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Effect of Integrated Nutrient Management on Growth Parameters, Yield Attributes and Yield of Mustard Crop in Chitrakoot Area

Sushma Bhalavi [a], Pawan Sirothia [a], Ashutosh Mishra [a*], U. S. Mishra [a], Ranjeet Singh Raghav [a], Opendra Kumar Singh [a] and Anisha Jendre [a]

[a] Department of Natural Resources Management, Faculty of Agriculture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.), 485334, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This field experiment was carried out during *Rabi* season of 2022-23 at Rajoula Agriculture farm, of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.). The experiment having 9 treatment combinations replicated thrice in randomized block design. Mustard variety Pusa Mahak was grown with recommended agronomic practices. On the basis of the results emanated from current investigation, it could be concluded that application of T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] significantly recorded maximum growth parameters such as plant height (188.34 cm), number of branches plant^{-1} (6.37) and maximum yield attributing characters such as number of siliqua plant^{-1} (295.85), number of seed siliqua^{-1} (13.48) and 1000 seed weight (6.52 g).

**Corresponding author: E-mail: ashutoshmishraa778@gmail.com;*

The findings showed highest grain yield (2179.83 kg ha^{-1}) and straw yield (8304.75 kg ha^{-1}), with treatment T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] in comparison to all the treatments. While the minimum value of growth parameters viz. plant height (169.24 cm), number of branches $plant^{-1}$ (4.93) and yield attributes such as number of siliqua $plant^{-1}$ (241.52), number of seed $siliqua^{-1}$ (12.45) and 1000 seed weight (4.8 g) recorded under the treatment T_9 [Absolute control].

Keywords: Nano-urea; mustard; yield; boron.

1. INTRODUCTION

"Indian mustard is one of the most important edible oilseed *rabi* crop of North India commonly known as *Sarson*, *Rai* or *Laha*. It belongs to the family *Brassicaceae* and genus *Brassica*. It comprises various traditionally grown indigenous species, namely, Toria (*Brassica campestris* L. var. toria), Brown sarson (*Brassica campestris* L. var. brown sarson), Yellow sarson (*Brassica campestris* L. var. yellow sarson), Black mustard (*Brassica nigra*) and Taramira (*Eruca sativa/vesicaria* Mill.) which are grown over different parts of the country" [1].

"Mustard is the main oilseed crop for the Rabi season which is planted on more than 74 % area covered under oilseeds. Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana and Gujarat are the highest sown states of mustard seed accounting for more than 70 % of total mustard acreage in the country. In India, mustard is cultivated on about 6.69 mha area with a production and productivity of about 10.11 MTs and 1511 kg ha^{-1} during 2020-21, respectively". (Economic Survey, 2021-2022) "However, in Madhya Pradesh, it is grown on about 7.7 lakh ha area with production and productivity of about 13.1 lakh tones and 1713 kg ha^{-1}, respectively" [2].

Mustard seeds can be used whole, crushed, or ground into a paste to flavour curries and fish dishes. It's also used as a condiment for medicinal purposes, as well as in the preparation of soaps, hair oils, lubricants, paints, plasticizers and as a condiment in pickles [3] "Oil cake is a by-product of oil extraction that can be used as manure or as a high-quality animal/poultry feed. Mustard meal or cake contains approximately 12 % oil and 38–42 % protein. Mustard seed in general contains 30-33 % oil, 17-25 % proteins, 8-10 % fibres, 6-10 % moisture and 10-12 % extractable substances" [4].

"Chemical fertilizers alone may not be able to keep up the maintaining soil health for sustaining productivity. Concerns about the sustainability of oilseed-based on cropping systems, combined with increasing chemical fertilizer prices, and has reawakened interest in organic manure usage. Though organic manures are not new in terms of nutrient recycling, their economic importance has increased in recent years. Because of their use as a renewable energy source, their effects on soil fertility and increased nutrient use efficiency, improving soil physical conditions and their role in achieving crop yields that are sustainable. Organic manures include vermicompost and vermiwash farm yard manure, compost, concentrated organic manures and green manures" [5].

The performance of fertilizer especially nitrogen efficiency, is poor, but this can be improved by using organic manures. These are absolutely vital for retaining water and nutrients, as well as improving the soil's physical conditions. The use of high-analysis fertilizers without the addition of organic manures hastens the degradation of secondary and micronutrients. Similarly, mixing fertilizer nitrogen with organic manure is known to promote organic-N mineralization while also immobilizing a portion of the added nitrogen, preventing N loss via leaching. As a result, the best combination of organic and fertilizer N sources will increase the quality and economy of applied N while also increasing soil fertility and productivity. The integrated approach to nutrient supply using inorganic and organic fertilizers is gaining popularity because it not only eliminates the use of expensive inorganic fertilizers, but it is also more environmentally friendly. Organic manure may be a viable alternative for maintaining productivity [6]. The use of vermicompost has been shown to increase the soil's physical, chemical and biological properties (Nagavallemma et al., 2004). The bulk density and total porosity of the soil can be improved by using FYM [7]. Bioremediation of contaminated soils is also aided by FYM [8].

Keeping in view the significance of integrated nutrient management on growth parameter, yield components and yield of mustard present investigation was undertaken at Rajoula

Agriculture Farm, of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.)

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was carried out at Rajaula Agriculture farm, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna (M.P.) which lies in the semi- arid and sub-tropical region of Madhya Pradesh between 25.148° North latitude and 80.855°East longitude. The altitude of town is about 190-210 meter above mean sea level.

2.2 Edaphic Condition

The soil was moist, well drained with uniform plane topography. The soil of the experimental field was alluvial in origin, sandy loam in texture and slightly alkaline in reaction having pH 7.4 (1:2.5 soil: water suspension method given by Jackson [9] low in organic carbon percentage in soil is 0.24 per cent (Walkley and Black's rapid titration method given by Walkley and Black,[10] low in available nitrogen 94.78 kg ha^{-1} (Alkaline permanganate method given by Subbiah and Asija,[11] medium in available phosphorus as sodium bicarbonate-extractable P was 16.08 kg ha^{-1} (Olsen's calorimetrically method, [12] high in available potassium was 308.15 kg ha^{-1} (Flame photometer method given by Hanwey and Heidel, [13].

2.3 Experimental Details

The experiment was laid out in randomized block design and replicated thrice comprising with 9 treatment combinations.

2.4 Fertilizer Application

FYM was applied @ 10 q ha^{-1} as basal dose. After the layout of experimental plot, the fertilizers were weighed and applied in the plots and thoroughly mixed with soil. As per the experimental recommended doses of Nitrogen, Phosphorus, Potassium were applied to assigned plots. Recommended dose of Nitrogen, Phosphorus and Potassium were applied through Urea, DAP and MOP (60:40:40 kg ha^{-1}).

2.4.1 Seed and sowing

The seed sowing was done on 19th Oct. 2022. The seed was sown in line after making a narrow furrow with the help of pointed wooden stick at different row spacing. The seeds were dropped in the furrow after mixture with fine dust of soil and then after seeds were covered with thin soil layer. The total quantity of seed was required @ 6 kg/ha. The Mustard variety was "Pusa Mahak".

2.4.2 Harvesting

The crop was harvested on 15th Feb., 2023 when it reached to its physiological maturity i.e. when the leaves were turned yellow and more than 70 % capsules were full matured to avoid shattering of the crop.

2.5 Observations Recorded

2.5.1 Grain yield (q ha^{-1})

The total weight of clean and dried grains from each plot was weighed with the help of electronic balance in kg/ha.

Table 1. Treatment details

Treatment	Combinations
T_1	NPK (30:40:0) kg ha^{-1}
T_2	NPK (60:50:0) kg ha^{-1}
T_3	NPK (80:60:0) kg ha^{-1}
T_4	IPNS (NPK + OM) (15:30:0 + 5 t FYM)
T_5	IPNS (NPK + OM) (30:40:0 + 5 t FYM)
T_6	IPNS (NPK + OM) (40:50:0 + 5 t FYM)
T_7	FYM alone @ 5 t ha^{-1}
T_8	FYM alone @ 10 t ha^{-1}
T_9	Absolute control

Recommended dose of fertilizer (60:40:40 kg ha^{-1}) was applied

2.5.2 Straw yield (q ha^{-1})

Straw yield of each plot can be obtained by deducting the grain yield from the respective biological yield and expressed in kg/ha.

2.6 Statistical Analysis

The data on various characters studied during the course of investigation were statistically analyzed for randomized block design. Wherever treatment differences were significant ("F" test), critical differences were worked out at five per cent probability level. The data obtained during the study were analyzed statistically using the methods advocated by Gomez and Gomez [14].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Data pertaining to growth parameters mainly plant height (cm), and number of branches plant^{-1} are presented in Table 2. clearly revealed that application of integrated nutrient management significantly increased growth parameters. The results revealed that the plant height varied in between 169.24 to 188.34 cm and all the treatments were significantly superior to treatment T_9 [Absolute control]. The treatment combination T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] gave the maximum plant height (188.34 cm). Number of branches plant^{-1} of mustard varied in between 4.93 to 6.37 and all the treatments were significantly superior to T_9 [Absolute control]. The treatment combination T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] gave the maximum no. of branches plant^{-1} (6.37). Minimum plant height (169.24 cm) and number of branches plant^{-1} (4.93) were associated with the treatment T_9 [Absolute control]. These findings are further supported by Singh et al., [15] Kumar et al. [16] Kaur & Kumar et al.[17] and Kaur & Verma et al. [18].

3.2 Yield Components

Data pertaining to yield attributing parameters mainly no. of siliqua plant^{-1}, no. of seed siliqua^{-1} and 1000 seed weight (g) are presented in Table 3. clearly revealed that application integrated nutrient management increased yield attributes significantly over control except 1000 seed weight (g). Maximum no. of siliqua plant^{-1} (295.85), no. of seed siliqua^{-1} (13.48) and 1000 seed weight (6.52 g) were recorded under the treatment T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] followed by treatment T_5 [IPNS (NPK + OM) (30:40:0 + 5 t FYM)] with the value 291.80, 13.25 and 6.28 g respectively and the minimum no. of siliqua plant^{-1} (241.52) no. of seed siliqua^{-1} (12.45) and 1000 seed weight (4.08 g) was recorded under the treatment T_9 [Absolute control]. These findings are further supported by Jat and Ahlawat ,[19] Kumar et al.[20] and Ajnar et al. [21].

3.3 Productivity Parameters

It was observed that application of integrated nutrient management enhanced the grain yield and straw yield of mustard significantly and present in Table 4. Maximum grain yield (2179.63 kg ha^{-1}) was recorded under the treatment T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] followed by treatment T_5 [IPNS (NPK + OM) (30:40:0 + 5 t FYM)] with the value 2014.15 kg ha^{-1} and the minimum grain yield (1466.87 kg ha^{-1}) was recorded under the treatment T_9 [Absolute control]. Maximum stover yield (8304.75 kg ha^{-1}) was recorded under the treatment T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] followed by treatment T5 [IPNS (NPK + OM) (30:40:0 + 5 t FYM)] with the value

Table 2. Effect of integrated nutrient management on growth parameters of mustard

Treatment	Plant height (cm)	No. of branches plant^{-1}
T_1	177.29	5.56
T_2	179.65	5.74
T_3	180.43	5.97
T_4	182.47	6.12
T_5	185.96	6.28
T_6	188.34	6.37
T_7	172.46	5.17
T_8	174.97	5.41
T_9	169.24	4.93
S.E.m±	1.25	0.13
C.D. (P= 0.05)	3.75	0.40

Table 3. Effect of integrated nutrient management on yield attributes of mustard

Treatment	No. of siliqua plant^{-1}	No. of Seed siliqua^{-1}	1000 seed weight (g)
T_1	281.76	12.94	5.01
T_2	284.98	12.99	5.29
T_3	289.07	13.05	5.76
T_4	289.46	13.12	6.04
T_5	291.80	13.25	6.28
T_6	295.85	13.48	6.52
T_7	269.14	12.78	4.27
T_8	272.01	12.90	4.49
T_9	241.52	12.45	4.08
S.E.m±	6.19	0.16	0.07
C.D. (P= 0.05)	18.58	0.49	NS

Table 4. Effect of integrated nutrient management on yields of mustard

Treatment	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	1639.25	6311.10
T_2	1789.29	6507.93
T_3	1852.27	6895.23
T_4	1936.74	7314.28
T_5	2014.15	7847.61
T_6	2179.63	8304.75
T_7	1499.08	5580.95
T_8	1572.69	5746.03
T_9	1466.87	5428.57
S.E.m±	31.20	8.25
C.D. (P= 0.05)	93.61	25.01

7847.61 kg ha^{-1} and the minimum stover yield (5428.57 kg ha^{-1}) was recorded under the treatment T_9 [Absolute control]. These findings are further supported by the findings of Nagar et al. [22] Singh et al,[23] Bisht et al. [24] Meitei & Bajpay [25] and Kumari [26,27].

4. CONCLUSION

The study concluded that superiority in regard to growth parameters, yield components and productivity parameters *viz,* grain yield (kg ha^{-1}), stover yield (kg ha^{-1}), with the use of treatment combination T_6 [IPNS (NPK + OM) (40:50:0 + 5 t FYM)] gave in soil ensure highest growth parameters, yield components and productivity, of mustard crop as comparison to all the treatments.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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