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Effect of integrated nutrient management on growth and yield of mustard (*Brassica juncea* L.)

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Abstract

A field experiment was allotted throughout 2021-2022 to envision the result of Integrated Nutrient Management and None on Mustard (*Brassica juncea* L.). Observations were recorded for Growth attributes, Yield attributes and yields, Nutrient content and uptake by mustard crop, Soil quality, and political economy in several combos (biofertilizers and organic manure) the treatment are employing a randomized Block design (RBD) with 3 replications, fourteen treatments were employed in the experiment, together with T₁ (Control, NO NPK + NO Non-eat 5 t/ha⁻¹), T₂ (100 P.C NPK + NO Non-eat 5 t/ha⁻¹), and T₃ (75 percent NPK + N- twenty-five percent (FYM) + NO None. 100 percent NPK+ S @40 weight unit + NO None, T₄. T₅ - {100% |one hundred pc |100 p.cat 5 t/ha⁻¹} NPK+ twenty five% kg ZnSO₄ + NO Non-eat 5 t/ha⁻¹, T₆ - 75% NPK+ 25% (FYM) +S @ kg + NO None, T₇: 75 percent NPK+ 25 percent (FYM) and 25 kg of ZnSO₄ + NO None, respectively. Thanks to differing INM and none treatments, plant height, branch count, and dry matter accumulation were all significantly completely different from treatment T₁-control (NO NPK+NO none). However, neither INM nor any of the sessions' activities considerably altered plant⁻¹ height or variety of branches at thirty DAS. The most plant height, number of branches, and dry matter accumulation were according for each year at 30 DAS once scrutiny the treatment T₆ + none @5 t/ha⁻¹ to alternative treatments. Treatment T₆ + None @5 t/ha⁻¹ at sixty DAS and harvest, followed by application of T₇ -75 P.C NPK+N-25 percent (FYM)+25kg ZnSO₄+ NO None there have been significantly higher yield qualities with the T₆ + None @5t/h⁻¹ application than with the INM and none treatments. The treatment T₁-management (NO NPK + NO None) showed the best pH scale and international organization lowering. The best internet returns (Rs. 49408.00 and 52309.00 ha⁻¹) were obtained by the T₆ + None @5 t/ha⁻¹ treatment, whereas the highest B:C ratios were generated by the T₆ - seventy-five p.c NPK+ N-25 percent (FYM) +S @40 weight unit + NO None treatment (1.32 and 1.45).

Keywords: Mustard (*Brassica juncea* L.), integrated nutrient management, actinomycetes

1. Introduction

Mustard (*Brassica juncea* L.) is an Indian crop with a respectable oilseed yield that belongs to the Cruciferae family, also known as Rai. It is touted as a fancy spice (38-40% oil content). This is appropriate for the short seasons and low rainfall in this region. Nitrogen increased crop yields by affecting unique developmental boundaries and providing more important growth and progression, as demonstrated in ways to increase plant size and flower-producing branches, total plant weight, record leaf area, and amount and mass of seeds and pods per plant. After peanuts, mustard is the second most important edible oil seed. It accounts for more than 30% of all oilseeds produced in India. India is a major producer of rapeseed and mustard. Countries in the world both rapeseed and mustard covered 6.33 million hectares in India and produced 6.69 million tons and yield kg ha⁻¹. During 2021-22. In UP, mustard is grown as an oilseed covering 0.95 million hectares of the region and 20.23 percent of total national production (0.79 million tons) in 2021-2022 with a typical production of 962 kg ha⁻¹, which is incredibly good. However, Indian mustard remains an important winter crop for oilseeds. In Uttar Pradesh, it has a very low rate of return. One of the key factors behind the low production is the insufficient use of plant supplements, especially nitrogen. The importance of nitrogen treatment in achieving the more extreme producing potential of mustard is not surprising I suppose. Nitrogen plays an important metabolic role.

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Component for plant growth and development. Biological substances such as chlorophyll and nucleic acids, which are cellular and corrosive components, are considered essential for the digestion of proteins and other foods. Hence it is the central idea. Part of the vegetation. It is a significant amount of vegetative development and administration of various supplements. It assumes an imperative role in the development of chlorophyll. Nitrogen is an important component of supplementation that gives the yield a rich green hue (due to increased chlorophyll) and its poor performance in arid and semi-arid areas is extensive due to the large number of natural elements that are the main source of raw nitrogen, are exceptionally low at the two sites and would be consumed immediately regardless of whether they were detected (Keivanrad and Zandi, 2012) [17]. They are essential to carry out the creation of and the most basic social acts throughout the planet. Among the agronomic elements recognized to improve crop production, manure is considered the most effective substance. Contribution to horticulture as a source of nutritional supplements, especially nitrogen, which is lacking in most of our Indian soils, for which it is said to be of great importance in the cultivation of mustard. Due to intensive pruning and pruning of the high-yielding cultivars and the increasing inadequacy of these supplements in the soil, Indian soils are considered poor in nitrogen, phosphorus and sulfur. Manure plays a crucial role in plant growth and significantly increases crop yields. The best nutritional supplement for canola mustard is nitrogen. Where there are no reliable agronomic recommendations for the amounts of N compost for a certain unit zone. Kumar *et al.*, (2007) [9] advocated 120 kg N ha⁻¹ for the optimum Indian mustard output, whereas Singh *et al.*, (2008) [19] and Singh and Verma (2007) [9] also suggested this quantity.

2. Materials and Methods

Effect of integrated nutrient management on the growth and yield of mustard (*Brassica juncea* L.) is proposed to be undertaken at the Agricultural Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, the area of Kanpur during 2021-2022. The district comes under a subtropical belt in the South East of Uttar Pradesh, which experiences extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46 °C and seldom falls as low as 4-5 °C. The relative humidity ranged between 20-94%. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months. Treatments T₁- Control (NO NPK), T₂- 100% NPK, T₃- 75% NPK + N-25% (FYM), T₄ - 100% NPK + S @40 kg, T₅ 100% NPK + ZnSO₄ @ 25 kg, T₆ - 75% NPK + N-25% (FYM) +S @ 40 kg, T₇ -75% NPK+ N-25% (FYM) + ZnSO₄ @ 25 kg were tested in randomized block design with three replications. The observations were recorded on three randomly selected plants from each treatment. Growth attributes, Yield attributes and yields, Nutrient content and uptake by mustard crop, Soil quality, Economics.

3. Results and Discussion

3.1 Growth characters

Vertically, plant population, height, and range of branches will all be accustomed quantify a plant' growth, whereas horizontally, dry matter accumulation is often used to live growth, among alternative things. Production of dry matter is a lot of crucial since it contains all other vegetative characteristics. The knowledge relating to the plant population of mustard at thirty days when planting as laid low with numerous levels of

nitrogen management and none has been reported in Table 1 and portrayed in Fig. The plant population of the mustard crop at 30 DAS wasn't considerably affected by variable nutrient levels or none practises; nevertheless, the best plant population was found with the treatment T₆ + None @ 5 t/ha⁻¹ for the years 2020 and 2021. Though in every of the 2 years the treatment T₁- Control (NO NPK+NO None) was shown to own the bottom plant population. The mustard crop' plant height at sixty DAS and at the harvest stage is shown in Table 1 with the continuance of the mustard crop, plant height step by step grew. Crop growth was at its quickest up till 60 DAS, following that it gradually picked up until harvest. The varied INM and None had a significant impact on plant height. Treatment T₆ + None @ 5 t/ha⁻¹, which was statistically at parity with T₈ and considerably higher than the treatments, recorded the utmost plant height in any respect stages. The treatment T₁- Control (NO NPK + NO None) was noted to own the bottom plant height at all stages. However, diminished weed density at the initial stage, an important time within the crop life cycle, was the rationale for the multiplied plant height. As a result, there was now not any conflict amongst crops for nutrients, moisture, or area (Upadhyay *et al.*, 2012; Gupta *et al.*, 2021) [21, 26]. The crop grew powerfully as a result. Multiplied fertilizer uptake by crops as a results of integrated nutrient management vegetative development Conversely, a decrease in atomic number 7 absorption by crop is higher up to speed and lower the assembly of growth regulators resulted in an exceedingly decrease within the crop' vegetative growth (Kumar *et al.*, Pandey *et al.*, 2021 and Regar *et al.*, 2007) [28, 20].

There have been considerably a lot of branches in plant⁻¹ than influenced by totally different INM strategies and none in any respect with the exception of thirty DAS throughout each the expansion years (Table 4.3). Below the treatment T₆ + None @ 5 t/ha⁻¹, the best number of branches plant⁻¹ at 60DAS were noted. It had been discovered to be statistically cherished T₂, T₃, T₄, T₅ and T₇ treatment in 2020–2021. The medical care T₆ was statistically superior to the treatment within the years T₂, T₃, T₄, and T₅ and considerably comparable to the remainder.

In any respect stages, the management therapy (No NPK and No None) had the fewest branches reported. Multiplied nutrient intake caused by INM and None techniques might have resulted in higher vegetative growth. A larger range of branches occurred from the favourable synthesis of growth-promoting substances within the plant system thanks to increased nutrient availability. The outcomes match those of Tatarwal *et al.*, (2013) [10] and Gupta *et al.*, (2021) [26].

In any respect growth phases except thirty DAS, plant one had the best dry matter accumulation. With the exception of treatment T₆ + None @ 5 t/ha⁻¹, that was statistically cherish treatments T₂, T₃, T₄, and T₅ and far higher than the rest of the medical care in 2020–2021, Statistics show that therapy T₆ is statistically comparable to treatments T₂, T₃, T₄, and T₅ which rest is statistically superior to treatment. It had been brought on by nothing the soil surface may stop. Additionally, it regulates soil temperature that results in less irrigations (Dubey, 2020, Pandey *et al.*, 2021) [14, 22].

The treatment T₆ + None @5 t/ha⁻¹ had the utmost dry matter accumulation plant⁻¹ at sixty DAS and harvest stage. Throughout each year of the experiment, this was statistically cherished T₂, T₃, T₄, T₅ and T₇ far higher than the remainder of the treatment. The build-up of dry matter at intervals a plant is the finish outcome of all internal metabolic (physiology and biochemistry) processes. The multiplied rate of the photosynthetic organ, specifically leaves, was accountable for the upper price of total dry matter per plant below these treatments, as a result of the

plants in these treatments were taller, they accumulated a lot of dry matter (Table 1). Tatarwal *et al.*, (2013) ^[10], Pandey *et al.*, 2021 ^[22], and Sharma and religious belief (2002) are in agreement with these findings. The treatment T₁-Control (NO

NPK + NO None) plots showed the lowest values of dry matter accumulation (1.22 and 1.23 g plant⁻¹) whereas, T₁ - Control (NO NPK +), accumulation plant⁻¹ (12.09 and 13.03 g plant⁻¹) was seen NO None) high dry matter accumulated.

Table 1: Effect of Integrated Nutrient Management on Growth parameters of Mustard

Treatments	Plant population (m ⁻¹)	Plant height (cm)	Number of branches plant ⁻¹
T ₁ - Control (No NPK)	13.76	136.05	16.75
T ₂ - 100% NPK	14.20	166.40	20.19
T ₃ - 75% NPK + N-25% (FYM)	14.40	170.42	20.25
T ₄ - 100% NPK+ S @ 40 kg	14.80	175.45	21.39
T ₅ 100% NPK+ ZnSO ₄ @ 25 kg	14.50	175.40	21.27
T ₆ - 75% NPK+ N-25% (FYM) +S @ 40 kg	15.80	183.75	23.25
T ₇ -75% NPK+ N-25% (FYM) + ZnSO ₄ @ 25 kg	15.00	176.45	22.40
F-test	S	S	NS
SE. d (+)	0.35	49.29	0.9
CD (5%)	1.06	3.42	1.2

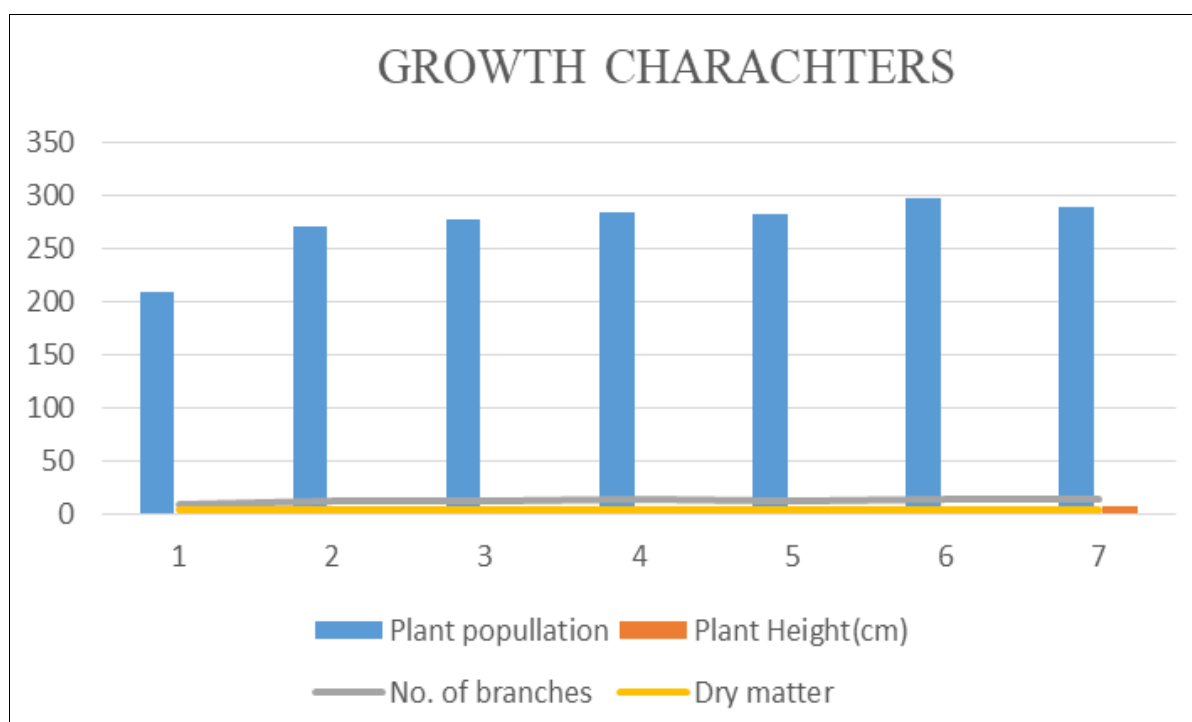


Fig 1: Effect of Integrated Nutrient Management on Growth parameters of Mustard

3.2 Yield and economic attributes

The remedy T₆ + None @5 t/ha⁻¹ produced the best variety of siliquae plant⁻¹ (304.83 and 316.96). The remedy T₁-Control (No NPK + NO None) become proven to have notably fewer siliquae plant⁻¹ (208.65 and 211.97) remedy T₆ + None @ 5 t/ha⁻¹ recorded the longest duration of siliquae (7.91 and 8.14 cm). The smallest duration of siliquae (5.79 and 5.90 cm) become recorded in remedy T₁ - Control (No NPK + NO None) plots at some stage in the yr. of 2021-22 respectively. Treatment T₆ + None @five t/h⁻¹ had a better variety of seeds siliquae⁻¹ (14.82 and 15.03) remedy T₁ - Control (No NPK + NO None), a notably decrease variety of seeds siliquae⁻¹ (9.05 and 9.26, respectively) have been discovered the best take a look at weights (4.92 and 5.03 g) have been recorded below the remedy T₆ + None @5 t/ha⁻¹, observed with the aid of using the bottom take a look at weights (3.29 and 3.71 g) below the remedy T₁ -

Control (No NPK + NO None), at some stage in the 2 years, respectively. T₆ + remedy. The finest recorded seed output (21.05 and 22.08 q ha⁻¹) in the course of each seasons become none @ 5 t/ha⁻¹. In relation to years the minimal seed yield (10.forty one and 10.41 q ha⁻¹) become determined under the remedy T₁ - Control (No NPK + NO None). Therapy T₆ + None @five t/ha⁻¹ maximum stover output, which become statistically akin to T₂, T₃, T₄, T₅, T₇, and 49.42 and 51.43 q ha⁻¹, the remedy T₁ - Control (No NPK + NO None) confirmed the bottom stover yield (31.59 and 32.23 q ha⁻¹). The remedy T₆ + None @ 5 t/ha⁻¹ after the remedy T₇ + None @ 5 t/ha⁻¹ had the best harvest index recorded (29.90 and 30.87 percent) (29.87 and 30.19 percent). During the years 2021–2022 and 2019–2020, respectively, the remedy T₁ Control (No NPK + NO None) had the lowest harvest index (24.03 and 24.15 percent).

Table 2: Effect of Integrated Nutrient Management on Yield Parameters of Mustard

Treatments	No. of siliquae/ plant	Length of Siliquae (cm)	No. of seeds/ Siliquae	Test Weight (g)
T ₁ - Control (NO NPK)	208.60	5.78	9.00	4.05
T ₂ - 100% NPK	271.00	6.50	12.64	4.15
T ₃ - 75% NPK + N-25% (FYM)	277.00	6.75	13.00	4.20
T ₄ - 100% NPK + S @ 40 kg	283.30	6.86	13.30	4.35
T ₅ 100% NPK + ZnSO ₄ @ 25 kg	281.30	6.85	13.10	4.25
T ₆ - 75% NPK + N-25% (FYM) + S @ 40 kg	297.65	7.00	14.00	4.55
T ₇ -75% NPK + N-25% (FYM) + ZnSO ₄ @ 25kg	288.00	6.85	13.35	4.40
F-test	S	NS	S	S
S.Ed(+)	52.91	2.13	2.8	4.2
CD (5%)	112.9	1.83	1.56	1.92

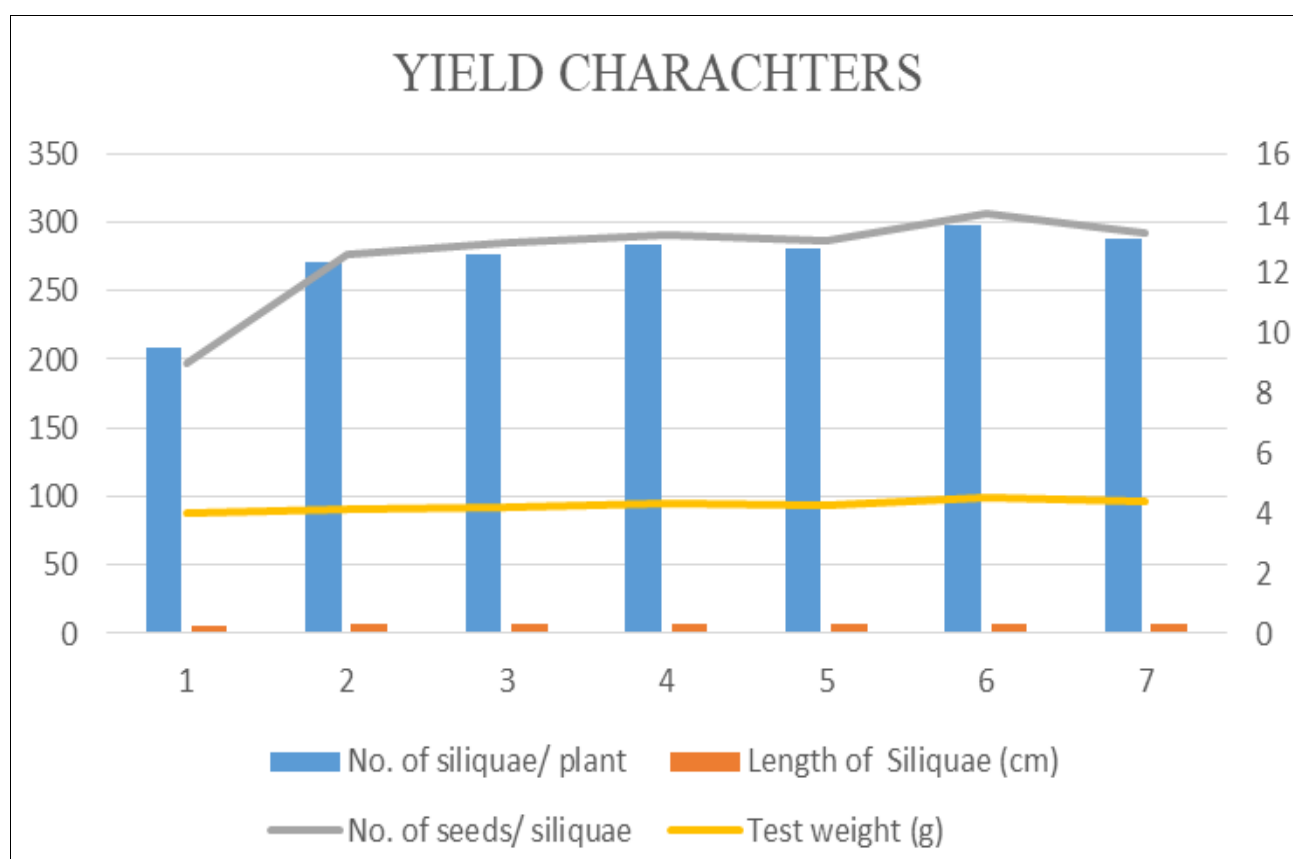


Fig 2: Effect of Integrated Nutrient Management on Yield Parameters of Mustard

3.3 Plant Nutrient Analysis

Treatment T₆ + None @5 t/ha⁻¹ had significantly higher N uptake by seed (50.52 and 57.18 metric weight unit ha⁻¹) and fodder (38.54 and 48.34 kg h⁻¹) over each year, respectively. very cheap N absorption by seed (20.85 and 26.43 kg ha⁻¹) and also the lowest N uptake by stover (22.11 and 24.46 kg ha⁻¹) throughout the 2 years, respectively, were examined with treatment T₁ -control (No NPK+ No None).The entire nitrogen uptake showed that among the various INM and None practises, treatment T₆ + None @5 t/ha⁻¹ recorded the very best total nitrogen uptake (89.06 and 105.52 kg ha⁻¹) and the lowest total gas uptake (42.96 and 50.89 metric weight unit ha⁻¹) was recorded in treatment T₁ - Control (No NPK + No None).

Higher phosphorus content (0.52 and 0.69%) in fodder throughout each the season underneath the treatment of T₆ + None @5 t/ha⁻¹ as compared to treatment T₁-control (NO NPK+ No None), that had a phosphorus content of 1.02 and 119 percent in seed and also the treatment T₆ + None @5 t/ha⁻¹ created the very best phosphorus uptake by seed (23.78 and 28.48 kg ha⁻¹). treatment T₁-control (NO NPK+ No None) throughout both years had very cheap measured phosphorus

uptake by seed (10.25 and 12.60 metric weight unit ha⁻¹, respectively), The treatment T₆ + None @5 t/ha⁻¹ had the very best phosphorus uptake by fodder (30.14 and 38.05 kg ha⁻¹), whereas largest phosphoric uptake (38.05 kg ha⁻¹) was conjointly recorded within the second year underneath constant treatment (T₆).The treatment T₁ management (No NPK+ No None) had very cheap P uptake (10.25 and 12.60 kg ha⁻¹) in seed and stover (16.42 and 22.24 kg ha⁻¹).The treatment T₆ + None @ 5 t/ha⁻¹ recorded the highest total phosphorus uptake (53.92 and 66.53 kg ha⁻¹). The treatment T₁Control - (No NPK + No None) plots were found to possess very cheap total uptake of P (26.67 and 34.63 metric weight unit ha⁻¹) throughout the corresponding years of (2021-22 and 2021-22).

The treatment T₆ + None @ 5 t/ha⁻¹ during each year was related to the very best metal concentration in seed (1.91 and 2.11 percent) and fodder (0.89 and 1.04 percent). whereas underneath the T₁ management (NO NPK + No None) very cheap potassium content in seed (1.78 and 1.94 percent) and lowest potassium content in stover (0.79 and 0.95 percent) were noted.

Information on however completely different INM and None procedures affected P uptake in seed and fodder were shown to

be significant. The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ considerably increased the utmost potassium uptake by seed (40.20 and 46.58 metric weight unit ha^{-1}) and also the maximum potassium uptake by stover (43.98 and 53.48 kg ha^{-1}). The treatment T_1 - management (No NPK+ No None) was shown to possess very cheap potassium uptake by seed (17.89 and 19.15 kg ha^{-1}) and the lowest potassium uptake by stover within the corresponding years.

The utmost total absorption of potassium (84.18 and 100.06) was obtained underneath the treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$. However, throughout each year, the treatment T_1 - management (NO NPK+ NO None) plots had very cheap metal uptake (42.85 and 50.50 metric weight unit ha^{-1} , respectively).

The impact of INM and None was determined to be insignificant. With treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$, it absolutely was attainable to look at a spread of INM and None practises with most sulphur content in seed (0.90 and 0.93 percent) and maximum fodder (0.51 and 0.58 percent) over both years. Whereas minimum content of sulphur in seed (0.76 and 0.79%) and minimum content of stover (0.39 and 0.46%) was discovered treatment T_1 - management (No NPK+ No None).

The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$, most sulphur uptake by seed (18.94 and 28.53 metric weight unit ha^{-1}) and also the maximum sulphur uptake by fodder (25.20 and 29.82 kg ha^{-1}) were identified. Whereas the treatment T_1 -control none) plots were shown to possess very cheap sulphur uptake by seed (7.64 and 8.22 kg ha^{-1}) and lowest sulphur uptake by stover (12.32 and 14.83 kg ha^{-1}).

The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ was shown to have the very best total sulphur uptake (44.14 and 58.35 kg ha^{-1}) over each year, followed by T_2 , T_3 , T_4 , and T_5 treatments. The treatment T_1 - management (No NPK + No None) had very cheap total sulphur uptake (19.96 and 23.05 metric weight unit ha^{-1}) for the years 2021–2022, nevertheless.

3.4 Soil Properties

The treatment $T_6 + \text{none @ } 5 \text{ t/ha}^{-1}$ for each years showed the best hydrogen ion concentration depletion (7.91 and 7.76) at the harvest stage. Whereas the treatment T_1 - management (NO NPK + NO None) showed the smallest amount pH depletion (8.25 and 8.23 respectively) over the corresponding years. At harvest stage, treatment T_6 -control (NO NPK + NO None) resulted within the largest soil EC depletion (0.21 and 0.20 dSm^{-1}), whereas control (0.23 and 0.23 dSm^{-1}) resulted in the smallest soil EC depletion throughout the course of both years. The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ made the best levels of organic carbon (3.60 and 3.83 g/kg). Whereas quantity} amount of organic carbon build up (2.11 and 2.35, respectively) was seen below the T_1 - management (No NPK + No None) for every of the 2 years.

3.5 Availability of Nutrients in Soil

It is evident that the treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ was used throughout each year to look at the utmost available nitrogen at 142.76 and 146.61 kilo ha^{-1} , respectively. The treatment T_1 - management (No NPK + NO None) plot throughout every of the 2 years, the bottom price of accessible nitrogen was found to be 128.03 and 126.96 kg ha^{-1} , respectively. The increase in accessible nitrogen content with the addition of organic sources may be due to nitrogen mineralization from organic manure. The most soluble soil state of the organic source may have assisted in the mineralization of soil nitrogen and the build-up of more readily accessible nitrogen (Verma *et al.*, 2017) [17].

The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ was found to own the very

best levels of accessible phosphorus in both years, at 14.50 and 18.70 kg ha^{-1} , respectively. That was statistically on par with T_7 and statistically considerably better at rest than treatments than T_2 , T_3 , T_4 , and T_5 , that was statistically on par with T_6 and significantly better at rest than treatments within the corresponding years 2021–2022 than T_6 . Beneath the treatment T_1 - management (No NPK + NO None) for every of the 2 years, the minimally accessible phosphorus was found to be 11.01 and 12.67 kg ha^{-1} , respectively (Singh *et al.*, 2015) [21].

The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ was shown to supply the very best levels of metallic element offered (288.51 and 291.95 kg ha^{-1}) was statistically such as the treatments however far better with T_4 . Beneath treatment T_1 - management (No NPK + No None), the minimum offered metallic element (273.45 and 274.90 kilo ha^{-1}) was seen in each of the 2 years, respectively. The addition of potassium to the soil's available potassium pool may also be responsible for the use of mulch. Singh *et al.*, (2015) [21].

The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ for every of the two years, the utmost accessible sulphur concentrations (7.78 and 7.98 ppm) were noted. Treatment T_7 was statistically at parity with Treatments T_2 , T_3 , T_4 , and T_5 respectively. Throughout each of the two years, the treatment T_1 - control (No NPK + No None) was found to own the minimum available sulphur (6.02 and 6.37 ppm, respectively) (Singh *et al.*, 2015) [29].

3.6 Microbial Population

The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ was found to own the very best microorganism population in each year (23.81 and 24.80 cfu g^{-1} , respectively). The T_1 -control (No NPK + NO None) treatment made very cheap bacterial population (15.80 and 16.60 cfu g^{-1}). The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ was employed in the years 2021 and 2022 to look at the best plant life populations (19.90 and 20.50 cuf g^{-1} , respectively). Underneath the therapy T_1 - management (No NPK + NO None) throughout every of the 2 years, the lowest bacterial population (12.60 and 13.30 cfu g^{-1}) was noted. The very best actinomycetes populations (21.00 and 22.00 cfu g^{-1}) were found throughout the corresponding years 2021 and 2022 with the treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$. This was statistically similar to the therapies over the 2 years treatments with T_2 and T_8 , respectively. Underneath therapy T_1 - management (No NPK + NO None), very cheap actinomycetes population (13.45 and 14.10 cfu g^{-1}) was noted in 2021-22 and 2021-22, respectively. (Dongale (2011) [17]). The mulch-treated plot had excellent crop development, which might be attributed to the mulch's capacity to improve the physical, chemical, and biological aspects of the soil and provide plants with a healthy habitat. According to, the use of various mixtures of straw mulch increased the bacterial population (Kaur *et al.*, 2014 and Tejashree *et al.*, 2020) [8, 25].

3.7 The economic feasibility of different treatments

For all of the treatments, the value of cultivation was calculated. The treatment $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ for mustard crop resulted within the highest total cost of cultivation of Rs. 39101.00 and 39226.00 ha^{-1}). The fertiliser, none cost, and alternative techniques were answerable for the upper expense of agriculture during this approach. $T_6 + \text{None @ } 5 \text{ t/ha}^{-1}$ made the best gross come back (88509.00 and 92835.00 rupees per hectare) and web return (44485.00 and 50685.00 rupees per hectare). The $T_6 - 75\% \text{ NPK} + \text{N-25 percent (FYM) + S @ } 40 \text{ weight unit} + \text{NO None}$ was found to own a B:C quantitative relation of 1.32 and 1.45. the bottom gross come back (Rs. 42273.00 and 45868.00 ha^{-1}), Net return (Rs. 16257.00 and 18427.00 ha^{-1}) and B:C ratio

(0.059 and 0.59) were reportable beneath treatment T₁- control (NO NPK + NO None) and treatment T₁ + None @ 5 t/ha⁻¹ plot, respectively, for the years 2020 and 2021. The increase in net and gross returns the larger addition return and lower input value is also the reason behind the rise in gross return, net return, and B:C ratio that was recorded under the T₆ therapy and T₇ treatment, respectively. Singh *et al.*, 2020^[27] and Mukherjee *et al.*, (2014)^[30] additionally found similar findings.

4. Conclusion

The treatment T₆+ None @5 t/ha⁻¹ each year was related to a larger microbe population within the soil (Bacteria, Fungi, and Actinomycetes, respectively). Supported by the findings of all annual tests, it had been determined that Treatment T₆+ None @ 5 t/ha⁻¹ was a lot of roaring in enhancing the yield and yield qualities of mustard. whereas T₇ + None @ 5 t/ha⁻¹ was found to be more successful than T₆ to spice up the yield and yield attributes of mustard throughout both seasons than alternative INM and none practises. The crop' most nutrient uptake was seen below the treatments T₆+ None @ 5 t/ha⁻¹ and T₇ + None @5 t/ha⁻¹. Treatment T₆+ None @ 5 t/ha⁻¹, the soil's highest levels of organic carbon, nutrients, and microbial population were noted. Treatment T₁-Control (NO NPK + NO None) showed the best hydrogen ion concentration and Common Market lowering. variations in pH and also the most web come in treatment T₆+ None @ 5 t/ha⁻¹ (Rs. 49408.00 and 52309.00 ha⁻¹, respectively), whereas the T₆ - 75% NPK+ N-25 percent (FYM) +S @40 weight unit + NO None created the best B:C ratios (1.32 and 1.45).

It may be the same that T₆+ None @ 5 t/ha⁻¹ and T₇ + None @ 5 t/ha⁻¹ were determined to be higher and superior for manufacturing mustard crops and enhancing soil quality. whereas T₆ - 75% NPK+ 25% (FYM) + S @ forty weight unit + NO None was discovered to be better for producing mustard crop yield.

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