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Effect of Integrated nutrient management on yield and quality of Indian Mustard (Brassica juncea L.).

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Abstract

In Madhya Pradesh, Mustard are most important edible oilseed group of crops with predominance of Indian mustard followed by toria and yellow sarson. Due to the intensive cultivation and use of unbalanced and inadequate fertilizers accompanied by rastricted use of organic manures in soils not only deficient in the nutriants, but also deteriorated the soil health resulting in decline in crop rasponses to the recommanded dose of NPK fertilizars in the region as well as chemical fertilizers are an expensive option for fullfill the need of nutrient with minimizing the cost of cultivation as well as maintenance soil fertility status ,Integrated Nutrient Management is best option Thus, intagration of organic manures with fertilizers, not only supply macronutrients but also meet the requirement of micronutrients . The responses of mustard to various treatmants were recorded i.e. growth attributes, yield and yield attribiutes, nutrient content and nutrient uptake, soil proparties and available nutrients and mustiard quality. many field experiment for INM in fenugreek was conducted by researcher which shows that how integrated nutrient management practices repercussion on fertility status of soil , uptake efficiency of nitrogen, phosphorus and potash, protein content , height of plant, no. of branches , biomass, number of pods , number of seeds pod-1, test weight as well as grain and straw yield of fenugreek.

Key Words :- INM, Vermicompost,Rhizobium,PSB, Poultry Manure, NADEP, Inorganic Fertilizers.

INTRODUCTION

The oilseeds have an important place in Indian agriculture next to cereals crops. Oilseed crops form the second major group among agricultural crops after cereals in the country. Mustard seed has high nutritive value with protein content of 28-36%. Mustard a winter (*Rabi*) season crop that requires relatively cool temperature, a fair supply of soil moisture during the growing season and a dry harvest period (Budzynski *et al.*, 2019), India, total area under mustard crop is 6671 thousand ha with production 7120 thousand ton. (Anonymous, 2018-19) but the average yield of rapeseed-mustard in India is only 1150 kg ha^{-1} (Economic survey, 2019) due to the lack of optimum use of nutrients particularly sculpture which is

one of the important factors responsible for its low yield. Application of sculpture was reported to increase yield attributes and yield of Indian mustard. The first position in area and second position in Production after China (Anonymous, 2019), The quality of the oil in the rapeseeds and mustard possess a adequate amount of erucic acid 40-60% together with Linolinic up to 4.5 to 13%.The oleic acid and linoleic acid which have a higher nutritive value together constituent only about 25-30%.It is desirable to increase the quality of oleic acid and linoleic acid by reducing the linolinic and erucicacid, a lower proportion of erucic acid will make the oil more palatable, nutritive, besides reducing metabolic disorders. The oil content in mustard about 35-40% and a protein content range from 25-30%.But the presence of toxic glucosinolate in mustard render it unavailable as a source of human protein and are present used as manures and an animal feed.

Use of chemical fertilizers in combination with organic manure is essentially required to improve the soil health (Presad *et al.,* 2017). Chamical fertilizers alone cannot sustain the desired levels of crop production under continuous farming. Integrated nutrient management is very essential which is not only sustains high crop production over the years (Verma *et al.,* 2016) but also improves soil health and ensures safer environment (Babu lal *et al.,* 2017). The nutriant supplied to crops through INM not only rastoring the soil fertility but also sustain desired level of production over the years (Pal and Pathak, 2016). Rapeseed-mustard oils are of high-value Agricultural commodity for use in refined edible oil products and as renewable industreial or fuel oils. The verious macro and micronutrients as required for quantitative and qualitative oilseed production. Sulphur and zinc in marked effect on mustard yield, oil content with oil quality and soil properties. The balanced nutrient management through conjunctive use of organic, inorganic and bio-fertilizers facilitate profitable and sustainable crop producetion and maintain soil quality (Sinsinwar *et al.,* 2016)..

Effect on Growth and seed yield parameters

Thanki *et al.,* (2011) repotted that carried out field trail on application of 25, 50 or 70 kg N ha^{-1}, 0, 25 or 50 kg P ha^{-1} and 0 or 10 t farmyard manure ha^{-1}. The results showed Plant height, number of branches per plant, number of siliqua per plant, 1000-seed weight, seed yield, oil yield and net returns increased, whereas oil content decreased with increasing rates of N. The values for all the parameters measured were highest with the application of 50 kg P ha^{-1} and 10 kg farmyard manure ha^{-1}. N, P and K uptake increased with increasing rates of N, P and farmyard manure rates.Kansotia *et al.,* (2013) repotted that proved that application of vermicompost up to 6t ha^{-1} and 80kg N ha^{-1}+ 40 kg P_2O_5 ha^{-1} significantly increased the growth parameters, nutrient content, nutrient uptake in seed, straw and total nitrogen and phosphorus uptake in Indian mustard.

Singh *et al.,* (2014) repotted that conducted field trail on effect of three levels of FYM (0, 2.5 & 5.0 t ha^{-1}) with two biofertilizers at the rate of 4.0 Kg ha^{-1} each and three levels of N (0, 40 & 80 kg ha^{-1}) on Indian Mustard (*Brassica juncia* L.), cv. RH-30. The yield attributes and seed as well as stover yield increased significantly with the application of FYM (5.0 t ha^{-1}) over control. Seed inoculation with either of the bacteria significantly increased the number of branches, pods $plant^{-1}$, seeds pod^{-1} and yield of seed and stover yield. Application of N showed liner increase of these characters up to 80 kg N ha^{-1}. Integrated use of bio fertilizers, FYM with 40 Kg of nitrogen gave seed yield equal to the 80 kg N ha^{-1} alone. Maximum seed yield was obtained in the use of higher doses of N fertilizer in conjunctions with bio fertilizers and FYM in both years.Lepcha *et al.,* (2015) also evaluated the combined application of different organic and inorganic sources of nitrogen their effect on the growth, yield, quality and economics of Indian mustard. The maximum value of yield and yield attributes parameters viz. siliqua $plant^{-1}$, seed $siliqua^{-1}$, test weight (g), harvest index (%), stalk yield (q ha^{-1}), grain yield (q ha^{-1}) and oil content (%) were found under the treatment 20 % Nitrogen through FYM + 20 % Nitrogen through vermicompost + 20 % Nitrogen through neemcake + 20 % Nitrogen through poultry manure + 20 % Nitrogen through inorganic followed by 50 % Nitrogen through vermicompost + 50 % Nitrogen through inorganic.

Thaneshwar *et al.,* (2017) repotted that the significantly better growth attributes, yield attributes and grain yield (22.75 q ha^{-1}) was obtained with combined application of RDF + vermicompost @ 5.0 t ha^{-1}

over rest of the treatments. The minimum grain yield (19.15 q ha^{-1}) was received in treatment RDF (120:60:40:30 Kg ha^{-1} NPKS). The application of RDF + vermicompost @ 5.0 t ha^{-1} was also found significantly higher gross income (Rs 81575) and net profit (Rs 35725) over rest of the treatments. While Benefit:Cost ratio was significantly higher (1.96) with application of RDF(120:60:40:30 Kg ha^{-1} NPKS).Vinod KB *et al.,* (2019) also repotted that the three levels of NPK @ 0%, 50% & 100% ha^{-1}, three levels of Organics manure @ 0%, 50% & 100% ha^{-1} respectively. The result showed that plant height, no. of branches, no. of leaves, fresh weight, dry weight, test weight, total seed yield and total straw yield during 30, 60, 90 &120 DAS were shown significantly increased with application of 100 % NPK & organic fertilizers.

Effect on Oil content and oil yield parameters

Dhaka and Satish (2012) repotted that the was found that the effects of fertilizer levels and organic fertilizer sources on the performance of late-planted raya (*Brassica juncea* cv. RH 30). The fertilizer applies as 40 kg N ha^{-1}; 80 kg N ha^{-1}; and 80 kg N ha^{-1} + 30 kg P ha^{-1} and the organic sources such as farmyard manure (FYM) at 5 t ha^{-1}; and vermicompost at 5 and 10 t ha^{-1}. Seed and grain yields increased with increasing N rates up to 80 kg ha^{-1}. Integration of P with N produced higher yields compared to N at 80 kg ha^{-1} alone. Oil content decreased, while oil protein content and yield increased, with increasing N rate. Vermicompost at 10 t ha^{-1} produced significantly higher seed yield compared to FYM and vermicompost at 5t ha^{-1}. Oil yield increased with increasing amount of organic matter applied, but oil content decreased with increasing organic matter applied, regardless of source. The effect of integrated nutrient management on the growth, yield, oil content and nutrient uptake by Indian mustard (Brassica juncea cv. RH 30) under 2 levels of farmyard manures (2.5 and 5t ha^{-1}) and inorganic N (0, 40 and 80 kg ha^{-1}) in combination with Azotobacter chroococcum and Azospirillum as biofertilizers. The number of branches, 1000-seed weight, and oil content of Indian mustard, and yields of seed and straw increased significantly with the application of farmyard manure at 5 t/ha + Azotobacter chroococcum + Azospirillum over the control. The application of nitrogen resulted in a linear increase in the aforementioned parameters up to 80 kg ha^{-1} .Singh and Sinsinwar (2013).

Jat *et al.,* (2014) repotted that the conducted a field trail to study the effect of FYM and mineral nutrients on seed and stover yield, content and uptake of nutrients in mustard. The experiment consisted of three levels of FYM *viz.*, control, 5 t ha^{-1} & 10 t ha^{-1} and five levels of mineral nutrients *viz.*, no mineral nutrients, 40 kg S ha^{-1}, 40 kg S ha^{-1}+ 25 kg $ZnSO_4$ ha^{-1}, 40 kg S ha^{-1} + 50 kg $FeSO_4$ ha^{-1} and 40 kg S ha^{-1} + 25 kg $ZnSO_4$ ha^{-1}+ 50 kg $FeSO_4$ ha^{-1}. The results showed that increasing levels of FYM and mineral nutrients individually and in combination significantly increased the seed and stover yield, content and uptake of nitrogen (N), sulphur (S), zinc (Zn) and iron (Fe) in seed and stover as compared to control.Pradhan *et al.,* (2017) conducted an experiment to observe the effect of fertility levels and cow urine application on growth and yield of Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson]. Application of 100 % fertility level and 900 liter cow urine significantly increased the dry matter accumulation, physiological growth and yield attributes as well as yield of mustard in comparison to 50 % RDF and control respectively. Application of 100 % RDF produced 12.1 and 31.2 % higher seed yield than 75 % and 50 %RDF respectively. As regards the urine application, the increasing levels of urine application up to 900L cow urine ha^{-1} enhanced the yield attributes as well as seed and stover yield.

Kumar A *et al.,* (2016) repotted that the to study Influence of biofertilizer and farm yard manure on growth, yield and seed quality of mustard (Brassica juncea L.) cultivar Kranti. Seven treatments consisting of 100 and 50 % of the recommended dose of fertilizers (RDF) (80 kg N + 40 kg P_2O_5 + 40 kg K_2O ha^{-1}) either alone or with successive addition of farmyard manure (FYM) and Azotobacter were tested. Application of 50 % recommended dose of fertilizers along with farmyard manure and Azotobacter (seed treatment) resulted in maximum plant height, number of primary branches per plant, number of secondary branches per plant, number of siliqua per plant, number of seed per siliqua, test weight and higher seed yield.Potdar DS *et al.,* (2019) repotted that the study the effect of fertilizer P, FYM and microbial inoculum alone and in combinations on growth, yield quality and nutrient uptake by mustard. Thirty two treatment

combinations consisting of four levels of phosphorus (0, 20, 40 and 60 kg P2O5 ha^{-1}) and two levels of FYM (0 and 5 t ha^{-1}) and four levels of microbial inoculum (no inoculum, PSB, VAM and PSB + VAM). Application of 60 kg P_2O_5 ha^{-1}, FYM @ 5 t ha^{-1} and PSB + VAM inoculation significantly enhanced the plant height, number of branches $plant^{-1}$, dry matter accumulation, number of siliquae $plant^{-1}$, seeds $siliqua^{-1}$, test weight, seed yield, straw yield and oil yield of mustard over respective control.

Effect on Oil quality parameters

Giri *et al.,* (2012) also repotted that the studied the effect of irrigation and sources of sulfur on the quality and nutrient uptake of mustard (*Brassica juncea*). It was found that the different irrigation levels applied at pre-sowing, vegetative, 50% flowering and grain filling stages significantly increased the quality parameters viz., oil content, protein content, oil yield, protein yield, S, N, P contents (%) in straw and seed and their total uptake (kg ha^{-1}) by mustard. Application of 30 kg S ha^{-1} through gypsum recorded the highest quality characters, S and N content in straw, seed and total uptake of S, N and P (kg ha^{-1}). Four irrigations in combination with 30 kg S ha^{-1} through gypsum recorded the highest S content in seed than all other treatments.

Hegde and Babu (2013) reported the current status of oilseed production in India under sub-optimal agro-ecological conditions is unsustainable. Profitable oilseeds cultivation is possible with integrated use of nutrient sources to improve the productivity and quality of oil and protein. The nutritional imbalance, mainly of secondary and micronutrients, has contributed to losses in oilseed yield and quality. Jahangir *et al.,* (2014) repotted that the investigated the effects of Mg (at 0, 7.5, 15 and 30 kg ha^{-1}) and S (0, 10, 20 and 30 kg ha^{-1}) on the growth, yield and nutrient content and oil quality of mustard [*Brassica juncea]* cv. Sonali. Seed yield and oil content was obtained increased with increasing rate of Mg and S. N, P and S with the treatments. The major fatty acids of rapeseed-mustard oil are oleic, linoleic, linolenic, eicosenoic and erucic acid. Erucic acid in oil of Indian rapeseed-mustard varieties is quite high (Chauhan *et al.* 2007). Rapeseed-mustardcultivars grown in India also have high level of glucosinolate content (Chauhan *et al.* 2007). Glucosinolates, a group of plant thioglucosides, found principally among members of family Brassicaceae are responsible for the characteristic pungency of rapeseed- mustard oil.

Singh and Pal (2015) repotted that the conducted an experiment to study the effect of integrated nutrient quality, economics and nutrient uptake of mustard [*Brassica juncea* (L.) Czernj &Cosson] in Indo-Gangetic plains of India. Application of either FYM or Zn or seed treatment along with RDF enhanced the mustard seed yield by 12.0, 11.5 and 13.0%, respectively over RDF alone. The inorganic fertilization had adverse effect on oil as well as glucosinolate contents and highest values were recorded at 50% RDF. Azotobacter seed treatment reduced the glucosinolate but improved the oil content. The highest values of N, P, K, S and Zn content and its uptake were recorded with combined application of RDF with FYM, Zn and Azotobacter.Kumar *et al.,* (2016) also repotted that the carried out experiment with the application of different levels of sulphur (0, 20, 40, 60 kg ha^{-1}) and nitrogen (0, 40, 80, 120 kg ha^{-1}) and data regarding various growth and yield parameters of Indian mustard were recorded using the standard procedures. The results revealed that the highest seed yield (2606.21 kg ha^{-1}) was obtained in 60 kg ha^{-1} S and 120 kg ha^{-1} N followed by 40 kg ha^{-1} S and 120 kg ha^{-1} N treatment which gave 2588.91 kg ha^{-1} seed yield while minimum seed yield (1417.02 kg ha^{-1}) was recorded in case of control *i.e.* with no S and N. Oil content progressively increased with increase of S level with N highest (41.73%) with a S level of 40 kg ha^{-1}. Glucosinolate content increased from 15.8 to 20.9 µmol g^{-1} as S rate was increased from 0 to 40 kg ha^{-1}.

Majumder *et al.,* (2017) different doses of S and Zn either alone or in combination of results revealed that in general, available N, P, K, S and Zn in soil decreased with increase in the period of crop growth. Addition of FYM increased organic carbon content in soils (upto 104.98 g kg^{-1} increase over initial value). Application of elemental S and Zn-EDTA increased SO4 -2 content (upto 101.03 kg ha^{-1} increase over initial value) in S-treated and DTPA extractable Zn content (upto 0.3 mg kg^{-1} increase over initial value) in Zn-treated systems respectively. Combined application of higher doses of S and Zn along with FYM and recommended doses of N, P and K fertilizers increased N, P, K, S and Zn uptake by rapeseed crop. Highest seed yield (14.2 q ha^{-1}) as well as oil (43.2 %) and protein contents (21.82 %) were recorded

in rapeseed which received comparatively higher doses of S and Zn along with FYM and RDF.

Effect on Soil quality parameters

Saha R *et al.*, (2011) reported that the study the effect of Addition of NPK fertilizers along with organic manure, lime, and biofertilizers increased soil organic carbon (SOC) content, aggregate stability, moisture-retention capacity, and infiltration rate of the soil while reducing bulk density. The SOC content under the treatment of 100% NPK + lime + biofertilizer + FYM was significantly greater (68.58%) than in control plots. Maize and mustard crop yields also significantly increased (4.73 and 21.09 folds) with continuous application of balanced inorganic (100% NPK) + lime + biofertilizer + FYM as compared to the control plots. However, crop yields drastically reduced under application of integrated nutrients without FYM as compared to the treatment with FYM application. Khambalkar *et al.*, (2012) reviewed during seed inoculants (Azotobactor and PSB), and FYM in combination with chemical fertilizers, positive influx of N, P and K over unfertilized control and other combinations of fertility. The B: C ratio was higher for chemical fertilizer along with Azotobactor and PSB in pearlmillet (4.0) due to lesser cost of cultivation compared to other treatments, where as it was highest (4.0) with 100% NPK+FYM (@10t/ha/year) + Azotobactor + PSB in mustard. Thus, INM with organic manure, inoculants and chemical fertilizers not only provided higher productivity but also sustained the soil fertility.

Singh *et al.*, (2013) reported that the investigated the effect of integrated nutrient management on productivity, quality and uptake of nutrient by Indian mustard and soil fertility. Application of 75% NPK and 5 t FYM ha^{-1}produced significantly higher seed (2.09 t ha^{-1}) and stover (6t ha^{-1}) yield over either only 100% inorganic fertilizer (4%) or FYM (50%). The maximum protein (429.3 kg ha^{-1}) and oil (869.0 kg ha^{-1}) yields were also recorded with 75% NPK+5t FYM ha^{-1}. The highest uptake of N, P, K and S was also associated with the conjunctive use of 75% NPK and FYM treatment. The maximum values of available N (175 kg ha^{-1}), P (12.0 kg ha^{-1}) and K (155.0 kg ha^{-1}) were noted fewer than 100% NPK alone. On the other hand, maximum value of available S (17.1 kg ha^{-1}) was noted with 75% NPK + 5t FYM ha^{-1}.Pathak *et al.*, (2015) reported that the investigated the direct incorporation of mustard crop residue in the field and green manuring at 50 and 75 per cent RDF. These amendments significantly increased seed yield in rapeseed mustardc. Nutrients uptake in terms of N, P and K was also positively affected by soil amendments in both the crops. Physical properties like bulk density (BD), water holding capacity (WHC) and infiltration rate were numerically but non-significantly increased in organically amended plots when compared to the control or to initial values. BD decreased from 1.47 g/cc to 1.44 g/cc while the water holding capacity and infiltration rate increased from 23.4 to 23.7 per cent and 2.76 to 2.79 cm/h respectively in organically amended plots. There was slight decline in soil pH in the plots amended with soil amendments but this decline was non-significant. EC was not affected but organic carbon; available N and available P were significantly affected by organic amendments.

Majumder S *et al.*, (2017) reported that the study the effect on yield and quality parameters of rapeseed (Brassica campestris L. var. yellow sarson), its revealed that in general, available N, P, K, S and Zn in soil decreased with increase in the period of crop growth. Addition of FYM increased organic carbon content in soils (upto 104.98 g kg^{-1} increase over initial value). Application of elemental S and Zn-EDTA increased SO4 -2 content (upto 101.03 kg ha^{-1} increase over initial value) in S-treated and DTPA extractable Zn content (upto 0.3 mg kg^{-1} increase over initial value) in Zn-treated systems respectively. Combined application of higher doses of S and Zn along with FYM and recommended doses of N, P and K fertilizers increased N, P, K, S and Zn uptake by rapeseed crop. Highest seed yield (14.2 q ha^{-1}) as well as oil (43.2 %) and protein contents (21.82 %) were recorded in rapeseed which received comparatively higher doses of S and Zn along with FYM and RDF.

Tomar PS *et al.*, (2018) repotted that the application of recommended levels of NPK to pearl millet and mustard with organic manure (10 t FYM ha^{-1} yr^{-1}) and biofertilizers (Azotobacter and phosphate

solubilizing bacteria, PSB) resulted in 100.9 and 130.2 per cent increase over control in pearl millet and mustard yields, respectively. Increasing levels of NPK from 50 to 150% significantly increased the yield of both the crops. Integrated use of organic, inorganic and biofertilizers improved the soil status of available N and P by 83 and 20.3 kg ha^{-1}, over the initial values.

Mhetre AG *et al.*, (2019) reported that the study further revealed that the treatment receiving the application of 50 % RDN through inorganics + 50 % RDN through poultry manure along with 60 kg S and 1 kg B was found beneficial for obtaining higher yield and yield attributing characters viz. seed yield (19.60 q ha^{-1}), stover yield (33.04 q ha^{-1}), No. of silique per plant (257.89) as well as quality parameters viz. oil (40.67%), protein (22.36%) and methionine (3.24%) content of mustard on lateritic soil of Konkan (M.S.).

Conclusion

From the discussion, it can be inferred that using a combination of organic and inorganic fertilisers in mustard can result in increased growth, yield, efficiency, and nutrient uptake. The results showed that advanced nutrient control on mustard crops has several benefits in terms of improving soil fertility and crop quality in a long-term sustainable manner. The current global scenario necessitates the adoption of environmentally responsible agricultural farming methods in order to ensure long-term crop production. Since the overuse of chemical fertilisers causes land erosion, groundwater depletion, and waste, resulting in an ecological imbalance. Balanced feeding activities are needed to manage this condition, which can be achieved by combining inorganic and organic sources of nutrients. Organic manures not only have much of the necessary plant nutrients, but they also improve soil structure, cation exchange capability, and water holding capacity. natural manures are also beneficial to the environment.Inoculation of biofertilizers such as Azospirillum, Azotobacter, Glucoacetobacter, Bacillus, Pseudomonas, and Aspergillus increases soil nitrogen and phosphorus content and saves 20-25 percent in inorganic fertilisers. Since seed is the foundation of agriculture production and industry, only using agrochemicals for a long time in intensive cultivation can result in a decrease in soil productivity and seed quality.

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