Integrated Nutrient Management for Improving Crop Yield and Nutrient Uptake in Mustard (*Brassica juncea* L.)

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Abstract

The field experiment was carried out in *Rabi* season of 2018-19 at Research Farm of Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur (U.P.). Experiment was laid-out in RBD and replicated thrice. The 11 treatments involved *viz*., T_1- Control, T_2- 100% RDF, T_3- 100% RDF + Vermicompost @ 5t ha^{-1} T_4- 100% RDF + Vermicompost @ 5t ha^{-1} + PSB, T_5- 100% RDF + Poultry manure @ 2t ha^{-1}, T_6- 100% RDF + Poultry manure @ 2t ha^{-1} + PSB, T_7 -75% RDF, T_8- 75% RDF + Vermicompost @ 5t ha^{-1}, T_9- 75% RDF + Vermicompost @ 5t ha^{-1} + PSB, T_{10}- 75% RDF + Poultry manure @ 2t ha^{-1} and T_{11}- 75% RDF + Poultry manure @ 2t ha^{-1} + PSB. The application of T_6 -100% RDF + Poultry manure @ 2t ha^{-1} + PSB was recorded highest grain yield (22.91 q ha^{-1}), Stover yield (52.65 q ha^{-1}) with nutrient uptake in compare to rest of the treatments.

Keywords: Mustard**, V**ermicompost, Poultry Manure and grain yield.

Introduction

In the world, Mustard has been grown over an area of 703.12 million ha with production of 68000 tones and consumption of 71000 tonnes during 2016-17. India is the third largest mustard producing country in the world after China and Canada. India accounts for nearly 12% of world production. As per COOTI's (Central Organization for Oil Industry and Trade) estimates, in Uttar Pradesh about 8.40 lakh tones is produced in the year 2015-16 while in previous year the state had produced only 6.75 lakh tones of Mustard. Uttar Pradesh is the second largest mustard producing state in India after Rajasthan (Anonymous, 2017).

Indian mustard (*Brassica juncea* L.) is a fast growing plant which produces a high biomass still in heavy metal polluted soils.

Use of indiscriminate chemical fertilizers for the supply of major nutrients and declining use of secondary nutrients and less use of organic sources as inputs led to the deficiency of secondary and micronutrients (De *et al.,* 2014). Through the approach of integrated nutrient management, it is important to use the potential of organic manures, composts, crop residues, agricultural wastes, biofertilizers and synergistic effect with inorganic fertilizers for increasing balanced nutrient supply and their use effectiveness for increasing productivity, sustainability of agriculture, and improving soil health and environment safety. Total organic farming may be an advantageous proposal for improving the quality of agricultural produce. It may not be feasible to maintain the quantity of the produce in commercial agriculture, where mostly the stress is given on yield. A number of various organic sources are available for use in agriculture. Organic manures like FYM, poultry manure (PM) and vermicompost (VC) can play important role in productivity of crops. These sources can decrease the mining of soil nutrient and improve soil organic matter, humus and overall soil productivity (Jenssen, 1993). Phosphate-solubilizing bacteria (PSB*)* release phosphobacterins, which make insoluble phosphorus available to the plant. The solubilization effect of phosphobacterins is generally due to the production of organic acids that lesser the soil pH and solubilize the insoluble forms of phosphate (Sundara *et al*., 2002).

Materials and Methods

Field experiment was carried out during *Rabi* seasons in 2017-18 at Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur (U. P.) at an altitude of 125.9 m and between ranging from 25^0 56' to 28^0 58' North latitude and 79^0 31' to 80^0 34' East longitudes. The soil of experimental field was sandy loam in texture class (56.34% Sand, 23.60 % silt and 21.63% clay) and neutral in reaction (pH 7.3). It was moderately fertile, low in soil organic carbon content (0.27 %), electrical conductivity

(EC) 0.96 dSm^{-1}, low in available nitrogen (60.76 kg/ha), medium in available phosphorus (17.76 kg/ha) and available potassium (114 kg/ha). Experiment was laid-out in RBD and replicated thrice. The 11 treatments involved *viz*., T_1- Control, T_2- 100% RDF, T_3- 100% RDF + Vermicompost @ 5t ha^{-1}, T_4- 100% RDF + Vermicompost @ 5t ha^{-1} + PSB, T_5- 100% RDF + Poultry manure @ 2t ha^{-1}, T_6- 100% RDF + Poultry manure @ 2t ha^{-1} + PSB, T_7 -75% RDF, T_8- 75% RDF + Vermicompost @ 5t ha^{-1}, T_9- 75% RDF + Vermicompost @ 5t ha^{-1} + PSB, T_{10}- 75% RDF + Poultry manure @ 2t ha^{-1} and T_{11}- 75% RDF + Poultry manure @ 2t ha^{-1} + PSB.

Result and Discussion

The highest seed yield (Table-1) was observed significantly (22.91 q ha^{-1}) under T_6 (100% RDF + Poultry manure @ 2t ha^{-1} + PSB) followed by T_4 (100% RDF + Vermicompost @ 5t ha^{-1} + PSB) and T_5 (100% RDF + Poultry manure @ 2t ha^{-1}) *viz*., 22.46 and 21.76 qha^{-1}, respectively. These three treatments were statistically at par with T_3 (21.65 qha^{-1}), T_{11} (20.27 qha^{-1}), T_9 (20.20 qha^{-1}). The highest straw yield (52.66 qha^{-1}) was observed under the treatment T_6 which was received 100% RDF + Poultry manure @ 2t ha^{-1} + PSB found significantly superior and statistically at par with T_4 (52.12 q ha^{-1})and T_5(51.74 q ha^{-1}) as compared to all other treatments during the observation period. The lowest yield was recorded with control plot T_1(49.33qha^{-1}).The basic vegetative phase has a major role in shaping of the reproductive organs, which is most important for obtaining high yield. The good improvement in various vegetative attributes and overall effective vegetative growth performance under adequate nutrient supply appears to be basic factor for enhance in maturity attributes. Saha *et al*. (2010), Singh *et al.*, (2014) and Mahata and Sinha (2018) assessed poultry manure superior towards seed and stover yield of mustard.

The highest nutrient uptake (Table-2) *viz*., N, P & K was found in the treatment T_6 *i.e*. 37.36 kg ha^{-1}, 14.33 kg ha^{-1}, and 33.47 kg ha^{-1} respectively as compared to all other integrated nutrient management practices. The lowest N, P and K uptake was recorded with control treatment *i.e*. 25.62 kg ha^{-1}, 8.21 kg ha^{-1}, 21.53 kg ha^{-1} and 7.62 kg ha^{-1}. Appliances of adequate manure induce marked improvement in nitrogen phosphorus and potassium content and uptake. Nitrogen phosphorus and potassium uptake were positively influenced by adequate supply of nutrients through organic manure and inorganic fertilizer. The release of nutrient in soil solution depends on intensity and capacity of soil to supply these nutrients.

Conclusion

On the basis of one-year field investigation during *rabi* 2018, it could be concluded that highest Seed yield, stover yield and Nutrient uptake was found under the application of T_6- 100% RDF + Poultry manure @ 2t ha^{-1} + PSB was significantly superior which was statistically at par with T_4 (100% RDF + Vermicompost @ 5t ha^{-1} + PSB) and T_5 (100% RDF + Poultry manure @ 2t ha^{-1}) over the rest treatments.

The overall results of the study showed that the application of poultry manuure, Vermicompost and biofertilizer in combination *i.e*., integrated nutrient management would be useful to enhance the productivity of mustard.

Table1: Effect of integrated nutrient management practices on seed and straw yield (qha^{-1})

Treatment combination	Seed yield (q/ha)	Stover yield (q/ha)
T_1- Control	16.68	49.31
T_2- 100% RDF	21.03	51.42
T_3- 100% RDF + Vermicompost @ 5t ha^{-1}	21.55	51.64
T_4- 100% RDF + Vermicompost @ 5t ha^{-1} + PSB	22.36	52.10
T_5- 100% RDF + Poultry manure @ 2t ha^{-1}	21.66	51.71`
T_6- 100% RDF + Poultry manure @ 2t ha^{-1} + PSB	22.91	52.65
T7- 75% RDF	18.26	50.01
T_8- 75% RDF + Vermicompost @ 5t ha^{-1}	19.31	50.46
T_9- 75% RDF + Vermicompost @ 5t ha^{-1} + PSB	20.20	50.91
T_{10}- 75% RDF + Poultry manure @ 2t ha^{-1}	19.37	50.73
T_{11}- 75% RDF + Poultry manure @ 2t ha^{-1} + PSB	20.27	51.00
SE(m)	**0.92**	**1.03**
C.D. @ 5%	**2.76**	**2.89**

Table 2: Effect of integrated nutrient management practices on N, P and K uptake (kg ha^{-1}) by seed

Treatment combination	N uptake ($kgha^{-1}$)	P Uptake ($kgha^{-1}$)	K uptake ($kgha^{-1}$)
T_1- Control	25.62	8.21	21.53
T_2- 100% RDF	33.94	12.34	29.56
T_3- 100% RDF + Vermicompost @ 5t ha^{-1}	34.93	12.94	30.77
T_4- 100% RDF + Vermicompost @ 5t ha^{-1} + PSB	36.29	13.94	32.55
T_5- 100% RDF + Poultry manure @ 2t ha^{-1}	35.05	13.36	31.33
T_6- 100% RDF + Poultry manure @ 2t ha^{-1} + PSB	37.36	14.33	33.47
T7- 75% RDF	28.58	9.70	24.39
T_8- 75% RDF + Vermicompost @ 5t ha^{-1}	30.28	10.38	26.07
T_9- 75% RDF + Vermicompost @ 5t ha^{-1} + PSB	32.07	11.36	27.75
T_{10}- 75% RDF + Poultry manure @ 2t ha^{-1}	30.84	10.66	26.75
T_{11}- 75% RDF + Poultry manure @ 2t ha^{-1} + PSB	32.35	11.61	28.10
SE(m)	**1.47**	**0.70**	**1.39**
C.D. @ 5%	**4.16**	**2.07**	**3.85**

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