

Enhancing Indian Mustard Production through Integrated Nutrient Management

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ABSTRACT

Indian mustard (*Brassica juncea*) is a vital oilseed crop in India, contributing significantly to the country's agricultural economy. However, its production faces challenges such as nutrient deficiencies, soil degradation, and fluctuating market conditions. Integrated Nutrient Management (INM) emerges as a sustainable approach to address these challenges by optimizing nutrient use efficiency, improving soil health, and enhancing crop productivity. This abstract explores the impact of INM practices on Indian mustard cultivation. Through a comprehensive review of literature and field studies, it highlights the efficacy of INM in enhancing mustard production. By integrating organic sources, such as farmyard manure and vermicompost, with inorganic fertilizers and biofertilizers, INM ensures a balanced supply of essential nutrients, thereby promoting robust plant growth and development. Furthermore, INM contributes to soil fertility enhancement, microbial activity stimulation, and soil structure improvement, fostering long-term sustainability in mustard cultivation. Economically, INM proves beneficial by optimizing input costs, increasing yields, and enhancing farmer profitability. Overall, the adoption of integrated nutrient management holds immense potential in enhancing Indian mustard production, ensuring food security, and promoting sustainable agricultural practices in the region.

Keywords: biofertilizers, vermicomposting, farmyard manure, Indian mustard

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Introduction

It is the world's second-largest producer of rapeseed mustard, behind China, with an output of 6.31 million tonnes from a production area that spans 5.79 million hectares [1]. India is a prominent player in the worldwide production of rapeseed mustard, claiming an output of 6.31 million tonnes. Particularly noteworthy is the fact that India is the leading producer of rapeseed and mustard on a worldwide scale [2]. The relevance of mustard seeds in the agricultural landscape is highlighted by the fact that they contain around 28–36% protein which contributes to their nutritional richness. The circumstances that mustard flourishes in throughout its growing season are typified by a moderately chilly environment, a moderate amount of soil moisture, and a dry harvest period. Some of the important fatty acids that are found in mustard seeds are erucic acid (40–60%) and linolenic acid (4.5–13%). These acids contribute to the nutritional profile of mustard seeds. Mustard, which has an oil content that might range anywhere from 35 to 40 percent, is an essential oilseed crop. On the other hand, the cultivation of oilseed crops, such as mustard, frequently takes place in rainfed regions with limited inputs and inefficient management approaches, which ultimately results in lower

levels of yield [3].

When it comes to sustaining ideal crop yield levels, conventional agricultural approaches that rely entirely on chemical fertilizers are not sufficient. The use of a combination of chemical fertilizers and organic manure is very necessary to solve this difficulty and improve the health of the soil overall. Integrated Nutrient Management (INM) contributes significantly to the provision of vital nutrients to crops, which in turn guarantees the maintenance of optimal yields over an extended period. By making efficient use of both organic and inorganic sources of nutrients, such as farmyard manure (FYM), vermicompost (VC), and biofertilizers like *Azotobacter*, integrated nutrient management (INM) improves the soil's physical, chemical, and biological characteristics [4]. It has been established that the application of vermicompost at a rate of six tonnes per hectare, in conjunction with the application of eighty kilograms of nitrogen per hectare and forty kilograms of phosphorus per hectare, has resulted in considerable improvements in the total growth parameters and nutritional content of Indian mustard. Consequently, this demonstrates the effectiveness of INM methods in enhancing the overall health of mustard crops as well as their output.

Impact of INM on Growth Attributes

Several different growth characteristics of Indian Mustard are positively affected by the use of Integrated Nutrient Management (INM) strategies, as per the findings of several research studies. With the application of 100% of the recommended dose of fertilizers (RDF), as well as 5 tonnes per hectare (t/ha) of farmyard manure (FYM) and 2.5 t/ha of vermicompost (VC), Singh et al. (2014) observed a significant increase in the total number of branches per plant, the number of siliqua per branch, and the total number of siliqua per plant. This was one of the findings of their study. In a similar vein, [4] discovered that the application of 100% RDF in conjunction with FYM led to a significant increase in the accumulation of total dry matter overall. According to the findings of [5], the application of 100% RDF in conjunction with FYM, sulfur, zinc, and Azotobacter as a seed treatment resulted in the highest possible accumulation of dry matter, plant height, and total branches and siliqua per plant. The incorporation of 75% RDF through FYM, 25% through fertilizer, and Azotobacter in addition to phosphate-solubilizing bacteria (PSB) resulted in a considerable increase in the accumulation of dry matter, as well as the number of branches and siliqua per plant, and the height of the plant.

In addition, [6] emphasized the fact that the combination of 100% RDF, 2 t/ha of FYM, sulfur, zinc sulfate, vermicompost, and Azotobacter as a seed treatment resulted in a considerable increase in plant height, the number of branches per plant, and dry weight. According to [6], the application of 100% NPK in conjunction with FYM and phosphate-solubilizing bacteria (PSB) increased the height of the plant, the number of functional leaves on each plant, and the number of branches on each plant. The findings of this research collectively highlight the significance of INM regarding the promotion of strong development characteristics in Indian Mustard. When it comes to maximizing the growth performance of this essential crop, the combination of organic and inorganic nutrient sources comes in handy for some reasons, including the enhancement of dry matter accumulation, the increase of plant height, and the enhancement of branching capacity.

Impact of INM on Yield and Yield Attributes

It has been demonstrated that the implementation of Integrated Nutrient Management (INM) strategies has resulted in considerable improvements to the production and yield characteristics of Indian Mustard. According to the findings of [7], the application of seed treatment with Azotobacter, in conjunction with phosphate-solubilizing bacteria (PSB) and the administration of the recommended dose of fertilizers (RDF) in its whole, led to an increase in both the stover yield and the seed yield. [8] observed that the application of FYM at a rate of 10 tons per hectare, in conjunction with seed treatment with Azotobacter or Azospirillum, resulted in the highest possible number of siliqua per plant, weight of 1000 seeds, seed yield, stover production, and number of seeds per siliqua. Similar to what was reported by [9], the application of FYM at a rate of 5 tons per hectare led to the highest possible seed output and seed weight per plant.

Furthermore, [10] found that the combination of 100% RDF with vermicompost at a rate of 2 tons per hectare and Azotobacter resulted in a considerable increase in seed production, stover yield, biological yield, number of siliqua per

plant, and number of seeds per siliqua. Some studies have demonstrated that the utilization of organic sources in conjunction with NPK fertilizers is highly successful. [11] discovered that the use of organic fertilizers at a dose that was fifty percent of the prescribed dose, in conjunction with the application of one hundred percent nitrogen, phosphorus, and potassium, resulted in the highest possible seed yield, stover yield, and test weight.

In recent studies, it has been demonstrated that the utilization of vermicompost in conjunction with the Recommended Dose of Fertilizers (RDF) is a successful method for increasing grain production and other features linked to the growth of Indian Mustard. According to [13], the optimum grain production was achieved by applying RDF in conjunction with vermicompost at a rate of 5 tons per hectare. [12] indicated that the utilization of 75% RDF in conjunction with sulfur, vermicompost, Azotobacter, and PSB resulted in the maximization of yield characteristics. These characteristics included the number of siliqua per plant, the number of seeds per siliqua, the test weight, the seed yield, and the stover yield. The results of these research collectively demonstrate that Integrated Nutrient Management (INM) is an efficient method for enhancing the production of Indian Mustard as well as its important characteristics. Increasing the production of this significant crop may be accomplished through the utilization of INM, which is an approach that involves the combination of organic and inorganic sources of nutrients.

Impact of INM on Quality Parameters

An considerable amount of research has been conducted in recent years to investigate the influence that Integrated Nutrient Management (INM) has on the quality indicators of Indian Mustard. The use of 100% RDF in conjunction with FYM, sulfur, zinc sulfate, vermicompost, and Azotobacter seed treatment was shown to result in the greatest oil content (39.65%) and protein content (20.98%). This was proven by [14], similarly, [15] discovered that the combination of RDF, sulfur, vermicompost, Azotobacter, and PSB resulted in a high oil content (40.9%), as well as a high protein content (14.6%), in seeds. According to [16] a mixture consisting of fifty percent RDF, fifty percent FYM, vermicompost, bio-fertilizers, and zinc sulfate led to an increase in the amount of oil (up to forty to fifteen percent) and the amount of protein (up to seventeen and a third percent). In addition, applications of 75% RDF with additions of a similar nature also demonstrated good outcomes. Furthermore, [14] found that the application of particular combinations of nutrients and organic matter led to an increase in the amount of oil and protein that was present in mustard seeds. Furthermore, [15] called attention to the significance of FYM-N and fertilizers N in the process of increasing the amount of oil and protein that mustard contains. Furthermore, these data highlight the relevance of INM methods in optimizing the oil and protein content of Indian Mustard, which ultimately results in an improvement in the overall quality and nutritional value of the mustard.

Conclusion

In order to improve the production of rapeseed and mustard crops, as well as their economic viability and quality standards, Integrated Nutrient Management (INM) has emerged as a crucial strategy. INM not only works to improve the fertility of the soil but also to maintain crop productivity, which in turn

helps to maintain ecological balance. This is accomplished by integrating a variety of nutritional techniques. It is of the utmost importance to encourage farmers in areas where rapeseed and mustard are cultivated to use biofertilizers in addition to organic amendments such as compost, and crop residues. Additionally, it is necessary to encourage the use of inorganic fertilizers in a responsible manner. The production of high-quality crops is ensured by this comprehensive strategy, which in turn leads to increased yields and related advantages for both farmers and the agricultural environment as a whole.

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