Original Research Article

Evaluation of Organic Manure and Bio-fertilizer on growth, yield and quality of Yellow Mustard (*Sinapis alba L.*)

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. The treatments which are T_1: FYM 5.0 t/ha + VAM 10ml/kg seed, T_2: FYM 5.0 t/ha + *Azospirillum* 10ml/kg seed, T_3: FYM 5.0 t/ha + *Azotobacter* 10ml/kg seed, T_4: Vermicompost 1.0 t/ha + VAM 10ml/kg seed, T_5: Vermicompost 5.0 t/ha + *Azospirillum* 10ml/kg seed, T_6: Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed, T_7: Neem cake 1.0 t/ha + VAM 10ml/kg seed, T_8: Neem cake 1.0 t/ha + *Azospirillum* 10ml/kg seed, T_9: Neem cake 1.0 t/ha + *Azotobacter* 10ml/kg seed are used. The results showed that application of Vermicompost 1.0 t/ha + *Azospirillum* 10ml/kg seed was recorded significantly higher 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 %), gross returns (Rs.102800.00/ha), net return (Rs.72240.00/ha) and benefit cost ratio (2.36) as compared to other treatments.

Key words: FYM, Neem cake, Vermicompost, VAM, *Azospirillum*, *Azotobacter*, yield.

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Introduction

Yellow mustard (Sinapis alba (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. Among the seven edible oilseed crop cultivated in India, rapeseed-mustard (Brassica Spp.) contributed about 25% in the total production of oil seed crops. In India, mustard was cultivated over an area of about 6.20 million hectare with production and productivity of 7.36 million tonnes and 11.88 q ha-1 respectively, during 2012-2013. 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).**

Yellow mustard is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. Rajasthan ranks first in area and production of rapeseed and mustard with 2.50 million ha area and 3.71 million tonnes production. Mustard oil is used as condiment in pickles, flavouring curries and vegetables, preparation of hair oils, medicines, soap making and in the tanning industry for softening of leather. The mustard cake is used mostly for cattle feed and manure **(potdar et al., 2019).**

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

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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).**

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Materials 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 which consisting of nine treatments with T_1: FYM 5.0 t/ha + VAM 10ml/kg seed, T_2: FYM 5.0 t/ha + *Azospirillum* 10ml/kg seed, T_3: FYM 5.0 t/ha + *Azotobacter* 10ml/kg seed, T_4: Vermicompost 1.0 t/ha + VAM 10ml/kg seed, T_5: Vermicompost 1.0 t/ha + *Azospirillum* 10ml/kg seed, T_6: Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed, T_7: Neem cake 1.0 t/ha + VAM 10ml/kg seed, T_8: Neem cake 1.0 t/ha + *Azospirillum* 10ml/kg seed, T_9: Neem cake 1.0 t/ha + *Azotobacter* 10ml/kg seed are used. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^H 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 yield parameters like No. of siliquae/plant, No. of seeds/siliquae, 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 K.A. and Gomez A.A. 1984).

Results and Discussion

Yield attrubutes 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 (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.

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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 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 (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)

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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 (1.54 t/ha) in Neem cake 1.0 t/ha + *Azospirillum* 10ml/kg seed which were found to be statistically at par with Vermicompost 1.0 t/ha + *Azospirillum* 10ml/kg seed.

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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)**.

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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).**

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Economics

Gross returns

Higher Gross returns have been recorded with the Vermicompost 1.0 t/ha + *Azospirillum* 10ml/kg seed (Rs.102800.00/ha) over rest of the treatments followed by Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (Rs.100600.00/ha) whereas minimum gross return was recorded with FYM 5.0 t/ha + VAM 10ml/kg seed (Rs.67800.00/ha).

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Net returns

Higher Net returns have been recorded with the treatment Vermicompost 1.0 t/ha + *Azospirillum* 10ml/kg seed (Rs.72240.00/ha) over rest of the treatments followed by Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (Rs.70100.00.00/ha) whereas minimum gross return was recorded with FYM 5.0 t/ha + VAM 10ml/kg seed (Rs.37340.00/ha).

B.C ratio

Higher Benefit cost ratio have been recorded with the treatment Vermicompost 1.0 t/ha + *Azospirillum* 10ml/kg seed (2.36) over rest of the treatments followed by Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed (2.30) whereas lower Benefit cost ratio was recorded with FYM -5.0 t/ha + VAM 10ml/kg seed (1.23).

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), higher gross returns (Rs.102800.00/ha), net returns (Rs.72240.00/ha) and benefit cost ratio (2.36) as compared to other treatments. Since, the findings based on the research done in one season.

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Table 1: Evaluation of Organic Manure and Bio-fertilizer on Yield attributes and Yield of Mustard

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. EM (±)	0.95	0.57	0.51	0.08	0.07
CD (P = 0.05)	2.85	1.72	1.53	0.24	0.22

Table 2: Evaluation of Organic Manure and Bio-fertilizer on Economics of Yellow mustard.

Treatments	Cost of cultivation	Gross returns	Net returns	B:C Ratio
1. FYM 5.0 t/ha + VAM 10ml/kg seed	30460.00	67800.00	37340.00	1.23
2. FYM 5.0 t/ha + *Azospirillum* 10ml/kg seed	30360.00	80600.00	50240.00	1.65
3. FYM 5.0 t/ha + *Azotobacter* 10ml/kg seed	30300.00	72200.00	41900.00	1.38
4. Vermicompost 1.0 t/ha + VAM 10ml/kg seed	30660.00	85200.00	54540.00	1.78
5. Vermicompost 1.0 t/ha + *Azospirillum* 10ml/kg seed	30560.00	102800.00	72240.00	2.36
6. Vermicompost 1.0 t/ha + *Azotobacter* 10ml/kg seed	30500.00	100600.00	70100.00	2.30
7. Neem cake 1.0 t/ha + VAM 10ml/kg seed	30560.00	77000.00	46440.00	1.52
8. Neem cake 1.0 t/ha + *Azospirillum* 10ml/kg seed	30460.00	92600.00	62140.00	2.04
9. Neem cake 1.0 t/ha + *Azotobacter* 10ml/kg seed	30400.00	88200.00	57800.00	1.90

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