *Journal of Agronomy*, 14(4), 234–240. <https://doi.org/10.3923/ja.2015.234.240>
- Karimvand, P.N., Nejad, T.S., & Shokohfar, A.R. (2013). The effects of basin, raised bed and furrow planting methods on yield components of cowpea at different irrigation levels. *International Journal of Agriculture and Crop Sciences*, 6(20), 1407–2013. [Link](#)
- Kumar, B., & Singh, G.R. (2014). Response of land configuration, IW/CPE ratio and integrated nutrient supply system on growth function, yield and water use efficiency of French bean (*Phaseolus vulgaris* L. PDR–14). *International Journal of Agriculture, Environment & Biotechnology*, 7(4), 825–831. [Link](#)
- Laleeta, S., Kushwah, S.S., & Jayashri, B. (2017). Effect of phosphorus nutrition on growth, yield and quality attributes of cowpea [*Vigna unguiculata* L. Walp.]. *International Journal of Agriculture Sciences*, 9(20), 4211–4213. [Link](#)
- Pal, D., Dwivedi, A., Singh, P., & Tomar, S.S. (2015). Integrated effect of land configurations and weed management regimes on performance and productivity of urdbean (*Vigna mungo* L. Hepper). *International Journal of Applied Agricultural & Horticultural Sciences*, 6(6), 1250–1254. [Link](#)
- Shashikumar, M., Gowda, B., Hosamani, V., Manu, T.G., Santhosh, U.N, & Kamble, P.B. (2013). Studies on methods of planting on seed yield and quality of chickpea (*Cicer arietinum* L.) genotypes. *Global Journal of Biology, Agriculture & Health Science*, 2(1), 25–28. [Link](#)

- Shinde, P.B., Prajapati, D.R., Ali, S., & Munde, S.D. (2013). Soil fertility and quality parameter as influenced by INM in soybean grown during summer season under different land configuration. *Advance Research Journal of Crop Improvement*, 4(1), 70–73. [Link](#)
- Singh, A., Baoule, A.L., Ahmed, H.G., Dikko, A.U., Aliyu, U., Sokoto, M.B., Alhassan, J., Musa, M., & Haliru, B. 2011. Influence of phosphorus on the performance of cowpea (*Vigna unguiculata* (L) Walp.) varieties in the Sudan savanna of Nigeria. *Agricultural Sciences*, 2(3), 313–317. <https://doi.org/10.4236/as.2011.23042>
- Sodavadiya. H.B., Niak, V.R., & Chaudzohari, S.D. (2017). Effect of land configuration, irrigation and INM on growth, yield and water use efficiency of Indian bean (var. GNIB-21). *International Journal of Current Microbiology and Applied Sciences*, 6(7), 2624–2630. <https://doi.org/10.20546/ijcmas.2017.607.310>