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Black Gram and its Production Constraints

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Abstract

Black gram (*Vigna mungo*) is a crucial pulse crop, renowned for its high nutritional value and economic significance, particularly in India, contributing to approximately 70% of the global production. Despite its pivotal role in the pulse economy, black gram cultivation is plagued by several production constraints. Challenges include moisture stress, pre-harvest sprouting, non-synchronous ripening, low seed replacement rates, along with poor soil fertility, high-temperature stress, soil salinity problems, and susceptibility to pests and diseases. These issues are compounded by erratic climate patterns that further jeopardize yield stability. To secure the future of black gram production, a multifaceted strategy is essential one that integrates advanced agronomic practices, improved irrigation and input management, enhanced seed quality and the development of high-yielding climate-resilient varieties. Implementing region-specific measures based on empirical data can boost productivity, enhance economic returns, and ensure food security for pulse-dependent farming communities in the face of ever-evolving agro-climatic challenges.

1. Introduction

Black gram is scientifically known as *Vigna mungo* syn: *Phaseolus mungo and Azukia mungo* and commonly called as Urad in India. This legume is primarily native to India and is extensively cultivated across various Asian nations, including Pakistan, Myanmar, and regions of Southern Asia. Approximately 70% of the global production of Black gram originates from India, making it the largest producer and consumer of this crop worldwide. Black gram occupies around 19% of India's total pulse cultivation area and contributes to 23% of the nation's overall pulse production, as noted in the Black gram outlook report of 2020. This tropical crop is grown during the *kharif*, *rabi*, and summer seasons and is characterized by its short growth duration. It is cultivated in numerous regions of India as a mixed crop, catch crop, or sole crop, often following rice or preceding other seasonal crops. Black gram is notable for its nutritional composition, containing 25% protein, 1.83% fat, and 61% carbohydrates, and it also exhibits resilience

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to drought and high temperatures. From 2010 to 2019 (Table 1), the area of black gram cultivation in India showed a general increasing trend, peaking in 2017-2018. However, production fluctuated, reaching the highest level in 2017-2018, and productivity of 662 kg/hectare. The data indicates periodic shifts in productivity, reflecting changes in cultivation practices, environmental conditions, or market demand.

Table 1: Area, production and productivity of black gram in India

Year	Area (In '000 Hectare)	Production (In '000 Tonne)	Productivity (In Kg. / Hectare)
2010-2011	3267	1779	545
2011-2012	3234	1785	552
2012-2013	3153	1971	625
2013-2014	3062	1699	555
2014-2015	3246	1959	604
2015-2016	3624	1945	537
2016-2017	4478	2832	632
2017-2018	5279	3492	662
2018-2019	5602	3060	546

2. Production Constraints of Black Gram

Black gram is a crop that thrives in a wide range of agro-climatic conditions. In India, pulses are primarily cultivated in rainfed areas characterized by low fertility, challenging soils, and unpredictable environmental factors, which present significant risks and numerous challenges. To achieve self-sufficiency in pulse production, it is projected that by 2050, the demand will reach 26.5 million tons (Narayan and Kumar, 2015). To fulfill this demand, productivity must be increased to approximately 1000 kg per hectare, and an additional 3.0 million hectares should be dedicated to pulse cultivation, alongside efforts to minimize post-harvest losses (Narayan and Kumar, 2015). This challenging objective must be met despite increasingly severe production constraints, including biotic stresses, sudden climate changes, the emergence of new insect pests, and deficiencies in fertilizers and micronutrients, particularly for rabi and summer pulses.

i. Moisture stress: A gradual decline in soil moisture content following rice harvest, leading to mid and terminal drought during the flowering stages, which negatively impacts pulse productivity. This can result in a reduction of seed yield by up to 50% due to increased leaf senescence, decreased photosynthesis, and impaired nutrient translocation from leaves to grains.

***ii. Pre-harvest sprouting*:** *Kharif* crops usually reach maturity in August or September, often coinciding with rainfall during harvest time. This leads to seed sprouting within the pods, resulting in significant losses in both yield and quality.

***iii. Non-synchronous maturity*:** These crops are generally harvested through multiple pickings, as most varieties do not mature simultaneously, necessitating 2-3 harvests.

***iv. Low seed replacement rate*:** A significant number of farmers rely on seeds saved from previous harvests, which diminishes seed vigor and overall yield over time. The lack of high-yielding varieties and low rates of seed or varietal replacement, which is considered the foremost constraint.

***v. Poor soil fertility*:** The practice of continuous monocropping and nutrient depletion contributes to decreased productivity.

***vi. Improper crop management*:** The failure to implement scientific agricultural practices, such as line sowing, seed treatment, and timely irrigation, adversely affects crop yields.

***vii. Water management issues*:** Both excessive and insufficient moisture levels can hinder crop growth, especially during critical stages like flowering and pod formation.

***viii. Drought stress*:** Black gram is predominantly cultivated under rainfed conditions, making it susceptible to unpredictable rainfall and extended dry periods.

***ix. High-temperature stress*:** Elevated temperatures during the flowering stage can diminish pollen viability, resulting in inadequate pod formation.

***x. Soil salinity and alkalinity*:** Poor soil health, particularly in semi-arid and arid regions, negatively impacts seed germination and crop establishment. Black gram prefers a neutral soil pH and is sensitive to acidic, saline, and alkaline conditions. The soils in Eastern and North-Eastern India are often acidic, which affects the availability of essential nutrients such as boron, molybdenum, and sulfur for Black gram cultivation. On contrary, semi-arid regions have salinity and alkalinity problem.

***xi. Sowing period*:** Late sowing of Black gram reduces the growing period and exposes the crop to cold injury during early growth stages, which can hinder biological activities for an extended time. Subsequently, a sudden increase in temperature can lead to a rise in diseases and pest occurrences.

***xii. Cropping system*:** Implementing the utera cropping system without adequate management practices results in reduced black gram yields in rice fallow conditions.

***xiii. Susceptibility to diseases*:** Black gram is notably susceptible to various diseases, such as yellow mosaic virus, leaf crinkle, and powdery mildew. The yellow mosaic virus (YMV) can result in significant yield losses, ranging from 10% to 100%, depending on the infection stage, while powdery mildew may cause yield reductions of up to 21% (Singh et al., 2018). The transmission of the yellow mosaic virus is primarily facilitated by the whitefly (*Bemisia tabaci*). Additionally, pod borers (*Helicoverpa armigera*) infests the flowers and developing pods of the plants. Aphids and thrips also pose threats by damaging the leaves and hindering plant growth. Powdery mildew (*Erysiphe polygoni*) affects the leaves, reducing the plant's photosynthetic capacity. Furthermore, root rot and wilt Cause premature plant wilting and reduce productivity.

***xiv. Climate change*:** Erratic and heavy rainfall can lead to temporary waterlogging which hampers growth and reduces yield. Extreme heat during the summer months (exceeding 44°C) adversely affects reproductive structures, while rainfall during the maturation phase can cause sprouting and spoilage of grains. Additionally, unfavorable weather conditions, such as high humidity and temperatures, exacerbate the incidence of pests and diseases. Research indicates that Black gram in India suffers overall losses of 7% to 35% due to various insect pests across different agro-climatic conditions (Singh et al., 2018).

***xv. Limited labor availability*:** Multiple pickings necessitate a greater number of labors, resulting in increased production costs.

3. Recommendations

A proactive approach is essential for researchers, planners, policymakers, extension workers, market participants, and farmers. This strategy should focus not only on enhancing land productivity per unit but also on lowering production costs. To effectively minimize risks and improve practices within pulse-based cropping systems while increasing pulse production, the following are crucial:

a) Various government departments, including Agriculture, Plant Protection, and Irrigation, must ensure the timely and sufficient provision of inputs and irrigation water. Organizations responsible for promoting advanced scientific techniques should conduct more hands-on training programs to enhance the knowledge and skills of black gram farmers.

b) Farmers should be educated about market information to facilitate the efficient sale of their marketable surplus.

c) For any agricultural inquiries or new technologies, farmers can contact the "Kisan Call Center" at 18001801551 and the "IFFCO Kisan Call Center" also offers assistance at 534351 (Kumar et al., 2017).

d) There is a need to establish regulated markets for food grains and increase the number of government procurement centers during harvest seasons.

e) Kisan Credit Cards and other institutional credit financial schemes have proven beneficial for farmers; however, these facilities should be made more accessible and flexible.

f) The development and distribution of high-yielding, disease-resistant crop varieties are essential.

g) Application of Biofertilizers and Rhizobium Cultures for Enhancing Soil Health which will ensure good yields further.

h) Implement a 2% KCl spray and provide live saving irrigation in arid conditions.

i) Intercrop high-yielding and short-duration pulse crops, such as black gram, to enhance profitability and improve soil health across various production systems especially in the long duration crops like sugarcane.

j) Ensure timely access to essential inputs, including quality seeds, fertilizers, nutrients, insecticides, and pesticides, from local markets.

k) A recent trend is the establishment of an informal seed village system, facilitating farmer-to-farmer seed production and distribution, which ensures the availability of quality seeds.

l) It is essential to develop pulse varieties that offer higher yields and desirable traits suitable for diverse agro-climatic conditions.

m) Minimum Support Prices (MSP) should be increased to help mitigate rising production costs.

n) Research initiatives should focus on creating high-yielding, low-temperature drought-resistant pulse varieties with pest resistance, specifically for the regions of

Rajasthan, Haryana, Uttar Pradesh, and Madhya Pradesh.

o) Establishing a pulse processing industry among village groups would be beneficial, allowing for proper milling immediately after harvest and the storage of split pulses (Dal) instead of whole seeds (Narayan and Kumar, 2015).

p) The transfer of technology related to pulses should be enhanced through a participatory approach involving active collaboration among a multidisciplinary team of scientists.

q) An effective Integrated Pest Management (IPM) module is essential for controlling insect pests and diseases, thereby preventing losses at all stages, including field, post-harvest, and storage.

r) The implementation of broad bed furrows promotes uniform germination and supports robust plant growth and development. Additionally, this method enhances water use efficiency and nutrient availability for crops. Proper seedbed preparation techniques facilitate the absorption and retention of soil moisture, leading to improved crop growth. Research indicates that broad beds are particularly advantageous for growth and yield, even in waterlogged conditions.

s) Several distinct varieties of black gram have been identified, including bold-seeded types such as MDU1, DU1, and VBN 9; mutants like TAU 2 and TU 94-2 (Reddy and Dhanasekar, 2007); summer-irrigated varieties such as VBN 8, Indira Urd Pratham, and DU 1; rice fallow varieties like LBG-648, LBG-402, LBG-22, and LBG-611; and varieties suitable for summer rice fallows, including LBG-20, WBG-26, LBG-623, and PU-31 (RARS, Tirupati), all of which could help improve productivity.

t) For synchronized flowering, varieties such as VBN 8, VBN 10, and KKM 1 are recommended.

u) In Kerala, the mutant variety TAU-2 is particularly well-suited for intercropping in coconut gardens (KAU, 2020).

v) Variety LBG-648 is resistant to Cercospora leaf spot and rust, while wilt-resistant varieties include LBG-402, LBG-648, LBG-611, LBG-22, LBG-645, and LBG-685 (RARS, Tirupati). Additionally, Trombay varieties TU68 and TU80 show reduced susceptibility to pulse beetles compared to other genotypes (Gopalaswamy et al., 2016).

w) Research by Anwarulla and Shivashankar (1987) on black gram and green gram highlighted the importance of molybdenum for nodulation and leghemoglobin production. They found that treating seeds with sodium molybdate at 12 g kg^{-1} and foliar feeding at 1.2 kg ha^{-1} significantly enhanced nodulation, dry weight, leghemoglobin content, and ultimately pod yield. For irrigated Blak gram, the application of pre-emergence herbicides such as pendimethalin at 1 kg ha^{-1} and alachlor at 1.5 kg ha^{-1} has proven effective. For post-emergence control, a combination of acifluorfen sodium (16.5%) and clodinafop propargyl (8% EC) at 187.5 g ha^{-1}, along with Imazethapyr at 0.075 kg ha^{-1}, has been reported to effectively manage weeds and increase yields, as noted by Jagadesh et al., (2018).

x) For non-chemical weed management, mulching with sugarcane trash has been shown to reduce weed density in Black gram.

y) Adoption of a IPM module consisting of components like seed treatment, erection of bird perches, installation traps against pest, use of bio rational pesticide, mechanical management and need based insecticide, was best for Black gram to control pod borer and pod bug damages (Gajendran et al., 2006).

4. Conclusion

Despite black gram's inherent advantages including a high nutritional profile, resilient nature, and adaptability to varied agro-climatic conditions the crop faces several production constraints. These challenges range from moisture and high-temperature stresses to issues like pre-harvest sprouting, non-synchronous maturity, and low seed replacement rates, compounded further by soil fertility problems, an array of pests and diseases, and the evolving impacts of climate change. Addressing these obstacles demands a comprehensive and coordinated strategy involving policymakers, agricultural departments, extension workers, researchers, and farmers. The recommendations provided underscore the importance of timely inputs, improved agricultural practices, better market access, and innovations in both technology and varietal development from high-yielding, synchronized flowering varieties to resilient mutants capable of withstanding extremes. In essence, the future of black gram production lies in transitioning from traditional, reactive practices to a more resilient, forward-thinking model. By leveraging scientific advancements and integrating sustainable agronomic practices, stakeholders can overcome current limitations and meet the increasing demand forecasted for the future. This concerted effort will not only secure the crop's performance in the face of environmental adversities but also ensure the economic stability and food security of pulse-based farming communities. Exploring further, one might consider how tailored local policies, farmer education initiatives, and innovative agro-technologies can further revolutionize black gram cultivation. Such avenues promise a dynamic future for pulse agriculture well beyond the challenges faced today.

5. References

Anwarulla, M.S., Shivashankar, K., 1987. Influence of seed treatment and foliar nutrition of molybdenum on green gram and black gram. The Journal of Agricultural Science 108(3), 627–634.

Black gram Outlook Report- January to December, 2020. Agricultural Market Intelligence Centre, ANGRAU, Lam.

Gajendran, G., Chandrasekaran, M., Jebaraj, S., 2006. Evaluation of integrated pest management module against major pests of black gram in rainfed ecosystem. Legume Research an International Journal 29, 53–56.

Gopalaswamy, S.V.S., Sesha Mahalakshmi, M., Souframanien, J., 2016. Evaluation of certain black gram varieties for resistance to pulse bruchid, *Callosobruchus maculatus*. ANGRAU Journal of Research 44 (1,2), 8–13.

IndiaStat, 2020. Agriculture data. *IndiaStat*. Retrieved from https://www.indiastat.com/data/agriculture

Jagadesh, M., Raju, M., Sharmila Rahale, C., 2018. Influence of different weed management practices on growth and yield attributes of irrigated black gram under Cauvery delta zone of Tamil Nadu. Journal of Pharmacognosy and Phytochemistry 8(3), 608–611.

KAU, 2020. Department of Plant Breeding & Genetics, Kerala Agricultural University. Available from https://www.kau.in

Kumar, R., Singh, R., Singh, K.K., Raghuvanshi, T., Singh, C., Singh, M.K., Kumar, M., 2017. Constraints and suitable policy measures for black gram growers on sample farms in Shahjahanpur district of western Uttar Pradesh. Journal of Pharmacognosy and Phytochemistry 6(6), 1029–1033.

Narayan, P., Kumar, S., 2015. Constraints of growth in area, production and productivity of pulses in India: an analytical approach to major pulses. Indian Journal of Agricultural Research 49(2), 114–124.

Reddy, K.S., Dhanasekar, P., 2007. Induced Mutations for Genetic Improvement of Mung bean, Urd bean and Cowpea Pulse Crops in India. IANCAS Bulletin, 299–307.

Singh, S., Singh, Y.P., Tomar, S.S., 2018. Review on climatic abnormalities impact on area, productivity of central India and strategies of mitigating technology on yield and benefits of black gram. Journal of Pharmacognosy and Phytochemistry 7(3), 1048–1056.