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RESEARCH PAPER

Effect of organic manure and bio-fertilizer on growth and yield of yellow mustard (*Sinapis alba* L.)

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Abstract : A field experiment was conducted during *Rabi* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice on the basis of one year experimentation. It was consisting of combination of three level of biofertilizer VAM,Azotobacter,*Azosprillium* 10ml/kg seed each and used organic manure FYM 5.0t/ha,Vermicompst and Neem cake 1.0t/ha each. The results showed that application of Vermicompost 1.0 t/ha +*Azospirillum*10ml/kg seed was recorded significantly higher plant height (97.37 cm), No. of branches/plant (12.62), plant dry weight (18.41 g/plant), siliquae/plant (159.32), seeds/siliquae (40.57), days to maturity (88.95), test weight (3.14 g), seed yield (1.71 t/ha) and oil content (42.38 %) as compared to other treatments.

Key Words : FYM, *Neem* cake, Vermicompost, VAM, *Azospirillum, Azotobacter*

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INTRODUCTION

Yellow mustard [*Sinapisalba* (L.) Czern. and coss.] belongs to the family Cruciferae. India is one of the largest mustard growing countries in the world, occupying the first position in area and third in production after China and Canada. It is most important winter (*Rabi*) oil seed crop in northern India. . Broadly seven varieties of mustard rapeseed are mostly grown in India. Rajasthan and Uttar Pradesh are the major mustard producing states in our country. Together, they contribute to about 50% of the total production. In India, mustard was cultivated over an area of about 6.23 million hectares with production and productivity of 9.34 million tonnes and n1499 kg/ha respectively (India starts 2019-2020). Oil seeds play an important role in Indian Agriculture and industries. Besides, immense value in our diet, oils and fats are used in cosmetics, soaps, lubricants, paints and varnish industries and their medicinal and therapeutic value. The requirement of vegetable oils and fats will be much higher in coming years in view of ever-increasing population (Kumar *et al.*, 2018).

Bio-fertilizers offer an economically attractive and ecologically sound means of reducing external inputs and improving quality and quantity of crop. They contain

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microorganisms which are capable of mobilizing nutrient elements from unavailable form to available form through different biological processes (Hadiyal *et al.*, 2017).

Azotobacter inoculants when applied to many non-leguminous crop plants, promote seed germination and initial vigour of plants by producing growth promoting substance (Kalita *et al.*, 2019).

Despite many fold advantages of organic farming and organic foods, organic inputs do not respond immediately particularly in the soil with wide C: N ratio. It entails the use of compost, FYM, vermicompost, crop residues, green manures, green leaf manuring in crop rotation and biofertilizers to enrich the soil organic carbon, supply all essentially required plant nutrients and improve soil properties. Nutrient management through organics plays a major role in maintaining soil health due to build-up of soil organic matter, beneficial microbes and enzymes. Long-term addition of organic materials to soil resulted as an increase in organic matter, crop productivity and soil biological activity (Collins *et al.,* 1992).

Material and Methods

The present examination was carried out during *Rabi* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level. The experiment laid out in Randomized Block Design with three replications and nine treatment, three level of biofertilizer VAM, *Azotobacter, Azosprillium* was applied 10kg/ml seed each and three level of organic manure FYM 5.0t/ha, vermicompost and Neem cake 1.0t/ha each. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in Organic carbon (0.38%), medium available N (225 kg ha^{-1}), higher available P (19.50 kg ha^{-1}) and medium available K (213.7 kg ha^{-1}). In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded those parameters are growth parameters, plant height, no. of barnches/ plant and plant dry weight are recorded. The yield parameters like No. of siliquea/plant, No. of seeds/ siliquea, Days to maturity, Test weight (g) and seed were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez and Gomez, 1984).

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Growth attributes:

Plant height :

Significantly highest plant height (97.37 cm) was recorded in the treatment with Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed over all the other treatments. However, the treatments with application of Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (97.20 cm) and Neem cake 1.0 t/ha + *Azospirillum*10ml/ kg seed (96.87 cm) which were found to be at par with treatment Vermicompost 1.0 t/ha + *Azospirillum*10ml/ kg seed as compared to all the treatments.

The application of vermicompost might have favoured better root proliferation, more solubility of phosphorous which consequently favoured higher biological nitrogen fixation and uptake of nutrients and availability of all plant nutrients during the crop growth period. Which resulted in the higher plant height. These results are in close in close conformity with the findings of Srivastava *et al*. (2020).

The inoculation of bacterial preparation accelerates plant growth provide biologically fixed nitrogen to the inoculated plant and also stimulate plant growth by excreting plant growth promoting substances like auxins, kinetin's, vitamins and gibberellins as similarly observed by Kumar *et al.* (2016).

Number of branches/plant :

Treatment with Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed was recorded with significantly highest No. of Branches /plant (12.62) over all the treatments. However, the treatments with Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (12.46) and *Neem* cake 1.0 t/ha +*Azospirillum*10ml/kg seed (12.35) which were found to be statistically at par with Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed.

The higher number of branches due to the application of vermicompost might be due to the availability of desired and required quantity of nutrients for longer period in root zone of growing plants which helped plant cells to divide. The results were found to in correspondence with Jat *et al.* (2012) and inoculation of Azospirillum leads to the production of organic acids, chelating oxoacids from sugars and exchange reactions

in growth environment Potdar *et al*. (2019).

Plant dry weight (g/plant) :

Treatment with Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg was recorded with significantly maximum dry weight (18.41 g/plant) over all the treatments. However, the treatments Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (18.22 g/plant) and Neem cake 1.0 t/ha + *Azospirillum*10ml/kg seed (18.08 g/plant) which were found to be statistically at par with Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg.

The increase in the total dry matter production may be due to better source and sink capacity developed due to better dry matter production with the application of vermicompost and its accumulation in assimilatory surface area and increase in the photosynthetic efficiency and thus, increased the production of photosynthates reflected in better growth and ultimately in higher dry accumulation. The results were found to be similar with Patil (2000).

The inoculation of biofertilizers stimulates activation of hormones which helps in shoot and root elongation and high dry matter production, similar results were observed by Meena *et al*. (2018).

Yield attributes and yield :

Number of siliquae/plant :

Significantly maximum number of siliquae/plant (159.32) was recorded with the treatment of application of Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed over all the treatments. However, the treatments Vermicompost 1.0 t/ha+*Azotobacter* 10ml/ kg seed

Table 1: Effect of organic manure and bio-fertilizer on growth attributes of mustard

Sr. No.	Treatments	Plant height (cm)	Branches/plant	Dry weight (g/plant)
1.	FYM 5.0 t/ha + VAM 10ml/kg seed	93.79	11.29	16.83
2.	FYM 5.0 t/ha + *Azospirillum*10ml/kg seed	95.62	11.89	17.43
3.	FYM 5.0 t/ha + *Azotobacter* 10ml/kg seed	94.14	11.52	16.91
4.	Vermicompost 1.0 t/ha + VAM 10ml/kg seed	95.90	12.02	17.63
5.	Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed	97.37	12.62	18.41
6.	Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed	97.20	12.46	18.22
7.	Neem cake 1.0 t/ha + VAM 10ml/kg seed	94.97	11.74	17.25
8.	Neem cake 1.0 t/ha +*Azospirillum*10ml/kg seed	96.94	12.35	18.08
9.	Neem cake 1.0 t/ha + *Azotobacter* 10ml/kg seed	96.41	12.16	17.89
	F- test	S	S	S
	S.E. (±)	0.17	0.08	0.15
	C. D. (P = 0.05)	0.50	0.24	0.45

Table 2: Effect of organic manure and bio-fertilizer on yield attributes and yield of mustard

Sr. No.	Treatments	Siliquae/plant	Seeds/siliquae	Days to maturity	Test weight (g)	Seed yield (t/ha)
1.	FYM 5.0 t/ha + VAM 10ml/kg seed	150.62	34.25	82.83	2.40	1.13
2.	FYM 5.0 t/ha + *Azospirillum*10ml/kg seed	153.74	36.43	84.19	2.60	1.34
3.	FYM 5.0 t/ha + *Azotobacter* 10ml/kg seed	151.74	35.00	83.04	2.44	1.20
4.	Vermicompost 1.0 t/ha + VAM 10ml/kg seed	154.64	37.44	85.11	2.68	1.42
5.	Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed	159.32	40.57	88.95	3.14	1.71
6.	Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed	158.44	40.02	87.98	3.05	1.68
7.	*Neem* cake 1.0 t/ha + VAM 10ml/kg seed	152.44	35.85	84.08	2.51	1.28
8.	*Neem* cake 1.0 t/ha + *Azospirillum*10ml/kg seed	156.84	39.17	86.33	2.94	1.54
9.	*Neem* cake 1.0 t/ha + *Azotobacter* 10ml/kg seed	155.86	38.29	85.98	2.83	1.47
	F test	S	S	S	S	S
	S.E. (±)	0.95	0.57	0.51	0.08	0.07
	C.D. (P = 0.05)	2.85	1.72	1.53	0.24	0.22

(158.44) and *Neem* cake 1.0 t/ha+*Azospirillum*10ml/kg seed (156.84) which were found to be statistically at par with vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed.

Number of seeds/Siliquae:

Significantly maximum number of seeds/siliquae (40.57) was recorded with the treatment of application of vermicompost 1.0 t/ha +*Azospirillum*10ml/kg seed over all the treatments. However, the treatments vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (40.02) and *Neem* cake 1.0 t/ha +*Azospirillum*10ml/kg seed (39.17) which were found to be statistically at par with vermicompost 1.0 t/ha +*Azospirillum*10ml/kg seed.

The greater photosynthesis production of metabolites and enzymatic activities due to the vermicompost application might have influenced into increased and extensive root system and the greater production of metabolites and their translocation to various sinks especially the productive structures (Siliqua and seeds) could have helped to increase into the number of Siliqua per plant besides increasing the overall growth. The results were found to be similar with Bana *et al*. (2012).

Days to maturity :

Significantly maximum days to maturity (88.95) was recorded with the treatment of application of vermicompost1.0 t/ha +*Azospirillum*10ml/kg seed over all the treatments. However, the treatments vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (87.98) and which were found to be statistically at par with vermicompost 1.0 t/ha +*Azospirillum*10ml/kg seed.

Test weight (*g*):

Significantly highest test weight (3.14 g) was recorded with the treatment of application of vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed over all the treatments. However, the treatments vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (3.05 g) and *Neem* cake 1.0 t/ha + *Azospirillum*10ml/kg seed (2.94 g) which were found to be statistically at par with Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed.

Seed yield (*t/ha*) :

Significantly highest seed yield (1.71/ha) was recorded with the treatment application of vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed over all the treatments. However, the treatments with (1.68/ha) in vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed and with (1.54t/ha) in Neem cake1.0 t/ha + *Azospirillum*10ml/kg seed which were found to be statistically at par with Vermicompost 1.0 t/ha + *Azospirillum*10ml/kg seed.

The higher increase in the yield has been reported to be associated with the release of macro and micro nutrients during the course of microbial decomposition. Organic matter also functions as source of energy for soil micro flora which brings about the transformation of other nutrients held in soil or applied through other means, in a form that is readily utilized by growing plants which helped in increase of seed yield. The results were in accordance with Bana *et al*. (2012).

The increase in yield attributes and yield through bio-fertilizer might be attributed to supply of more plant hormones (auxin, cytokinin, gibberellin etc.) by the microorganisms inoculated or by the root resulting from reaction to microbial population Hadiyal *et al*. (2017).

Conclusion:

It is concluded that application of treatment vermicompost 1.0 t/ha +*Azospirillum*10ml/kg seed was recorded significantly higher seed yield (1.71 t/ha) as compared to other treatments. Since, the findings based on the research done in one season, the experiment may be repeated to confirm findings.

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