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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(6): 1327-1331

www.thepharmajournal.com
Received: 06-04-2022
Accepted: 09-05-2022

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Integrated nutrient management (INM) in black gram for sustaining crop yield and soil health: A review

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Abstract
The scientific effort of numerous scientists has been reviewed in this text. The use of organic and inorganic fertilizers in conjunction with a balanced application of plant nutrients has been shown to improve growth as well as production of black gram. Organic fertilizers are basically source of different useful nutrient for growing plant. Organic fertilizers that are utilized as a recycled or external input in agriculture to grow crops for both subsistence and commercial uses. Farms by product like crop residues straw/husk can be used as organic resources. In pulse-based cropping systems, combining inorganic fertilizers with various sources of organic manures in various proportions provides considerable benefits for increasing production, improving nutrient absorption by plants, and maintaining soil nutrient status. When inorganic fertilizers are combined with bio fertilizers of plant nutritional components, they are more readily absorbed than when inorganic fertilizers are used alone. The usage of inorganic fertilizers and organic fertilizer in tandem may be recommended for increased production and overall improvement in soil health.

Keywords: Integrated nutrient management, blackgram, bio-fertilizers, inorganic fertilizers

Introduction

The core premise of integrated nutrient management (INM) is to provide sufficient plant nutrients to maintain significant crop yield and minimizing adverse effects on soil health. Black gram (*Vigna mungo*) is one of the most significant pulse crops farmed in India. To increase the output of black gram, proper fertilization is required. It can fulfill its nitrogen needs by symbiotically fixing nitrogen from the atmosphere. Phosphorus and sulphur are two nutrients that require special care [1, 2]. Sulphur application makes Blackgram incredibly responsive. Both phosphorus and sulphur can help to increase crop quality and yield. As a result, the current study was conducted to see how blackgram responded to various doses of phosphorus, sulphur, and PSB treatment [3]. India is the world's largest producer of pulses, accounting for more than 25% of global output. Pulses have long been a cornerstone of sustainable agriculture due to their importance in nutritional security and soil rehabilitation [4]. By holding atmospheric nitrogen in the root nodules, they keep the soil fruitful and healthy. Among the numerous pulses, black gramme or urad (*Vigna mungo* L. Hepper) of the leguminous family is extremely important since it includes 60% carbs, 24% protein, 1.3 percent fat, and is the richest in phosphorus of all the pulses, having 5-10 times the amount of other pulses [5]. "Daal-chawal (pulse rice) or Daal-roti (pulse-wheat bread) is a staple in the normal Indian diet. In India, the crop is extensively farmed on 1.38 Mha, yielding 1.46 MT per year, despite its productivity of just 459 kg ha^{-1}." [6]. The annual consumption of N: P: K during year 2015-16 was 173.7: 69.7: 24 Lakh Tonne in India [49]. The maximum amount of chemical fertilizer import from other countries. There is need to make a judicious balance of organic and inorganic fertilizers in India for growing pulses crops.

Climatic condition for blackgram (*Vigna mungo*)

Blackgram is mostly a summer crop. It may be grown in places with annual rainfall ranging from 600 to 1000 mm. It may be grown everywhere from sea level to 1800 metres above sea level. The crop prefers temperatures between 28 and 32 degrees Celsius. Germination does not take place at temperatures below 10 °C. The black gram is a short-day plant, with most cultivars flowering in 12 to 13 hours of light. An longer photoperiod causes flowering to be delayed. Flowering is delayed as altitude rises owing to reduced ambient temperature [7, 8]. The absence of value seeds of improved and brief span assortments, developing heartbeats on negligible and less ripe soils with low sources of info and without irritation and infection the executives, developing heartbeats under dampness stress, and informal post-reap rehearses are factors adding to India's low heartbeat yields when contrasted with worldwide efficiency. Subsequently, natural excrements, inorganic composts, and biofertilizers should be utilized to expand this yield's creation potential [9, 10].

Environmental and Soil Requirements for Black Gram (*Vigna mungo*) [11, 12]

- It is primarily a warm-weather crop
- In the north, where winter temperatures are relatively low
- It is cultivated primarily during the rainy and summer seasons.
- In the east, it is also grown during the winter; and in the central and southern states
- Where climate variation is minimal
- It is cultivated during the winter and rainy seasons
- Black gramme may be cultivated in a wide range of soils, from sandy to heavy cotton soils.
- A well-drained loam with a pH of 4.7 to 7.5 is desirable
- Black gram cannot be cultivated on alkaline or salty soils.

Effect of Integrated Nutrient Management (INM) on growth and yield of black gram (*Vigna mungo*)

When compared to global efficiency, India's poor yields are due to a lack of access to high-value seeds of enhanced and short-term varieties, growing in minimum and less-rich soil with low data sources and without bug and infection across the board, developing under dampness stress, informal post-harvest methods, and capacity under adverse conditions. As a result, the use of inorganic and bio-fertilizers has the potential to increase the yield of this crop. India has made incredible progress in fertiliser production and use over the last four decades [13, 14, 15]. However, in the future, the use of renewable energy sources, may be a good substitute as chemical fertilizers, will be a major limiting factor in agricultural productivity. Chemical fertilizers are not accessible at a reasonable price to farmers due to rising energy costs. Besides, the awkwardness and proceeded with utilization of synthetic manures adversely affects the physical, substance, and organic parts of soil, diminishing yield creation maintainability, as well as representing a wellbeing and ecological risk [16, 17]. Chemical composts are fundamental for meeting the harvest's nourishing prerequisites. Supplement exhaustion is turning into a more serious issue for maintainable agribusiness. Therefore, limiting the utilization of substance manures while expanding the utilization of organics to keep up with creation and quality standards is basic. Because of their poor nourishing status, organics alone don't bring about a critical improvement in crop yields [18]. because of the previously mentioned ramifications, dark gram may now be developed utilizing both inorganic and biofertilizers. Biofertilizers are all the more harmless to the ecosystem in nature [19]. They can assume a key part in fixing climatic nitrogen and plant advancement advertisers, as well as making phosphorus accessible to plants, by causing a good change in the dirt microenvironment, bringing about the solubilization of insoluble natural phosphate sources. Microbial natural acids can disintegrate fixed phosphate and make it available for plants. Since insoluble phosphate, which isn't promptly available to plants, represents 95-99 percent of complete soil phosphorus, the utilization of bio-composts is basic [20, 21]. Integrated nutrition management aims to fulfil four primary objectives [22, 23].

1. To keep soil production high and maintain long-term productivity
2. To sustain soil fertility and quality
3. To avoid environmental deterioration
4. To lower the expense of chemical fertilizers.

From early development through pod filling, the optimal plant density may produce a comfortable environment with the least amount of light disruption. It is feasible to achieve optimal vegetative and reproductive development to increase seed productivity per unit area by adjusting plant spacing [24]. Patil *et al*., (2007). The effect of integrated nutrient management on yield and yield attributes character was investigated, and it was discovered that it boosted dry matter accumulation, number of nodules per plant, yield characteristics, and yield considerably above control. In terms of grain output, the interaction impact between farmyard waste and the prescribed fertiliser dose was considerable [25]. Apoorva *et al*., (2010) "Integrated plant nutrient supply on finger millet development, yield, and economics" was researched. The use of fertilizers and FYM on an STCR (Soil Test Crop Response) basis, along with dual microbial inoculation, resulted in increased plant height, test weight, grain production (3740.5 kg ha^{-1}) and straw output (9485.9 kg ha^{-1}) of finger millet (Finger millet) [26]. Patel *et al*., (2016)In comparison to the other treatment combinations, 75 percent RDF with 2tFYM ha^{-1} and Rhizobium + PSB produced the highest plant height, branches per plant, fresh and dry weight of root nodules, podsplant^{-1}, length of pod, number of seeds pod^{-1}, and seed production per plant. From plots fertilised with 75 percent RDF+2tFYM ha^{-1} + Rhizobium + PSB followed by 50 percent RDF+4tFYMha^{-1} + Rhizobium +PSB, maximum seed (746 kg ha^{-1}) and Stover yield (1806 kg ha^{-1}) of greengram were reported [27].

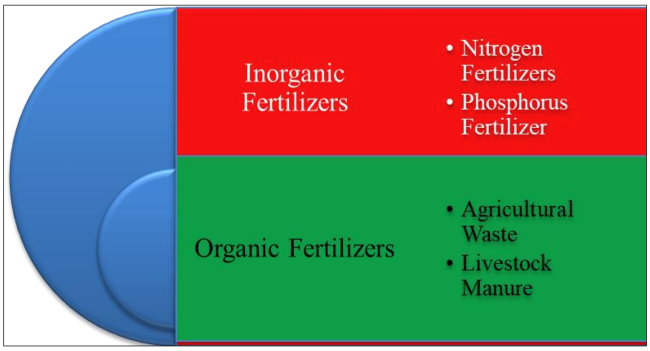

Fig 1: Classification of fertilizers

Effect of Inorganic Fertilizerson growth and yield of black gram (*Vigna mungo*)

Because its nutritional levels are calibrated to be consistent, inorganic fertiliser gives gardeners and farmers a more predictable source of plant sustenance. It comprises a combination of chemicals and minerals that were created in a refinery. Inorganic fertiliser, on the other hand, has an effect on soil that might harm plants if not administered properly. Inorganic manures, as indicated by the Maryland Cooperative Extension, supply similar three vital supplements as natural composts: potassium, phosphorus, and nitrogen [28, 29]. Inorganic compost, then again, gives these supplements to plants quicker since the treatment facility has previously separated them into a palatable structure; natural composts should break down in the dirt first, and the amount of sustenance they give is inconsistent. Inorganic manure has a quicker and more productive impact on plants thus [30, 31].

Chemical fertilizers, on the other hand, are critical in meeting the crop's nitrogen requirements. Nutrient depletion is becoming a bigger problem for sustainable agriculture. As a result, it is critical to minimise the use of chemical fertilizers while increasing the use of organics in order to maintain production and quality standards. Due to their poor nutritional status, organics alone don't bring about a huge improvement in crop yields [32, 33]. Furthermore, the irregularity and proceeded with utilization of synthetic manures adversely affects soil physical, compound, and organic characteristics, diminishing harvest creation manageability and contaminating the environment [34, 35].

Raju *et al*., (1999) According to the study, utilizing natural and inorganic composts alone or in blend further developed root length by 47.8% and 50.7 percent, individually, and seed yield by 25.2 and 30.8 percent. Blend of the most extreme number of fruiting branches per plant (8.14), number of cases per plant (44.1), haulm yield (4325 kg ha^{-1}), phytomass (185 g/plant), and seed yield (1204 kg ha^{-1}) [36]. Srinivasan *et al*., (2000) The response of green gramto inorganic and biofertilizers was investigated. Only the seed index was altered by the different NPK, Rhizobium, Phosphobacterium, or Azospirillum treatments in 1995, according to data on growth, yield attributing features, and yield. Green gram grain production was lowest in the control plot (no inorganic or biofertilizers) in 1995 and 1996 (491 and 309 kg ha^{-1}). Green gram yields of 532 kg ha^{-1} were observed in 1996 after treatment with 75 percent N and 100 percent P + Rhizobium + Phosphobacterium. In addition, this therapy had the greatest benefit-to-cost ratio for green gramme. In the cotton green gram sequence, treatment with 75 percent N + Azospirillum + Phosphobacterium + 100 percent P + 100 percent K to the previous cotton produced the maximum seed cotton yield of 1069 kg ha^{-1}, according to the combined analysis of yield data over seasons (pooled mean). Similarly, a 75 percent N + Rhizobium + Phosphobacterium + 100 percent P treatment to green gram with a grain yield of 610 kg ha^{-1} was shown to be a cost-effective integrated nutrient management program under an irrigated cotton-based cropping sequence [37]. Ramesh *et al*. (2016) The use of 50 kg ha^{-1} DAP through communicating in the last water system to going before rice, as well as foliar showers of 2% DAP + 1% KCl at 30 and 45 DAS to urd bean, brought about fundamentally higher plant level (24.6 cm) at 20 DAS, number of units per plant (18.4), and grain yield (639 kg ha-1) contrasted with ranchers' training. DAP at 50 kg ha^{-1}utilized in the last water system to going before rice brought about an impressively bigger grain yield of following urd bean (613 kg ha^{-1}) than the control (488 kg ha^{-1}), which was identical to foliar use of 2% DAP and 1% KCl to urd bean [38]. Hussain *et al*., (2011) in view of examination done to look at how N, P, and K treatment impacted seed result and supplement retention in blackgram during the kharif times of 2004 and 2005. Three supplements controlled together extensively expanded seed yield over control, in spite of the fact that N and K alone were comparable to control. The use of 15:60:20 kg N:P_2O_5:K2O ha^{-1} brought about the greatest seed creation. The use of 30 kg N ha^{-1} alone decreased seed creation contrasted with 15 kg N ha^{-1} alone, showing that more prominent N levels are wasteful for vegetables. The effect of P seems, by all accounts, to be answerable for the expansion in seed creation, as seen by the overall more noteworthy yields with P medicines contrasted with those without P or with lower P medicines. The blackgram's absolute supplement retention was connected to expanded biomass yield [39].

Effect of bio fertilizers on growth and yield of black gram (*Vigna mungo*)

Biofertilizers, which are part of integrated nutrient management, are considered environmentally beneficial since they are low-cost plant nutrients that supplement chemical fertilizers in India's sustainable agricultural system. Their importance is amplified in the current climate of sky-high chemical fertiliser prices [40]. The use of biofertilizers may play a larger role in enhancing fertiliser efficiency. In terms of accessible nitrogen and phosphorus, Indian soils are in low to medium condition. Organic nutrient sources provided to the previous crop help the succeeding crop to a large extent, and system productivity is increased by the integration of organic and inorganic nutrient sources [41, 42].

By creating auxins and gibberellins, microorganisms (natural manures) in the root zone upgrade plant development and supplement retention. They likewise raise the degrees of indole acidic corrosive and gibberellic corrosive in plants. Biofertilizers could assume a basic part in diminishing the use of substance composts by fixing climatic nitrogen for crops and additionally helping the accessibility of phosphorus and different supplements to [43].

Meena *et al*., (2013) founded that inorganic wellsprings of supplements, for example, NPK at 100 percent suggested portion and natural wellsprings of supplements like FYM at 10 t ha^{-1} and vermicompost at 5 t ha^{-1} altogether further developed yield ascribes, yield, and financial matters of greengram when contrasted with control and lower levels of inorganic and natural wellsprings of supplements [44]. Mainul *et al*.,(2016)The tallest plant (40.44cm), greatest number of leaves $plant^{-1}$ (19.01), number of branches $plant^{-1}$ (10.21), normal dry weight $plant^{-1}$ (7.16 g), number of pods $plant^{-1}$ (14.59), number of seeds pod^{-1} (4.40), 1000-seed weight (41.56 g), seed yield (1.01 t ha-1), stover yield (1.93 t ha^{-1}) were all measurably like P2 (7 t ha^{-1}) in the vast majority of the boundaries (Control) [45]. Abraham *et al*., (2004) Under the blackgram wheat greengram system, an experiment was undertaken to see how fertiliser levels, organic manures, and biofertilizer, as well as organic spray, affected blackgram production. Farm compost + chicken manure, when used in conjunction with inorganic fertilizers, had a synergistic impact on crop growth and production. A lower dose of NPK fertiliser, either alone or in conjunction with biofertilizers, was equivalent to the full recommended quantity. There was no significant variation in plant dry weight values between RDF levels of 100% and 33%. Some yield parameters followed the same pattern. In comparison to the control, organic manure treatment boosted yield. Biofertilizer and organic spray assisted in increasing dry matter output and test weight significantly [46]. Khatkar *et al*.,(2007) Biofertilizers and sulfur levels affect the turn of events and creation of urd bean (*Vigna mungo*) cv. The outcomes showed that applying sulfur at a pace of 20 kg ha^{-1}+ joined immunization with Rhizobium and PSB helped blackgram development highlights (plant level, knobs, and dry weight), as well as grain and straw yields [47]. Zahida *et al*., (2016). The most elevated cases/plant (13.40), seeds/unit (5.00), case length (11.01 cm), 100-seed weight (g), and seed yield (1386.67 kg ha^{-1}) were recorded with the use of 125% RDF and with treatment (T12) including replacement of 50% RDF through

25% FYM + 25% VC + biofertilizer (1.5 ton FYM ha^{-1} + 0.55 ton VC ha^{-1}+ 20 g biofertilizer kg Thus, the coordinated usage of natural and inorganic food sources, too as supplement the board, can help development and efficiency [48].

Conclusion

In comparison to the sole use of bio fertilizers and inorganic fertilizers, a comprehensive literature survey indicated that, integrated nutrient management improves reductions of Black Gram (*Vigna mungo*), nutrient absorption, and economic return. Fertilizer application in a balanced and appropriate amount is an efficient way to boost pulse growth and output while also ensuring environmental sustainability. The issue about whether farming can support the total populace with food out of luck, which outperforms 4 billion tons yearly, will be a test later on years. Incorporated supplement the board is an instrument that can give great choices and a financially smart method for furnishing plants with satisfactory measures of generally full scale and micronutrients, as well as decrease the utilization of substance composts, make ideal soil physiochemical conditions and a sound climate, eliminate requirements, safeguard soil supplement balance over the long haul, create an ideal level for supporting wanted crop efficiency, lastly track down safe techniques to utilize. Natural fertilizers can assist with holding soil natural matter and give adjusted supplements to the ongoing yield while likewise leaving a lot of extra supplements for later reaps in a trimming framework. Throughout the late spring season, dark gram ended up being very productive.

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