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Influence of mustard production through Integrated Nutrient Management in the Southern Humid plains of Rajasthan

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Abstract:

A field experiment was conducted at the Instructional Farm (Agronomy), Career Point University, Alaniya, Kota during 2023-2024. The experiment was laid out in Randomized Block Design with three replications. The experiment consisted of ten treatments combination viz, Control, 100 % RDF, 100% RDF+ 5 ton FYM, 100% RDF + 2 ton FYM + 0.5 ton Vermicompost, 75% RDF + 5 ton FYM, 75% RDF + 1 ton Vermicompost, 125% RDF, 75% RDF + 2.5 ton FYM + 0.5 ton Vermicompost, 75% RDF + 3 ton FYM + 2.5 Kg Zn and 75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn with Randomized Block Design and three replications. As regard to yield parameters, treatment nitrogen 75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn had the maximum number of siliquae per plant (214.10), highest number of seeds per siliqua (16.46), highest test weight (5.65 g), maximum seed yield (1786.74 kg ha-1), highest stover yield (3799.89 kg ha-1) as well as maximum oil content (40.81%).

Keywords: Mustard, Vermicompost, nutrient, RDF

I Introduction

Oilseeds crops have important place in Indian agriculture next to cereals. In India, nine oilseeds crops (seven edible oilseeds i.e., rapeseed and mustard, soybean, groundnut, sunflower, sesamum, safflower and niger, and two non-edible oilseeds viz., castor and linseeds) are major source of vegetable oil and fats. Globally, India is the fourth largest oilseed crops producing country after United States, China and Brazil. However, it secures

first position in sesame, niger, castor and safflower production and second position in groundnut production after China. In India, the oilseeds are grown on 14.4% of total gross cropped area (25.50 million ha), which produced 32.26 million tonnes oilseeds with 1265 kg/ha productivity.

The basic concept underlying the principle of integrated nutrient management (INM) is the maintenance or adjustment and possibly improvement of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. The appropriate combination of mineral fertilizers, organic manures, crop residues and biofertilizers varies according to the system of land use, ecological, social and economic conditions. Contrary to low external input (LEI) and organic approaches, the INM involve low to medium external input approach, taking into account a holistic view of soil fertility and plant nutrition requirement for a targeted yield. It should be based not only on cropping and farming system but also on distinct geographical area or village as a dynamic system. The INM approach can be modulated, a factor of targeted yield in any area according to land, water and climatic potentials.

There is great need for research on biological nitrogen fixation and phosphorus solublization for energy conservation. Biofertilzer may help in boosting up atmospheric nitrogen and more solubilization of insoluble phosphorus in the soil. Many scientists revealed that seed inoculation with heterotrophic free living N2-fixer like Azotobacter proved beneficial at different locations. It is a low monetary input, although the response varied depending upon the location, the variety planted and initial inorganic nitrogen status of soil. The FYM as a component of INM favourably affects the physical chemical and biological environments. It is well recognized that neither organic manure alone nor exclusive application of chemical fertilizer can achieve the yield sustainability at an optimum level under modern farming where nutrient turnover in the soil plant system is quite high.

Materials and Methods

Location

Kota district is located at 25.18° N to 75.83° E Latitude in South Eastern Rajasthan. It covers an area of 221.36 km2. Agro-climatically, the district falls in Zone V, known as Humid South Eastern Plain. The average rainfall in the region is 660.6. mm. Maximum temperature range in the summer is 40 to 48°C and minimum 1.0- 2.6°C during winter. Main Rainy

season crops of the district are maize, soybean and pulses. While in winter, wheat, mustard, coriander and garlic are main crops.

II Literature Review

Integrated Nutrient Management (INM) has emerged as a crucial strategy for improving mustard production, particularly in the challenging agro-climatic conditions of the Southern Humid Plains of Rajasthan. Research by Singh et al. (2022) underscores the importance of combining organic and inorganic fertilizers to enhance soil fertility and optimize crop yields. This region, with its diverse climatic conditions and soil variability, requires tailored nutrient management practices to achieve optimal results (Sharma & Patel, 2020).

Several studies have highlighted the benefits of integrating bio-fertilizers, organic manures, and chemical fertilizers in mustard cultivation. According to Kumar et al. (2021), balanced nutrient management, including the application of nitrogen, phosphorus, potassium, and essential micronutrients, can significantly boost mustard yield while maintaining soil health. Moreover, the use of organic amendments such as compost and green manure has been reported to improve soil structure, enhance moisture retention, and increase microbial activity, contributing to long-term sustainability (Gupta & Rao, 2019).

The integration of these practices is particularly beneficial in the Southern Humid Plains, where soil degradation and nutrient depletion pose significant challenges to agricultural productivity (Verma & Chauhan, 2023). Overall, the adoption of INM in mustard cultivation not only addresses these challenges but also ensures better crop performance and environmental sustainability in the region (Choudhary et al., 2020).

III Methodology

Experimental Details A field experiment was conducted at the Instructional Farm (Agronomy), Career Point University, Alaniya, Kota during 2023-2024. The experiment was laid out in Randomized Block Design with three replications. The experiment consisted of ten treatments combination viz, Control, 100 % RDF, 100% RDF+ 5 ton FYM, 100% RDF + 2 ton FYM + 0.5 ton Vermicompost, 75% RDF + 5 ton FYM, 75% RDF + 1 ton Vermicompost, 125% RDF, 75% RDF + 2.5 ton FYM + 0.5 ton Vermicompost, 75% RDF + 3 ton FYM + 2.5 Kg Zn and 75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn.

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Measurement of the parameters

The total number of Siliqua was counted in 5 randomly selected plants. The average values of developed pods were expressed as the total no. of Siliqua plant-1. The total number of seeds in each siliqua was counted in 5 randomly selected pods in each treatment. The average values of developed seeds per siliqua were expressed as the number of seeds siliqua-1. Seed yield of each plot was obtained separately by threshing and cleaning the seed and expressed in t ha-1. Stover yield was obtained by subtracting the seed yield from the total weight of the dry plants harvested from 1 m2 area and expressed in t ha-1. Analysis of variance for individual character was done on the basis of mean values as suggested by Panse and Sukhatme (1942).

Results

Data presented in Table 1 indicate that application of vermicompost, FYM and zinc significantly increased number of siliquae per plant over control. The maximum number of siliquae per plant (214.10) was recorded under application of 75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn (T10) and the minimum (143.17) under control (T1). However, the treatment T4 & T6 and T5 & T7 were found to be statistically at par.

An examination of data (Table 2) establishes that the number of seeds per siliqua at harvest significantly varied from 12.92 to 16.46 per plant among treatments in the experiment. The maximum number of seeds per siliqua (16.46) was recorded under application of 75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn (T10) and the minimum (12.92) under control (T1). However, the treatment T2 & T3, T4 & T6 and T5 & T7 were found to be statistically at par.

Perusal of data (Table 3) shows that various treatments of vermicompost, FYM and zinc significantly increased test weight over control. The highest test weight (5.65 g) was recorded under application of 75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn (T10) and the minimum (4.48) under control (T1). However, the treatment T2 & T3, T4 & T5, T4 & T6, T5 & T6, T5 & T7 and T6 & T7 were found to be statistically at par.

A critical examination of data (Table 4) revealed that application of vermicompost, FYM and zinc significantly increased seed yield over control. The maximum seed yield (1786.74 kg ha-1) was recorded under application of 75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn (T10) and the minimum (984.63 kg ha-1) under control (T1). However, the treatment T4 & T5, T4 & T6, T4 & T7, T5 & T6,T5 & T7 and T6 & T7 were found to be statistically at par.

The perusal of data pertaining to Table 5 revealed that the highest stover yield of mustard (3799.89 kg ha-1) was obtained from the application of 75% RDF + 2 ton FYM + 0.5 ton vermicompost + 2.5 Kg Zn (T10) and the minimum (2021.11 kg ha-1) under control (T1). However, the treatment T4 & T5, T4 & T6, T4 & T7, T5 & T6, T5 & T7 and T6 & T7 were found to be statistically at par.

Discussion

The data about the yield characters (Table 2) indicated that application of all the nutrient viz., soil test recommendation (NPK) along with FYM, Zn and vermicompost treatment showed increase in the yield characters as compared to soil test recommendations of fertilizers and control. The highest seed yield realized with combined application of various plant nutrients could be ascribed to its profound influence on vegetative and reproductive growth of the crop. Hence, marked increase in seed yield with combined application of various plant nutrients seems to be due to more exploitation of crop genetic potential for vegetative and reproductive growth. The best result on seed yield was obtained with application of 75% RDF + 2 ton FYM + 0.5 ton vermicompost + 2.5 Kg Zn (T10). This indicates that mustard responds well to integrated nutrient management which might be owing to the favorable soil condition. Application of FYM with chemical fertilizers improved the physio-chemical condition of the soil, provided favorable environment, stimulated the uptake of nutrients and almost continuous supply of N, P, K, S and micronutrient distributed over the entire crop and batter availability in sufficient amounts of plant nutrients throughout the growth period and especially at critical period of crops growth which has resulted in batter plant vigour and superior yield attributes (Kashved et al. 2010)

Application of zinc sulphute also increased seed yield over the treatments without it. This might be due to the positive influence of sulphur on cell multiplication and elongation and production to deep colour to leaf which favour the chlorophyll synthesis resulting in increased photosynthesis and assimilation rates and zinc on carbohydrates and protein metabolism and promoting growth hormone (Mohapatra and Dixit 2010, Parihar et al. 2012). As yield is the resultant outcome of the effect of various growth and yield parameters, its expression was observed with their integrated influence. With the increment in supply of essential nutrients to mustard, their availability, acquisition, mobilization and influx into the plant tissues increased and thus improved growth attributes and yield components and finally the yield. These results are in agreement with the findings of (Tripathi et al. 2010).

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The highest seed was attained under 75% RDF + 2 ton FYM + 0.5 ton vermicompost + 2.5 Kg Zn. This was attributed to improved availability of essential nutrient and growth hormones that led to enhanced N metabolism and protein synthesis. Similar findings have also been made by Singh and Pal, (2011).

Data presented in Table 2 show that effect of fertilizers with FYM, Zn and seed treatment on stover yield of mustard which shows similar result to seed yield of mustard. Higher stover yield was obtained with application 75% RDF + 2 ton FYM + 0.5 ton vermicompost + 2.5 Kg Zn. The significant increase in stover yield due to integrated application of chemical fertilizers with FYM and Zn. The greater stover yield at higher fertility was attributed to increased plant height and leaf area and finally dry matter accumulation plant-1 and this was also concluded by (Singh and Pal, 2011). This could be due to FYM incorporated with chemical fertilizers and seed treatment, FYM improved the physio-chemical condition of the soil, provided favorable environment, stimulated the uptake of nutrients and enhanced major as well as secondary and micronutrients to the mustard and seed inoculants increased the seed germination, plant growth, plant stands, and vegetative growth of plants increased the stover yield of mustard over the treatments where chemical fertilizers applied. As stover yield is the resultant outcome of the effect of various growth and yield parameters, its expression was observed with their integrated influence. These results corroborate the finding of others (Tripathi et al. 2010). Application of FYM increased the seed and stover yield. It was due to improved physic-chemical properties of soil and provides a better soil environment for the biological activity and improved microbial population of the experiment soil, fixing the atmospheric nitrogen in soil and also supplies micronutrient beneficial to the crop growth and productivity. Similar results were reported by Das, et al. (2010), Khafi et al. (2010), Saha et al.(2010) Arya et al. (2007), Chand, et al. (2007) and Nagdive, et al. (2007).

Table 1 Effect of nutrient management on number of siliquae per plant of mustard

Treatments	Number of siliquae per plant
Control	143.17
100 % RDF	156.23
100% RDF+ 5 ton FYM	162.91

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100% RDF + 2 ton FYM + 0.5 ton vermicompost	169.92
75% RDF + 5 ton FYM	181.66
75% RDF + 1 ton vermicompost	171.70
125% RDF	183.32
75% RDF + 2.5 ton FYM + 0.5 ton vermicompost	198.55
75% RDF + 3 ton FYM + 2.5 Kg Zn	208.30
75% RDF + 2 ton FYM + 0.5 ton vermicompost + 2.5 Kg Zn	214.10
S.Em+	2.90
CD (P=0.05)	6.32

Table 2 Effect of nutrient management on number of seeds per siliqua of mustard

Treatments	**Number of seeds per siliqua**
Control	12.92
100 % RDF	13.83
100% RDF+ 5 ton FYM	14.04
100% RDF + 2 ton FYM + 0.5 ton vermicompost	14.49
75% RDF + 5 ton FYM	14.93
75% RDF + 1 ton vermicompost	14.53
125% RDF	15.03
75% RDF + 2.5 ton FYM + 0.5 ton vermicompost	15.51
75% RDF + 3 ton FYM + 2.5 Kg Zn	16.33
75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn	16.46
S.Em+	1.11
CD (P=0.05)	3.33

Table 3 Effect of nutrient management on number of seeds test weight (g) of Mustard.

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Treatments	Test weight (g)
Control	4.48
100 % RDF	4.73
100% RDF+ 5 ton FYM	4.81
100% RDF + 2 ton FYM + 0.5 ton Vermicompost	5.03
75% RDF + 5 ton FYM	5.12
75% RDF + 1 ton Vermicompost	5.05
125% RDF	5.15
75% RDF + 2.5 ton FYM + 0.5 ton Vermicompost	5.32
75% RDF + 3 ton FYM + 2.5 Kg Zn	5.58
75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn	5.65
S.Em+	1.06
CD (P=0.05)	3.17

Table 4 Effect of nutrient management on number of seeds Yield (Kg/ha) of Mustard.

Treatments	Seed Yield (Kg/ha)
Control	984.63
100 % RDF	1128.75
100% RDF+ 5 ton FYM	1269.17
100% RDF + 2 ton FYM + 0.5 ton Vermicompost	1409.48
75% RDF + 5 ton FYM	1449.83
75% RDF + 1 ton Vermicompost	1413.54
125% RDF	1458.27
75% RDF + 2.5 ton FYM + 0.5 ton Vermicompost	1596.84
75% RDF + 3 ton FYM + 2.5 Kg Zn	1764.10
75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn	1786.74
S.Em+	50.90
CD (P=0.05)	150.32

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Table 5 Effect of nutrient management on number of seeds test weight (g) of mustard

Treatments	Stover Yield (Kg/ha)
Control	2021.11
100 % RDF	2380.89
100% RDF+ 5 ton FYM	2744.43
100% RDF + 2 ton FYM + 0.5 ton Vermicompost	3105.79
75% RDF + 5 ton FYM	3197.44
75% RDF + 1 ton Vermicompost	3114.66
125% RDF	3215.87
75% RDF + 2.5 ton FYM + 0.5 ton Vermicompost	3496.34
75% RDF + 3 ton FYM + 2.5 Kg Zn	3777.60
75% RDF + 2 ton FYM + 0.5 ton Vermicompost + 2.5 Kg Zn	3799.89
S.Em+	61.15
CD (P=0.05)	182.04

Conclusion:

The field experiment conducted at the Instructional Farm (Agronomy), Career Point University, Alaniya, Kota during 2023-2024 provided valuable insights into the efficacy of various nutrient management practices for mustard cultivation. The experiment, laid out in a Randomized Block Design with three replications, included ten treatment combinations aimed at optimizing yield parameters. This study contributes valuable insights into optimizing mustard cultivation practices through integrated nutrient management. The identified treatment combination can serve as a practical guideline for mustard growers, helping them enhance productivity and profitability while ensuring sustainable agricultural practices. Further research and extension efforts in this direction are warranted to promote the adoption of integrated nutrient management practices for oilseed cultivation, thereby contributing to agricultural sustainability and food security in India.

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