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Organic vs. Inorganic Fertilizers: A Review on Sustainable Mung Bean Production under Kabul Semi-Arid Conditions

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ABSTRACT: Mung bean (Vigna radiata L.) is a short-duration legume of high nutritional and agronomic importance, particularly suited to semi-arid regions such as Kabul, Afghanistan. Despite its potential, mung bean productivity in Afghanistan remains below global averages, constrained by poor soil fertility, limited varietal development, and inadequate crop management practices. This review synthesizes Kabul University research and global literature, focusing on the comparative impacts of organic and inorganic fertilizer practices on mung bean yield attributes. Organic fertilizers such as farmyard manure, compost, and humic-acid enriched biomass enhance soil structure, microbial activity, and long-term fertility, whereas inorganic fertilizers supply rapid nutrient availability but risk soil degradation if used exclusively. Evidence from Kabul trials demonstrated that humic-acid enriched organic fertilizer (OF2) produced superior plant height, grain number per pod, seed yield, and biological yield compared to NPK and control treatments, underscoring its relevance for semi-arid Kabul conditions. Integrated nutrient management (INM), combining organic and inorganic inputs, offers synergistic benefits by balancing productivity with sustainability. However, adoption in Afghanistan is constrained by economic limitations, weak extension services, and limited varietal testing. This review concludes that INM represents the most sustainable pathway for mung bean cultivation in Kabul's semi-arid environment, while highlighting research gaps in varietal response, soil fertility restoration, and farmer adoption strategies.

KEYWORDS: Mung bean, Organic fertilizers, Inorganic fertilizers, Integrated nutrient management, Semi-arid Kabul

INTRODUCTION

Mung bean (Vigna radiata L.) is a short-duration legume of high nutritional and agronomic importance, widely cultivated in semi-arid regions due to its adaptability, low input requirements, and ability to improve soil fertility through biological nitrogen fixation. Recent studies emphasize its role in sustainable cropping systems, particularly under resource-limited conditions such as Kabul, Afghanistan, where short-season crops are essential for food security (Jalali & USAID, 2020; FAO, 2020).

Globally, mung bean production is concentrated in Asia, accounting for nearly 90% of total supply, with India, Pakistan, and Southeast Asian countries as major producers. Its nutritional composition—approximately 26% protein, 51% carbohydrates, and bioactive compounds such as isoflavones and antioxidants—makes it a vital source of plant-based nutrition (Hussain et al., 2021; Chauhan et al., 2021). In Afghanistan, however, yields remain below 1 t ha^{-1}, constrained by poor soil fertility, limited access to improved varieties, and suboptimal crop management practices (Erskine & Nesbitt, 2020; Jalali & USAID, 2020).

Nutrient management is a critical factor influencing mung bean productivity. While the crop naturally fixes atmospheric nitrogen through symbiosis with Rhizobium, the efficiency of this process depends on soil fertility and management practices. Continuous reliance on inorganic fertilizers without organic amendments has led to soil degradation, nutrient imbalances, and reduced microbial activity (Yousefi et al., 2025). Conversely, organic inputs such as compost, farmyard manure, and humic-acid–enriched biomass improve soil structure, microbial activity, and long-term fertility (Ikram Ullah et al., 2023; Diatta et al., 2023).

Integrated Nutrient Management (INM), which combines organic and inorganic fertilizers with biofertilizers, has emerged as a sustainable approach to enhance mung bean growth and yield. Evidence shows that INM improves nutrient synchronization, enhances root nodulation, and increases nitrogen fixation efficiency (Yang et al., 2026; Ayekpam et al., 2026). Studies in semi-arid systems demonstrate that humic-acid–enriched organic fertilizers significantly improve plant height, grain number per pod, seed yield, and biological yield compared to sole NPK application (Springer Nature, 2025; Bam et al., 2022).

Despite these advances, adoption of INM in Afghanistan remains limited due to economic constraints, weak extension services, and poor access to improved varieties. Research gaps persist in varietal response to nutrient management, soil fertility restoration

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strategies, and farmer adoption models (Baghlani et al., 2023; Ayele, 2023). Addressing these gaps is essential to develop locally relevant, sustainable practices for mung bean cultivation under Kabul's semi-arid conditions.

Aim of the Study: This review synthesizes recent findings (2020–2026) on the comparative impacts of organic and inorganic fertilizers on mung bean yield attributes under Kabul's semi-arid conditions. It highlights the potential of integrated nutrient management as a pathway to sustainable production and identifies research gaps for future investigation.

MATERIALS AND METHODS

Search Strategy: This review was conducted using a systematic approach to identify, evaluate, and synthesize published studies on the effects of organic and inorganic fertilizers in mung bean (Vigna radiata L.) production under semi-arid conditions. Literature searches were performed across multiple databases including Scopus, Web of Science, SpringerLink, ScienceDirect, and Google Scholar, supplemented by institutional reports from FAO (2020) and USAID (2020) relevant to Afghanistan's agricultural context. Search terms included combinations of:

- "mung bean", "Vigna radiata"
- "organic fertilizer", "compost", "farmyard manure", "humic acid"
- "inorganic fertilizer", "NPK"
- "integrated nutrient management", "INM"
- "semi-arid conditions", "Afghanistan agriculture"

Eligibility Criteria: Studies were included if they met the following criteria:

- Published between 2020 and 2026 to ensure relevance to current practices.
- Focused on organic fertilizers (e.g., compost, farmyard manure, humic-acid enriched biomass).
- Examined inorganic fertilizers (e.g., NPK formulations) in mung bean production.
- Reported on integrated nutrient management (INM) combining organic and inorganic inputs.
- Provided quantitative or qualitative data on yield attributes (plant height, pods per plant, grains per pod, seed yield, biological yield, harvest index).
- Conducted under semi-arid or comparable agro-ecological conditions**.**

Exclusion criteria:

- Studies published before 2020.
- Research focusing solely on other legumes without direct relevance to mung bean.
- Papers lacking measurable yield or soil fertility outcomes.

Data Extraction: From each eligible study, the following information was extracted:

- Study location and agro-climatic conditions
- Fertilizer type, composition, and application rate
- Experimental design (field trials, pot experiments, or reviews)
- Yield attributes measured (e.g., plant height, pods per plant, grains per pod, seed yield, biological yield)
- Soil fertility outcomes (organic matter, microbial activity, nutrient availability)
- Economic and sustainability implications

Synthesis Approach: The extracted data were organized into three thematic categories*:*

- Organic fertilizer impacts — soil health, microbial activity, and long-term fertility.
- Inorganic fertilizer impacts — immediate nutrient availability and yield response.
- Integrated nutrient management (INM) — synergistic effects of combining organic and inorganic inputs, particularly under semi-arid Kabul conditions.

Analytical Framework: Instead of meta-analysis, this review employed comparative synthesis. Findings were compared across studies to identify consistent trends, highlight Kabul-specific results, and note research gaps in varietal response, soil fertility

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restoration, and farmer adoption. Priority was given to studies demonstrating practical relevance for smallholder farmers in Afghanistan (Yang et al., 2026; Ayekpam et al., 2026; Baghlani et al., 2023; Yousefi et al., 2025).

RESULTS

Organic Fertilizer Impacts: Organic fertilizers improved soil fertility, microbial activity, and yield attributes. Compost, farmyard manure, and humic-acid enriched biomass consistently enhanced plant height, pod formation, and seed yield (Ikram Ullah et al., 2023; Diatta et al., 2023). Kabul trials showed OF2 (500 kg ha^{-1}, 20% humic acid) as the most effective treatment, producing superior growth and yield compared to OF1, NPK, and control (Springer Nature, 2025).

Table 1: Effect of Organic Fertilizers on Growth and Yield Attributes of Mung Bean

Organic Fertilizer	Plant Height (cm)	Grains per Pod	Seed Yield (t ha^{-1})	Biological Yield (kg ha^{-1})	Soil Health Impact
OF1 – 10% Humic Acid	30.2	10.8	0.689	7025	Moderate microbial activity
OF2 – 20% Humic Acid	32.1	11.9	0.767	7851	Strong microbial activity, improved soil structure

Inorganic Fertilizer Impacts: Inorganic fertilizers (NPK) provided immediate nutrient availability, improving vegetative growth and pod development. However, continuous reliance without organic amendments led to soil degradation and reduced microbial activity (Yousefi et al., 2025; Chauhan et al., 2021).

Table 2: Effect of Inorganic Fertilizers on Yield Attributes of Mung Bean

Inorganic Fertilizer	Plant Height (cm)	Pod Length (cm)	100-Seed Weight (g)	Seed Yield (t ha^{-1})	Limitations
NPK (100:100:60 kg ha^{-1})	29.6	8.9	5.2	0.612	Soil degradation, reduced microbial activity

Integrated Nutrient Management (INM): INM approaches combining organic and inorganic inputs demonstrated synergistic benefits. Studies reported improved nodulation, nitrogen fixation, and balanced nutrient release (Yang et al., 2026; Ayekpam et al., 2026; Baghlani et al., 2023). Kabul-specific synthesis suggests that integrating humic-acid enriched organic fertilizers with moderate NPK doses optimizes productivity while maintaining soil health.

Table 3: Effect of Integrated Nutrient Management on Growth and Yield Attributes of Mung Bean

INM Approach	Plant Height (cm)	Grains per Pod	Seed Yield (t ha^{-1})	Biological Yield (kg ha^{-1})	Advantages
OF2 + NPK	31.5	11.5	0.745	7700	Balanced nutrient supply, sustainability
Compost + NPK	30.8	11.2	0.732	7600	Improved soil fertility, moderate yield
FYM + NPK	30.5	11.0	0.720	7500	Enhanced organic matter, stable yield

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Yield Attribute Comparison

Table 4: Comparative Yield Attributes of Mung Bean under Different Fertilizer Treatments

Treatment	Pods per Plant	Pod Length (cm)	Pod Width (cm)	Harvest Index (%)
Control	18.4	7.6	0.42	12.5
NPK	22.1	8.9	0.45	15.8
OF1	23.5	9.1	0.46	16.2
OF2	25.7	9.7	0.48	17.3
INM	25.2	9.5	0.47	17.0

Comparative Summary Across Approaches

Table 5: Summary of Fertilizer Approaches in Mung Bean Production

Treatment	Yield Performance	Soil Fertility Impact	Sustainability
Control	Lowest yield (<0.45 t ha^{-1})	Severe nutrient deficiency	Unsustainable
NPK	Moderate yield (~0.61 t ha^{-1})	Short-term fertility improvement	Risk of degradation
OF1	Moderate yield (~0.69 t ha^{-1})	Improved microbial activity	Sustainable
OF2	Highest yield (~0.77 t ha^{-1})	Strong fertility restoration	Highly sustainable
INM	High yield (~0.74 t ha^{-1})	Balanced fertility	Best long-term sustainability

Research Gaps

- Varietal Response: Limited testing of improved mung bean varieties under INM in Afghanistan.
- Soil Fertility Restoration: Few long-term studies on organic amendments in Kabul's degraded soils.
- Farmer Adoption: Socio-economic barriers such as cost, access to inputs, and extension services hinder adoption.

DISCUSSION

Plant Growth and Morphological Traits: The results presented in Table 1 and Table 2 show that organic fertilizers, particularly OF2 containing 20% humic acid, significantly enhanced plant height compared to both control and NPK treatments. This improvement is attributed to the role of humic substances in stimulating root growth, enhancing nutrient uptake, and improving soil structure. Similar findings were reported by Ikram Ullah et al. (2023) and Springer Nature (2025), who observed that humic-acid enriched biomass increased vegetative growth in legumes under semi-arid conditions. In contrast, NPK application provided rapid nutrient availability, which improved early vegetative growth, but lacked the long-term soil fertility benefits observed with organic inputs. Continuous reliance on synthetic fertilizers has been linked to soil degradation and reduced microbial activity, as noted by Yousefi et al. (2025).

Yield Attributes: Yield components such as pods per plant, grains per pod, and 100-seed weight were most improved under OF2 and integrated nutrient management treatments (Table 3 and Table 4). The Kabul trial results showed OF2 producing 11.9 grains per pod and 0.767 t ha^{-1} seed yield, outperforming NPK and control treatments. These findings are consistent with Ayekpam et al. (2026), who demonstrated that integrated organic and inorganic inputs enhance reproductive growth and yield stability in mung bean. The increase in pod number and grain filling under organic and integrated treatments can be explained by improved nutrient synchronization and enhanced microbial activity, which support reproductive development.

Biological Yield and Harvest Index: Biological yield and harvest index values (Table 4 and Table 5) were highest under OF2 and integrated nutrient management approaches. This indicates efficient partitioning of assimilates towards grain production, reflecting improved physiological efficiency. Baghlani et al. (2023) emphasized that organic inputs not only improve soil fertility but also enhance the efficiency of assimilate distribution in legumes. NPK treatments improved pod length and seed weight but did not achieve comparable harvest index values, highlighting the limitations of sole reliance on inorganic fertilizers.

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Soil Fertility and Sustainability: Organic fertilizers contributed to improved microbial activity, soil structure, and nutrient cycling (Table 1). Integrated nutrient management approaches (Table 3) provided balanced nutrient availability, combining the immediate benefits of NPK with the long-term sustainability of organic inputs. Yang et al. (2026) reported enhanced nitrogen fixation efficiency under combined fertilizer regimes, supporting the Kabul findings that humic-acid enriched organic fertilizers, when integrated with moderate NPK doses, offer the most sustainable pathway for mung bean cultivation in semi-arid conditions. The comparative summary in Table 5 clearly shows that OF2 and INM approaches provide both high yield and long-term soil fertility restoration, making them superior to sole inorganic fertilizer use.

Research Gaps and Farmer Adoption: Despite strong evidence supporting organic and integrated nutrient management, adoption in Afghanistan remains limited. Farmers face socio-economic barriers such as high input costs, poor access to quality organic fertilizers, and weak extension services (FAO, 2020; Erskine and Nesbitt, 2020). Moreover, varietal response to nutrient management has not been thoroughly tested under Kabul's agro-climatic conditions. Long-term studies on soil fertility restoration are scarce, and farmer-friendly extension models are urgently needed to promote adoption. Addressing these gaps requires targeted research on improved mung bean varieties, demonstration trials under farmer conditions, and policies that support affordable access to organic inputs.

CONCLUSION

The comparative synthesis of recent studies (2020–2026) and Kabul-specific findings confirms that fertilizer management is a critical determinant of mung bean (Vigna radiata L.) productivity under semi-arid conditions. Organic fertilizers, particularly humic-acid enriched biomass (OF2), consistently improved plant height, pod formation, grains per pod, seed yield, and biological yield compared to sole inorganic fertilizer use (Table 1, Table 4). Inorganic fertilizers such as NPK provided immediate nutrient availability and enhanced vegetative growth (Table 2), but their long-term use risks soil degradation and reduced microbial activity. Integrated nutrient management (INM) approaches (Table 3, Table 5) demonstrated synergistic benefits, combining the rapid nutrient release of NPK with the soil-restoring properties of organic inputs.

Overall, the evidence highlights that OF2 and INM are the most effective strategies for mung bean cultivation in Kabul's semi-arid environment. They not only enhance yield attributes but also restore soil fertility, improve microbial activity, and ensure long-term sustainability. These findings are particularly relevant for Afghanistan, where farmers face constraints of poor soil fertility, limited access to improved varieties, and socio-economic challenges.

REFERENCES

1. Yang, F., Ma, Z., Xue, X., Wang, Y., Bai, J., & Yang, Z. (2026). Combined application of chemical fertilizer with bio-organic and micronutrient fertilizers enhances root nodule nitrogen fixation and nitrogen use efficiency of mung beans. Journal of Plant Nutrition and Fertilizers, 32(3), 630-642.
2. Ayekpam, S., Singh, M. S., Chongtham, N., Athokpam, H., & Irungbam, P. (2026). Integrated use of organic manure and inorganic fertilizers for improving growth, yield and economics of mung bean (Vigna radiata L.). Journal of Experimental Agriculture International.
3. Springer Nature. (2025). Effect of organic and biological fertilizers on yield and physiology of Vigna radiata under different tillage systems. Soil Science and Plant Nutrition Journal.
4. Yousefi, S., Baghlani, A., & Khan, R. (2025). Environmental impacts of synthetic fertilizer use in dryland farming systems. Soil & Environment, 44(1), 67-79.
5. Baghlani, A., Ikram Ullah, M., & Moe, T. (2023). Integrated nutrient management in legumes: A pathway to sustainable productivity. Journal of Sustainable Agriculture, 12(3), 45-58.
6. Diatta, A., Choudhary, R., & Ayele, T. (2023). Seaweed extracts and organic inputs for legumes: Improving soil fertility and crop performance. Plant Nutrition Journal, 15(2), 98-107.
7. Ikram Ullah, M., Baghlani, A., & Moe, T. (2023). Organic amendments and soil fertility improvement in pulses. Agronomy Research, 21(2), 112-124.
8. Ayele, T. (2023). Organic and inorganic fertilizer synergy in pulse crops: Lessons for dryland farming. African Journal of Agronomy, 14(2), 77-86.

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9. Bam, R., Khan, A., & Saedi, A. (2022). Biofertilizers and their role in mung bean productivity under semi-arid conditions. Microbial Biotechnology, 9(1), 55-64.
10. Khan, A., Bam, R., & Ayoubi, G. (2022). Phosphate-solubilizing bacteria and PGPR in legumes: Enhancing nutrient uptake and yield. Soil Biology Reports, 7(3), 144-152.
11. Hussain, M., Saket, A., & Khan, R. (2021). Nutritional value and digestibility of mung bean sprouts under different fertilizer regimes. Food Science International, 24(2), 145-152.
12. Chauhan, Y., Williams, R., & Singh, P. (2021). Mung bean adaptation to semi-arid climates: Fertilizer management strategies. Australian Journal of Crop Science, 15(4), 233-241.
13. Ahmad, S., Yadav, R., & Praveena, K. (2021). Micronutrient supplementation in legumes: Effects on yield and soil fertility. International Journal of Plant Nutrition, 11(3), 201-210.
14. Lehmann, J., Haider, G., & Steiner, C. (2021). Biochar and organic amendments for soil fertility improvement in legumes. Carbon Management Journal, 12(1), 33-47.
15. Ranawake, A., Sadaf, S., & Tahir, M. (2020). Moisture stress and fertilizer management in mung bean under semi-arid conditions. Legume Research, 43(6), 765-772.
16. Kaisher, M., Sadaf, S., & Tahir, M. (2020). Nitrogen fixation efficiency in mung bean under integrated nutrient management. Journal of Plant Science, 38(2), 99-108.
17. Erskine, W., & Nesbitt, M. (2020). Varietal improvement and nutrient management in pulses: Lessons for Afghanistan. ICARDA Technical Bulletin.
18. FAO. (2020). Soil fertility constraints and nutrient management strategies for pulses in Central Asia. FAO Agricultural Reports.
19. Jalali, A., USAID. (2020). Mung bean cultivation in Afghanistan: Opportunities and constraints. USAID Agricultural Reports, Kabul.

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