



Effect of Different Phosphorus Levels and Mulch Types on Growth and Yield of Mung Bean

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/ijpss/2024/v36i84938>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/121342>

Original Research Article

Received: 16/06/2024

Accepted: 19/08/2024

Published: 21/08/2024

ABSTRACT

A field experiment was conducted at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan) during Rabi season of 2022-23 to effect of different nutrient management practices on growth and yield of mung bean variety "SML-832" was used in this study. The required quantities of nutrient as per treatments were applied. The experiment was laid out in randomized complete block design with four replications combinations four phosphorus levels *i.e.* P₀-Control- critical growth stages, P₁-20 kg P₂O₅, P₂-30 kg P₂O₅ and P₃-40 kg P₂O₅ and mulch types *i.e.* M₀-Control (No Mulch), M₁-Organic Mulch *i.e.* Bajra Bhusa @ 5t ha⁻¹, M₂-Black Polythene Sheet and M₃-Silver Colour Sheet.

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Cite as: Solanki, Akshayraj Singh, Chandrakanta Jakhar, Neelu Jain, and Indra Raj Yadav. 2024. "Effect of Different Phosphorus Levels and Mulch Types on Growth and Yield of Mung Bean". *International Journal of Plant & Soil Science* 36 (8):1058-67. <https://doi.org/10.9734/ijpss/2024/v36i84938>.

The increased growth attributes (Plant height, number of root nodules per plant, weight of nodules per plant and dry weight per plant), and yield parameter such as (Number of pods per plant, number of seed per pod, seed yield and stover yield) was recorded treatment with P₂ (30 kg P₂O₅) and M₁-Organic Mulch i.e. Bajra Bhusa @ 5t ha⁻¹.

Keywords: Mulch; phosphorus; mung bean; yield.

1. INTRODUCTION

Pulses are a staple food around the world, playing a key role in many traditional cuisines. In India, it is an important group of food crops that can play a vital role to address national food and nutritional security and also tackle environmental challenges. The leguminous grain crop known as "green gram," or botanically known as *Vigna radiata*, is noted for its great flexibility and minimal input requirements. India is one of the important mung bean growing countries in Asia with an area 8.7 million hectares and production of 8.83 million tonnes with a productivity of 1014 kg ha⁻¹ [1].

The most crucial ingredient for grain legumes is phosphorus, which is also an essential component of protein and nucleic acid and aids in the digestion of nitrogen. The most significant single factor affecting the quality and production of mung beans is deficiency, which is caused by its high fixation capacity and poor mobility. Legumes need more phosphorus for growth, nodulation, and nitrogen fixation than other plants do. This nutritional element has long been understood to be a necessary component of all living things and to be crucial for energy transmission and conservation in living cells' metabolic energy reactions, which include biological energy transformations. The phosphorus affects a number of biological processes, including membrane transport, cytoplasmic streaming, protein and phospholipid formation, nucleic acid synthesis, and photosynthesis.

Utilizing stored water effectively can result in increased productivity by using various management techniques. Mulching the soil to conserve water could also increase crop yields. Straw mulch improves grain output and water use efficiency by drastically lowering evaporation loss. However, the effects of straw mulch on mung bean yield have varied, primarily because of variations in meteorological circumstances.

Mulch also enhanced roots by changing the soil's hydrothermal regime. Improved roots facilitate the crop's ability to more effectively draw water from the soil, which results in a favorable plant

water status (as indicated by the temperature of the canopy). Mulches work best at preserving water in the wet range in conditions when evaporation is steady and regulated by atmospheric demand. Mulching has been emphasized by a number of researchers as a way to conserve soil water and increase crop output (Sharma et al., 1990).

2. MATERIALS AND METHODS

A field experiment was conducted during Rabi season of 2022-23 at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam in texture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.16%), deficient in available zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment was laid out in randomized complete block design with four replications. The required quantities of nutrients as per treatments were applied. The doses of phosphorus were applied in the form of single super phosphate. The growth and yield parameters were recorded as per standard calculations.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

The application of different phosphorus levels and mulch types have a noticeably significantly impact on plant height, number of nodules per plant, weight of nodules per plant and dry weight per plant. The information shown in Table 1 and Figs. 2 to 3 demonstrates how various phosphorus levels and mulch types have an influence on the growth attributes of mung bean.

Data presented in Table 1 and Fig. 2 indicated that differences in plant height due to different phosphorus levels and mulch types were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the highest plant height

(26.11, 38.89 and 50.50 cm). The minimum plant height was recorded (22.64, 30.69 and 42.43 cm) at 20, 50 DAS and harvest stages, respectively. Treatment M₁-Organic Mulch i.e. Bajra Bhusa @ 5t ha⁻¹ recorded significantly the highest plant height (25.08, 35.31 and 47.38 cm). The minimum plant height was recorded (21.90, 31.48 and 43.43 cm) at 20, 50 DAS and harvest stages, respectively. Similar result also reported by Bunna et al. [2], Trivedi et al [3] and Chakraborty et al. [4].

Data presented in Fig. 1 and Fig. 3 indicated that differences in number of root nodules per plant due to different phosphorus levels and mulch types were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the highest number of root nodules per plant (38.95). The minimum number of root nodules per plant was recorded (35.18). Treatment M₁-Organic Mulch i.e. Bajra Bhusa @ 5t ha⁻¹ recorded significantly the highest number of root nodules per plant (38.00). The minimum number of root nodules per plant was recorded (35.87).

Data presented in Fig. 1 and Fig. 3 indicated that differences in weight of nodules per plant due to different phosphorus levels and mulch types were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the highest weight of nodules per plant (44.45 mg/plant). The minimum weight of nodules per plant was recorded (36.85 mg/plant). Treatment M₂-Black Polythene Sheet recorded significantly the highest weight of nodules per plant (45.66 mg/plant). The minimum weight of nodules per plant was recorded (38.90 mg/plant). Similar concluded by Mitra et al [5] and Sekhon et al. [6].

Data presented in Fig. 1 and Fig. 3 indicated that differences in dry matter accumulation due to different phosphorus levels and mulch types were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the highest dry matter accumulation (15.85 g). The minimum dry matter accumulation was recorded (8.36 g). Treatment M₂-Black Polythene Sheet recorded significantly the highest dry matter accumulation (14.66 g). The minimum dry matter accumulation was recorded (8.25 g). This finding also supported by Bunkar et al [7], Chavan et al. [8] and Choudhary et al [9].

3.2 Yield Attributes

The application of different phosphorus levels and mulch types have a noticeably significantly impact on pods per plant, number of seed per

pod, seed yield and stover yield. The information shown in Table 2 and Fig. 3 demonstrates how various phosphorus levels and mulch types have an influence on the yield attributes and yield of mung bean.

Data presented in Table 2 indicated that differences in number of pods per plant due to different phosphorus levels were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the maximum number of pods per plant (30.68). The minimum number of pods per plant was recorded (26.51). Treatment M₁-Organic Mulch i.e. Bajra Bhusa @ 5t ha⁻¹ recorded significantly the maximum number of pods per plant (30.28), closely. The minimum number of pods per plant was recorded (25.75). Same result recorded by Gupta and Rao [10], Singh et al. [11], Imran et al. [12] and Khan et al. [13].

Data presented in Table 2 indicated that differences in number of seeds per pod due to different phosphorus levels were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the maximum number of seeds per pod (9.55). The minimum number of seeds per pod was recorded (6.02). Treatment M₁-Organic Mulch i.e. Bajra Bhusa @ 5t ha⁻¹ recorded significantly the maximum number of seeds per pod (9.20). The minimum number of seeds per pod was recorded (6.05).

Data presented in Table 2 and Fig. 3 indicated that differences in seed yield due to different phosphorus levels were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the maximum seed yield (1234.03 kg/ha). The minimum seed yield was recorded (585.42 kg/ha). Treatment M₁-Organic Mulch i.e. Bajra Bhusa @ 5t ha⁻¹ recorded significantly the maximum seed yield (1128.47 kg/ha). The minimum seed yield was recorded (795.83 kg/ha). These data also supported by Imran et al. [14] and Jahish et al. [15].

Data presented in Table 2 and Fig. 3 indicated that differences in straw yield due to different phosphorus levels were significant. Treatment P₂ (30 kg P₂O₅) recorded significantly the maximum straw yield (2303.47 kg/ha). The minimum straw yield was recorded (1714.58 kg/ha). Treatment M₁-Organic Mulch i.e. Bajra Bhusa @ 5t ha⁻¹ recorded significantly the maximum straw yield (2076.36 kg/ha). The minimum straw yield was recorded (1767.36 kg/ha). Similar results also concluded by Sapkota et al. [16], Singh et al. [17], Ram et al [18] and Singh et al [17],[19,20].

Table 1. Influence of different phosphorus levels and mulches type on growth attributes of mung bean

Treatment	Periodical Plant Height (cm)			Number of Nodules per Plant at 60 DAS	Weight of Nodules (mg/plant) at 45 DAS	Dry matter Accumulation (g) at Harvest
	20 DAS	50 DAS	At Harvest			
Main plot treatment: Phosphorus (P)						
P ₀ -Control- critical growth stages	22.64	30.69	42.43	35.18	36.85	8.36
P ₁ -20 kg P ₂ O ₅	23.20	31.3	43.86	36.54	40.28	12.45
P ₂ -30 kg P ₂ O ₅	26.11	38.89	50.5	38.95	44.45	15.85
P ₃ -40 kg P ₂ O ₅	23.48	33.32	45.91	36.81	42.82	13.45
S.Em. ±	0.77	0.88	1.02	0.72	1.01	0.98
C D. (5 %)	2.32	2.65	3.08	2.26	3.04	2.95
C.V. %	12.86	10.53	8.9	7.8	9.45	10.45
Sub plot treatment: Mulches (M)						
M ₀ -Control (No Mulch)	21.9	31.48	43.43	35.87	38.90	8.25
M ₁ -Organic Mulch i.e. Bajra Bhusa @ 5t ha ⁻¹	25.08	35.31	47.38	38	40.27	9.68
M ₂ -Black Polythene Sheet	24.28	33.99	46.30	36	45.66	14.66
M ₃ -Silver Colour Sheet	24.10	33.42	45.26	37.20	44.45	12.85
S.Em. ±	0.77	0.88	1.02	0.70	1.07	0.98
C D. (5 %)	2.32	2.65	3.09	2.11	3.22	2.95
Interaction (P x M)						
S. Em. ±	1.05	1.27	1.89	1.32	2.25	2.10
C D. (5 %)	NS	NS	NS	NS	NS	NS
C.V. %	8.81	7.52	8.27	7.13	10.60	8.58

Table 2. Influence of different phosphorus levels and mulches type on yield attributes and yield of mung bean

Treatment	Number of Pods Per Plant at harvest	Number of Seeds Per Pod	Seed Yield (kg ha ⁻¹)	Straw Yield (kg ha ⁻¹)
Main plot treatment: Phosphorus (P)				
P ₀ -Control- critical growth stages	26.51	6.02	585.42	1714.58
P ₁ -20 kg P ₂ O ₅	26.81	6.85	916.67	1756.94
P ₂ -30 kg P ₂ O ₅	30.68	9.55	1234.03	2303.47
P ₃ -40 kg P ₂ O ₅	27.64	8.98	1115.28	1978.47
S.Em. ±	0.81	0.19	48.51	60.93
C D. (5 %)	2.42	0.57	155.18	184.69
C.V. %	11.66	7.69	10.15	8.76
Sub plot treatment: Mulches (M)				
M ₀ -Control (No Mulch)	25.75	6.05	585.42	1767.36
M ₁ -Organic Mulch i.e. Bajra Bhusa @ 5t ha ⁻¹	30.28	9.20	916.67	2076.36
M ₂ -Black Polythene Sheet	27.89	8.02	1234.03	1993.75
M ₃ -Silver Colour Sheet	27.73	7.66	1115.28	1915.97
S.Em. ±	0.81	0.39	48.51	60.65
C D. (5 %)	2.42	6.88	155.18	182.58
Interaction (P x M)				
S. Em. ±	1,36	0.66	81.48	127.2
C D. (5 %)	NS	NS	NS	NS
C.V. %	9.73	7.02	9.92	11.12

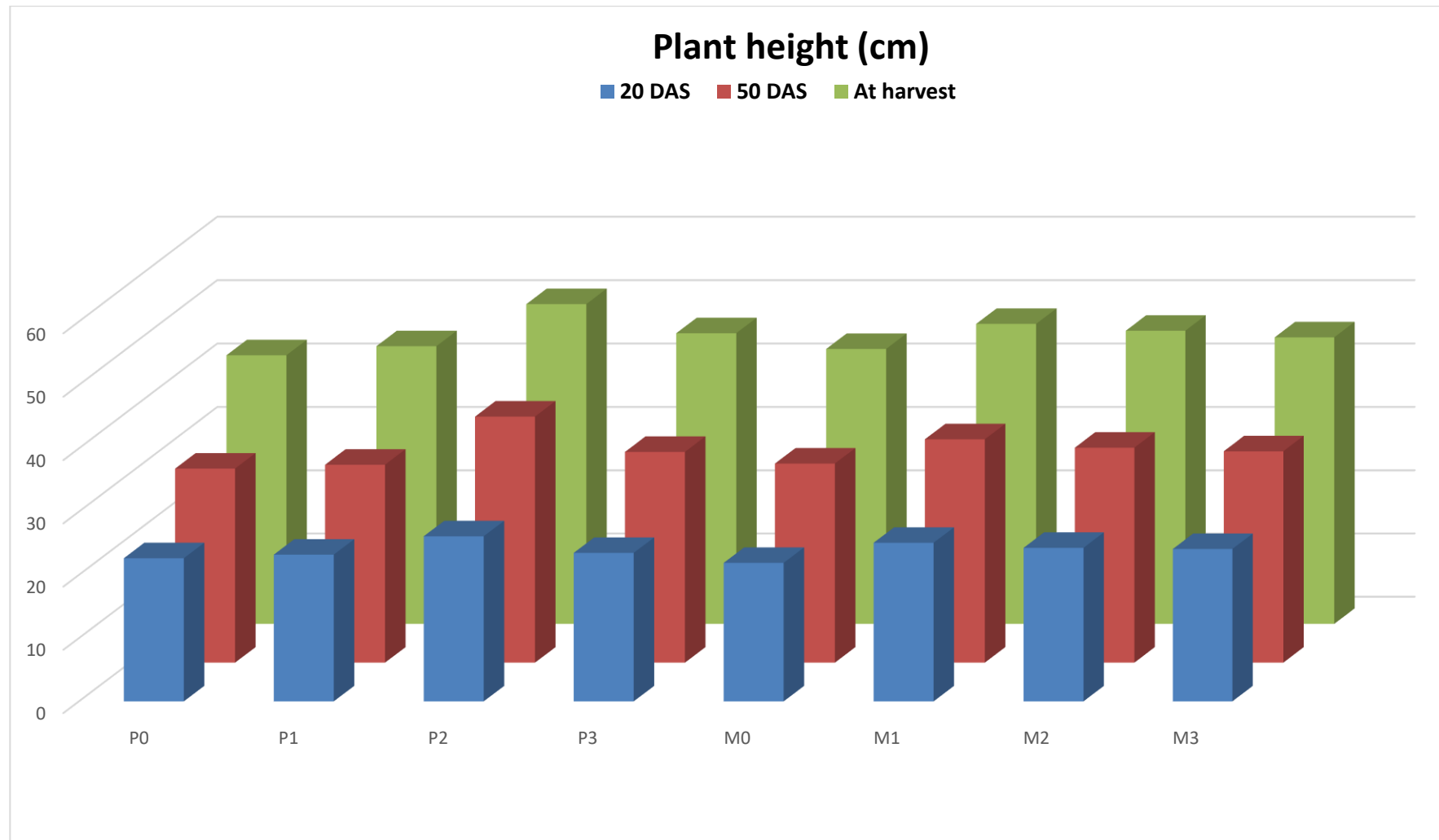


Fig. 1. Influence of different phosphorus levels and mulches type on plant height of mung bean

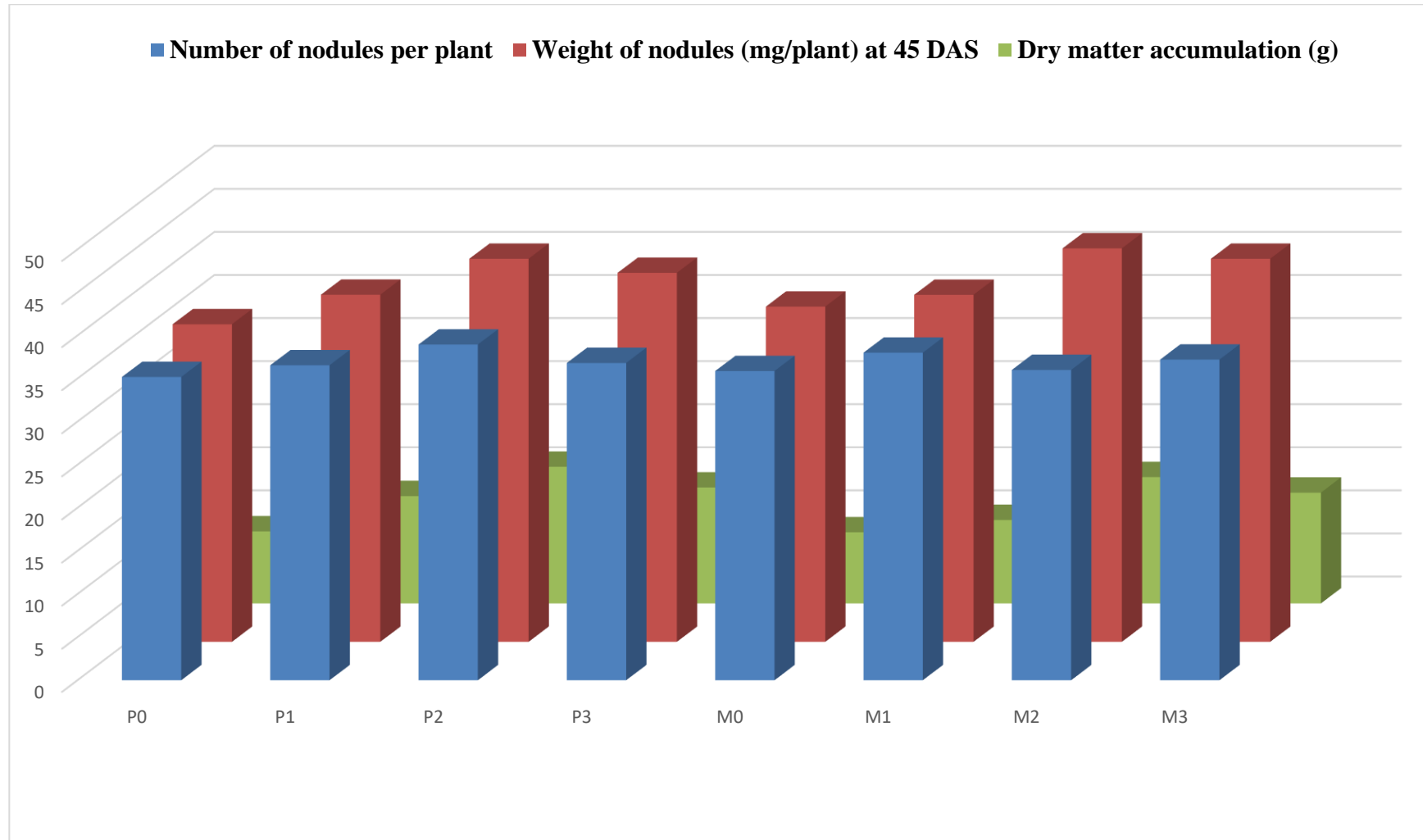


Fig. 2. Influence of different phosphorus levels and mulches type on growth attributes of mung bean

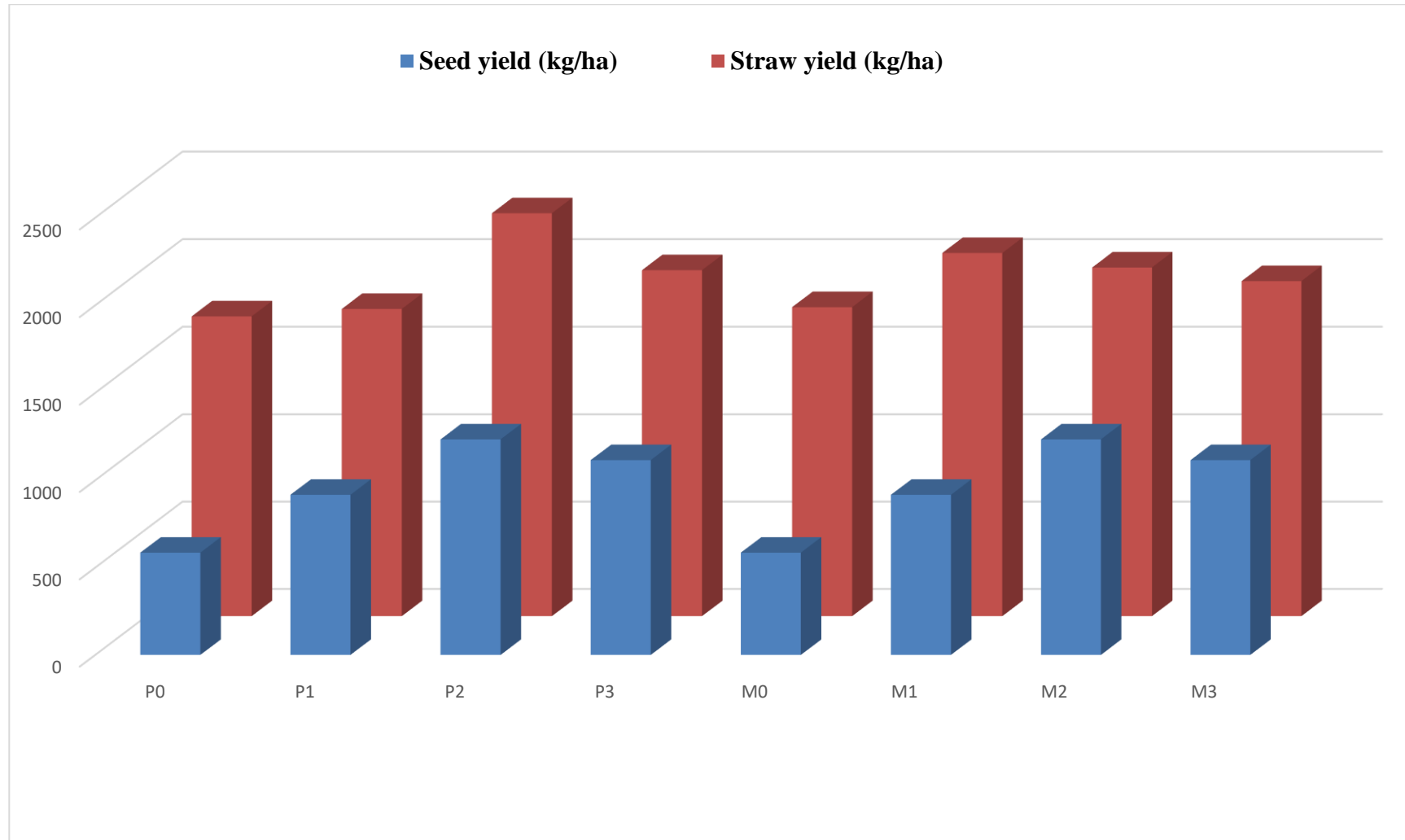


Fig. 3. Influence of different phosphorus levels and mulches type on yield of mung bean

4. CONCLUSION

On the basis of one-year experimentation it is advisable to apply (30 kg P₂O₅ kg/ha) and organic mulch *i.e.* Bajra Bhusa @ 5 t ha⁻¹ for securing higher growth and yield of mung bean. So, the combine application of 30 kg P₂O₅ kg/ha with Bajra Bhusa @ 5 t ha⁻¹ getting higher production.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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