MedCrave Step into the World of Research

Journal of Historical Archaeology and Anthropological Sciences

Research Article Open Access CrossMark

Agronomic, historical, and socio-economic dimensions of Mung bean (*Vigna radiata* L. Wilczek)

Abstract

This study explores the historical migration and cultivation expansion of mung beans (*Vigna radiata*) over the past 4,500 years, highlighting their nutritional benefits and significant role in global agriculture. Originating in ancient India, mung beans spread across Southeast Asia, Africa, South America, and Australia, becoming essential to various diets and agricultural systems. The research emphasizes the importance of optimal cultivation practices and sustainable agricultural methods to enhance yields and soil fertility. It also underscores the need for international breeding programs to improve mung bean resilience and adaptability, contributing to global food security. The study's findings are based on a qualitative descriptive design and an extensive literature review, identifying key themes and patterns in mung bean history, cultivation, and use.

Keywords: mung bean, *vigna radiata*, green gram, nutritional benefits, crop rotation, sustainable agriculture, genetic diversity, pest resistance, climate adaptation, global food security

Volume 9 Issue 2 - 2024

Romualdo Generalao,[1] Skye Anitra S Largo,[2] James S Pino,[3] Mark Steven Pandan,[4] Joseph Florenz B Rodriguez[5]

[1]Graduate Faculty, College of Arts and Sciences, Cebu Normal University, Philippines
[2]Graduate State Scholar, College of Teacher Education, Cebu Normal University, Philippines
[3]Faculty, College of Education, Lapu-Lapu City College, Philippines
[4]Faculty, College of Education, Holy Name University, Philippines
[5]Faculty, Senior High School Department, University of Bohol, Philippines

Correspondence: Mark Steven A Pandan, Holy Name University, Tagbilaran City, Bohol, Philippines, Email mpandan@hnu.edu.ph

Received: July 21, 2024 | **Published:** August 06, 2024

Introduction

Mung bean (*Vigna radiata* L. Wilczek), also known as green gram, is native to India and widely grown in Asia and other regions. This legume, characterized by its green colour and circular shape, is versatile and nutritious, rich in high-quality protein, and commonly consumed in various forms such as whole grains, dhal, or sprouts. It complements rice well, contributing to a balanced diet. Additionally, mung bean enhances soil fertility through nitrogen fixation. The plant grows to about 60-76 cm with a branched structure, trifoliate leaves, and deep roots. Clusters of 12-15 pale yellow flowers develop into cylindrical pods containing nearly globular seeds. These seeds have a protective seed coat, cotyledon, and embryo, with distinctive features like the micropyle and hilum for water absorption and seed formation. Mung bean shares a genus with adzuki and cowpea, differing mainly in species. It has an upright growth habit but can exhibit vine-like tendencies. The root system includes a well-developed taproot and lateral roots, with a branched stem covered in spreading hairs. Leaves are alternately arranged and typically trifoliate, with stipules and petioles. The pods mature to a yellowish-brown to black, each containing 10-15 seeds that vary in colour and shape depending on the variety.

Mung bean differs from black gram primarily in corolla colour and pod orientation. It is known by various names across cultures, reflecting its global cultivation and culinary significance. Its rich history, nutritional value, and adaptability make it an essential subject for research, particularly in understanding its role in agriculture, diet, and global food security.

Therefore, this research seeks to answer the following questions:

a) What are mung bean's historical migration routes and cultivation expansion patterns over the past 4,500 years?

b) What are the nutritional benefits, culinary applications, and optimal cultivation practices for mung beans in various climates and soil types?

c) How do mung bean production processes, distribution patterns, and environmental impacts affect global agriculture and food security?

Material and methods

This study uses a qualitative descriptive design, focusing on an extensive literature review to explore several aspects of mung beans. These include historical migration routes, cultivation expansion patterns, nutritional benefits, culinary applications, optimal cultivation practices, and their production and distribution impacts on global agriculture and food security. The data collection involves thoroughly reviewing existing literature and gathering information from scholarly articles, historical texts, agricultural reports, and other relevant documents. The analysis technique employed in this research involves thematic analysis, which identifies, analyzes, and reports patterns (themes) within the data. This method allows for a comprehensive understanding of the various aspects of mung beans, synthesizing information from diverse sources to provide a detailed narrative of their historical and contemporary significance.

Results and discussion

Historical and geographical spread of mung beans

The historical migration routes and cultivation expansion patterns of mung beans (*Vigna radiata*) have evolved over 4,500 years, starting in ancient India and spreading across Southeast Asia, Africa, South America, and Australia. Initially cultivated in the Indian subcontinent, mung beans were significant in the diets and traditional medicine of early Indian societies. Ancient texts and archaeological evidence suggest that these legumes were prized for their high protein content and ease of cultivation, making them a crucial staple for nourishment and Ayurvedic practices.

As cultural exchange and trade routes developed, mung beans spread from India to Southeast Asia. They reached Thailand, Vietnam, and Indonesia, where the warm, humid climates were ideal for their growth. These regions, known for their diverse culinary traditions, quickly integrated mung beans into various dishes and desserts. The beans were transported along with goods and cultural practices, becoming essential to local diets and agriculture.

The migration of mung beans continued northward into China, notably gaining prominence during the Han dynasty (206 BCE – 220 CE). The Chinese utilized mung beans in numerous ways, including sprouted beans, starch noodles, and medicinal preparations. This period marked a significant integration of mung beans into Chinese culinary culture, driven by the beans' nutritional benefits and versatility in cooking. In the Philippines, mung beans likely arrived through early trade routes that connected the archipelago with other parts of Southeast Asia and the broader Indian Ocean trade network. The tropical climate of the Philippines proved conducive to mung bean cultivation, allowing the crop to thrive in various regions. Mung beans were particularly valued for their short growing season, typically around 60 to 90 days, making them an efficient and reliable crop for farmers. They were often grown as a secondary crop after rice, maximizing agricultural land use and resources.

Incorporating mung beans into Philippine agriculture brought several benefits, including enhancing soil fertility through nitrogen fixation, which reduces the need for chemical fertilizers. This improvement in soil health made mung beans an essential component of crop rotation systems, promoting long-term agricultural productivity and sustainability. Mung beans also became a crucial dietary component for many Filipinos, providing a rich source of protein, vitamins, and minerals, particularly in rural areas with limited access to diverse and nutrient-rich foods. Mung beans also became deeply embedded in Filipino cuisine, featuring in traditional dishes like "ginisang monggo" and "mongo guisado." These dishes highlight the beans' versatility and cultural significance, with mung beans celebrated in local festivals and markets, reflecting their role in local economies and heritage. Economically, mung beans provide a valuable income source for small-scale farmers, offering a low-input, high-reward crop option that supports agricultural diversification and resilience.

As trade and exploration expanded, mung beans spread westward along the Silk Road, reaching the Middle East. They were prized in the region for their nutritional value and adaptability to local cooking styles, becoming a common ingredient in various dishes. The beans' journey continued to Africa, where they adapted well to the continent's diverse climates and soils. In African cuisines, known for their rich and hearty dishes, mung beans were incorporated into stews and soups, becoming a reliable and nutritious food source that enhanced food security in many regions. During the Age of Exploration, European explorers and traders brought mung beans to Europe and the Americas. While they did not become as widespread in Europe, mung beans found a niche in certain agricultural regions of the Americas. The introduction of mung beans to the New World was facilitated by European colonization and trade networks, and they were appreciated for their quick growing season and nutritional benefits.

Nair and Schreinemachers[1] provide a detailed account of mung beans' global distribution and historical significance, emphasizing their adaptability to various climatic conditions, including heat and drought. This adaptability has enabled mung beans to expand beyond traditional regions, supported by international collaborations and public sector initiatives focused on genetic improvement and dissemination. These efforts have been crucial in enhancing mung beans' resilience and adaptation across different agro-ecological zones.

Manjunatha[2] trace the origins and domestication of mung beans to the Indo-Burma region, identifying it as the primary Centre of genetic diversity. The study highlights the spread of mung beans from this region to other parts of Asia, including Southeast and East Asia, facilitated by early agricultural practices and trade. The Indo-Gangetic Plains are noted for their rich genetic diversity of mung beans, which has been vital for the crop's adaptation to various environments. The spread of mung beans also reached the Middle East, East Africa, and Australia, demonstrating the crop's broad dissemination and the role of genetic diversity in supporting cultivation in diverse climatic regions.

Ong et al.,[3] utilize genomic sequencing, climatic niche modelling, and historical records to explore the global spread of mung beans. Their research underscores the significant influence of climatic factors, such as water availability, on mung beans' expansion from South Asia to other regions. This study illustrates the complex interplay between environmental factors and human activities in shaping the historical distribution of mung beans, highlighting variations in traits like drought tolerance and yield across different regions.

Nutritional values, uses, and cultivation

The nutritional benefits, culinary applications, and optimal cultivation practices for mung beans illustrate this versatile legume's potential. Nutritionally, mung beans are highly valued for their rich protein content, providing 20-30% protein on a dry matter basis. This makes them a significant addition to cereal-based diets, particularly beneficial for children, the elderly, and those with dietary restrictions requiring nutrient-dense foods. Additionally, mung beans contain essential vitamins and minerals, such as vitamin A, iron, calcium, zinc, and folate. They are also a good source of vitamins B1, B2, C, and niacin. However, it is essential to note that mung beans are not a complete protein source, lacking certain essential amino acids. Therefore, they should be consumed alongside other protein-rich foods like cereals, rice, and sesame to ensure a balanced intake of essential amino acids.

In culinary applications, mung beans are remarkably versatile. They are widely used to produce mung bean sprouts, vermicelli (Sotanghon), and various traditional dishes, including soups, porridge, bread, noodles, and ice cream. This versatility extends to their role in agriculture, where they are integrated into different cropping systems, such as intercrops, rotation crops, or relay crops. The by-products from mung bean processing, including vermicelli by-products, are also valuable as animal feed, providing a moderate to high protein content that is particularly beneficial in livestock nutrition.[4]

Optimal cultivation practices for mung beans involve understanding their environmental preferences and addressing potential challenges. Mung beans thrive in warm, humid climates with temperatures ranging from 25°C to 35°C and require 400-550 mm of rainfall evenly distributed throughout their 60 to 90-day growing period. They are adaptable to various soil types, including red laterite, black cotton, and sandy soils, but perform best in well-drained loamy to sandy loam soils. However, they are sensitive to saline or alkaline conditions and waterlogging, which can severely affect their growth. In the Philippines, mung beans can be cultivated

Citation: Generalao R, Largo SAS, Pino JS, et al. Agronomic, historical, and socio-economic dimensions of Mung bean (*Vigna radiata* L.Wilczek). *J His Arch & Anthropol Sci.* 2024;9(2):69–72. DOI: 10.15406/jhaas.2024.09.00309

in different seasons, including the wet season (May-June), dry season (September-October), and late dry season (February-March). It is crucial to avoid excessive humidity during cultivation to maintain seed quality. They perform exceptionally well in sandy loam soils and tolerate dry conditions, which supports their integration into diverse cropping systems. Proper land preparation, including thorough ploughing and harrowing, ensures uniform germination and effective weed competition. Inoculating seeds with the appropriate Rhizobia strain before planting enhances nitrogen fixation, reducing the need for additional nitrogen fertilizers.[5]

Water and nutrient management are critical for optimal mung bean growth. While mung beans are relatively drought-tolerant, adequate water is essential, especially during critical growth phases. Nutrient management involves applying phosphorus and potassium fertilizers based on soil analysis. Organic fertilizers can improve soil conditions, and applying fertilizers in furrows before planting ensures their accessibility to seedlings. The genetic diversity of mung beans, as explored by Burlyaeva et al.,[6] highlights the importance of preserving this diversity to support breeding programs. Such programs aim to develop varieties resilient to environmental stresses, ensuring the crop's sustainability in various climates and soil types. Similarly, studies by Manjunatha et al.,[2] emphasize breeding efforts to enhance essential amino acid levels, further boosting the nutritional value of mung beans.

While mung beans offer substantial nutritional benefits and versatile culinary uses, their cultivation presents challenges, including susceptibility to erratic weather, pests, diseases, and subpar management practices. Addressing these challenges requires a comprehensive understanding of optimal cultivation techniques and the genetic potential of mung beans to enhance their resilience and productivity.

Production, distribution and its impact

To understand the impact of mung bean production processes, distribution patterns, and environmental factors on global agriculture and food security, it is first essential to explore mung bean's botanical and agricultural characteristics (*Vigna radiata* (L.) R. Wilczek). Mung beans are versatile legumes primarily cultivated for their seeds and sprouts, with three notable subgroups: the cultivated *Vigna radiata* subsp. radiata and the wild types *Vigna radiata* subsp. sublobata and *Vigna radiata* subsp glabra.[7]These plants, which are annuals reaching heights between 0.15 and 1.25 meters, can be erect or semi-erect. The cultivated varieties tend to be more upright compared to the sprawling nature of wild types, featuring slightly hairy stems, multi-branched structures, and a robust root system. The plants produce alternate, trifoliolate leaves with elliptic to ovate leaflets, pale yellow or greenish flowers, and long, cylindrical pods that are hairy and contain 7 to 20 seeds of varying colours, including green, yellow, olive, brown, purplish-brown, black, mottled, or ridged.[7]

Mung beans are distinguished from black gramby[8] their pale yellow flowers and pendulous pods, in contrast to black grams bright yellow flowers and erect pods. Mung beans are less hairy and are grown on lighter soils, which makes them an integral part of agriculture in regions with scarce meat supply or predominant vegetarian diets, such as parts of Asia, Southern Europe, and the Southern USA. The beans can be consumed whole, split, or processed into various products, including flour, soups, porridge, snacks, bread, noodles, and even ice cream. Additionally, sprouted seeds, known as "bean sprouts," are consumed raw and cooked, while immature pods and young leaves are eaten as vegetables.[7]

The agricultural versatility of mung beans extends beyond food products; they are also cultivated for animal feed and soil improvement. Mung bean processing produces by-products like mung bean bran (chuni in India) from dehulling and residues from vermicelli manufacturing. These by-products serve as valuable feed for ruminants, pigs, poultry, rabbits, fish, and crustaceans, offering a high-protein, digestible option when appropriately processed. Moreover, mung beans are grown for hay, straw, or silage, providing early forage that often outperforms other legumes in the initial growth stages. Green manure and cover crops contribute to soil fertility and erosion prevention.[9,10]

Mung beans originated from the Indian subcontinent around 1500 BC and have since spread globally, thriving in tropical regions up to 1850 meters in the Himalayas. These beans prefer warm climates, with optimal growth temperatures ranging from 28-30°C. They are drought-tolerant but sensitive to waterlogging, favoring well-drained loamy or sandy loam soils with a pH between 5 and 8. Primary production occurs in Asia, particularly India, China, and Thailand.[7]Mung beans are harvested by hand when pods darken, or newer varieties are used to allow uniform harvesting. Forage uses include grazing six weeks post-planting or cutting for hay at flowering.[11–13] Yields vary widely, from 0.4 to 2.5 t/ha, with intercropping and residual moisture enhancing productivity.[7] Environmentally, mung beans are beneficial as they fix nitrogen and enrich the soil, although they contain antinutritional factors that can be mitigated through processing.[5]

The regional disparities in mung bean production and distribution patterns, as explored by Nair and Schreinemachers,[1] highlight significant challenges and opportunities in global agriculture. India, the largest producer, and Myanmar, the leading exporter, illustrate the variations in cultivation practices and yield improvements needed to meet global demand. These disparities underscore the importance of developing better varieties to address disease susceptibility and yield optimization. The environmental benefits of mung beans, particularly in sustainable agriculture through crop rotation and soil enrichment, further emphasize their role in global food security.[14–16]

Furthermore, the research by Manjunatha et al. delves into the genetic resources and breeding approaches for mung beans, focusing on enhancing traits such as yield, disease resistance, and environmental resilience. The study uses advanced genetic tools like genome-wide association studies (GWAS) to identify genes linked to economically significant traits, thereby improving mung bean adaptability to various growing conditions while minimizing environmental impacts. By developing pest- and disease-resistant varieties that require fewer inputs, breeding programs can significantly reduce the environmental footprint of mung bean cultivation while boosting productivity.

Finally, Ong et al., explore the genetic and environmental factors influencing mung bean's historical spread and cultivation. The study emphasizes the importance of climatic adaptation, with traits such as drought tolerance playing a crucial role in the legume's success in arid regions. Sustainable agricultural practices that align with regional climatic conditions are essential for optimizing mung bean production and mitigating environmental impacts, thereby contributing to global food security.

Conclusion

This study relies on a qualitative descriptive design and an extensive literature review, which may not comprehensively capture all aspects of mung bean cultivation, distribution, and nutritional benefits. The reliance on existing literature means the findings may be influenced by the availability and quality of prior research, potentially leading to gaps in data, especially concerning less-studied regions or emerging agricultural practices. The study's focus on historical and contemporary data may not fully account for the rapidly changing agricultural landscapes and climate conditions, which could impact mung bean cultivation and distribution patterns. Finally, the lack of primary data collection limits the ability to provide empirical evidence for some of the conclusions drawn.

The study highlights mung beans' historical migration and cultivation expansion (*Vigna radiata*) over the past 4,500 years, emphasizing their adaptability and nutritional benefits. Originating in ancient India, mung beans spread across Southeast Asia, Africa, South America, and Australia, becoming integral to various diets and agricultural systems. Their high protein content and versatility in culinary applications make them a valuable crop, especially in regions with limited access to diverse food sources. The research underscores the importance of optimal cultivation practices, including proper soil management and crop rotation, to maximize yields and enhance soil fertility. Mung beans also play a significant role in global food security, supported by international breeding programs to improve yield, disease resistance, and environmental resilience.

Several key strategies should be considered to enhance the production and utilization of mung beans. Firstly, there is a need to focus on enhanced breeding programs that develop mung bean varieties with improved resistance to pests and diseases, higher yields, and better adaptability to diverse climatic conditions. Utilizing advanced genetic tools like genome-wide association studies (GWAS) can help identify and incorporate beneficial traits such as drought tolerance and improved nutrient content, ensuring the crop's resilience and productivity. Additionally, promoting sustainable agricultural practices is crucial. This includes encouraging the adoption of techniques such as crop rotation, intercropping, and organic fertilizers. These practices not only improve soil fertility and reduce the environmental impact but also enhance the overall sustainability of mung bean cultivation, making it a more viable option for farmers in various regions.

Diversifying the use of mung beans is another crucial recommendation. By promoting their inclusion in various culinary applications and value-added products, there can be an increase in market demand and income opportunities for farmers. Exploring new markets and product innovations that leverage the nutritional benefits of mung beans can further boost their popularity and economic value. Given the changing climate conditions, developing and disseminating climate adaptation strategies is essential. This involves providing farmers with guidelines on the best practices for mung bean cultivation, including water management techniques and the selection of varieties suited to specific environmental conditions. Such strategies can help mitigate the risks associated with climate variability and ensure consistent yields. Lastly, there is a need for further research to address gaps in the current understanding of mung bean cultivation and distribution. Comprehensive studies, including primary data collection, are necessary to explore under-researched regions and the impact of emerging agricultural practices and technologies. This continued research effort will support the ongoing improvement and adaptation of mung bean cultivation worldwide.

Acknowledgments

The authors of this study would like to thank their respective families, friends, and organizations who supported them in writing and publishing this article.

Conflicts of interest

The author declares that there are no conflicts of interest.

References

1. Nair R, Schreinemachers P. Global status and economic importance of mungbean. *The Mungbean Genome*. 2020;1–8.
2. Manjunatha PB, Harisha R, Kohli M, et al. Exploring the world of mungbean: uncovering its origins, taxonomy, genetic resources and research approaches. *Int J Plant Soil Sci*. 2023;35(20):614–635.
3. Ong, PW, Lin YP, Chen HW, et al. Environment as a limiting factor of the historical global spread of mungbean. *eLife*. 2023;12:e85725.
4. Luce WG, Maxwell CV, Buchanan DS, et al. Raw mung beans as a protein source for bred gilts. *J Anim Sci*. 1988;67:329–333.
5. Harmuth-Hoene AE, Bognar AE, Kornemann U, et al. The influence of germination on the nutritional value of wheat, mung beans and chickpeas. *Z Lebensm Unters Forsch*. 1987;185(5):386–393.
6. Burlyaeva M, Vishnyakova M, Gurkina M, et al. Collections of mungbean [*Vigna radiata*)(L.) R. Wilczek] and urdbean [*V. mungo* (L.) Hepper] in Vavilov Institute (VIR): traits diversity and trends in the breeding process over the last 100 years. *Gene Resour Crop Evol*. 2019;66(4):767–781.
7. Heuzé V, Tran G, Bastianelli D, et al. Mung bean (*Vigna radiata*). *Feedipedia*. 2015.
8. Xuzhen C, Jing T. Status and future perspectives of Vigna (mungbean and azuki bean) production and research in China. In: Tomooka N, Vaughan DA, eds. 14th NIAS int. workshop on genetic resources – Genetic resources and comparative genomics of legumes (Glycine and Vigna). Tsukuba: National Institute of Agrobiological Science. 2011:83–86.
9. Amber, KH. Effect of replacing mung beans (*Phaseolus aureus*) for soybean meal in diets for growing rabbits. *7th World Rabbit Congress, Valencia*. 2000:69–77.
10. Singh D. Alternative protein sources from legumes for pigs. *Australian Pork Research Database*. 2000.
11. Department of agriculture MIMAROPA. (n.d.). Mungbean production guide.2024.
12. Mogotsi KK. *Vigna radiata* (L.) R. Wilczek. In: Brink, M. & Belay, G. (Editors). PROTA 1: Cereals and pulses/Céréales et légumes secs. [CD-Rom]. PROTA, Wageningen, Netherlands. 2006.
13. Grassland index. A searchable catalogue of grass and forage legumes. FAO, Rome, Italy. 2012.
14. Singh OM. Field guide Mung bean and Urd bean. Government of India, department of agriculture and co-operation, NCIPM, ICAR, New Delhi, India. 2011.
15. Singh DN, Barneveld RJ, van Ru, et al. Digestibility of amino acids and energy in mung bean, chickpea and lablab when fed to pigs. In: Paterson, J. E. (Ed.) Manipulating pig production X. Proc. 10th Bienn. Conf. Austral. *Pig Sci Assoc* Christchurch, New Zealand. 2005:268
16. Sitthigripong R, Alcantara PF. Amino acid supplementation of high mungbean meal vermicelli by-product diets for growing-finishing pigs. *Kasetsart J Nat Sci*. 1998;32(2):242–252.

Citation: Generalao R, Largo SAS, Pino JS, et al. Agronomic, historical, and socio-economic dimensions of Mung bean (*Vigna radiata* L.Wilczek). *J His Arch & Anthropol Sci.* 2024;9(2):69–72. DOI: 10.15406/jhaas.2024.09.00309