Effect of different levels of NPK, Vermicompost and Sulphur on Growth, Yield and Economics Attributes of Mustard (*Brassica juncea* L.) *var. Giriraj*

ABSTRACT

A field experiment was conducted at Research farm, Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) during the *Rabi* season of 2023-24 with the objective to differentiate levels of NPK, Vermicompost and Sulphur on yield attributes of Mustard (*Brassica juncea* L.) *var. Giriraj*. The experiment was laid out in a Randomized Block Design with nine treatment combinations, consisting of three N, P and K levels (0, 50 and 100%), Vermicompost (0, 50 and 100%) and Sulphur (0, 50 and 100%). It was observed that the treatment of the application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) was best in terms of growth parameters in maximum plant height (124.01 cm), Number of branches (12.28), No. of leaves (75.96), number of silique plant^{-1} (168.67), test weight (4.24) and total yield was highest *i.e.* (19.90 qha^{-1}).

Keywords**:** *NPK Levels, Vermicompost, Sulphur and Mustard***.**

Introduction

"Rapeseed and mustard [*Brassica juncea* (L) Czern and Coss] are an important oilseed crop but its productivity in the state is much lower than its realizable yield potential which can only be increased by balanced fertilization and other management practices Rapeseed and mustard are one of the important edible oilseed crops of India next to groundnut and soybean. Its alone accounts for about one-third of total oilseeds production in the country. India ranked second during 2020-21 both in terms of production and area under rapeseed and mustard in the world with 9.8 % of production and 19.8 % of area. India produced 10.11 million tons of rapeseed and mustard from 6.69 million hectares of land with an average yield of 1511 kg ha^{-1}" (Anonymous, 2020-21).

The soil is lacking in both macro and micronutrients as a result of intensive farming. As a result, soil health and productivity have declined and production has decreased. Any agricultural system's ability to succeed depends on how well resources are managed, especially how manures and fertilizers are used in balance. Utilizing organic manures might be a practical way to maintain output. (Tejada *et al.,* 2009). Applying vermicompost has been shown to

enhance the physical, chemical, and biological characteristics of soil. (Nagavallemma *et al.*, 2004).

“Although balance used of fertilizers plays an important role in mustard production in our country. Besides the chemical fertilizers the vermicompost organic manure and other plant nutrient in sufficient quantity also played miracle role in soil fertility, productivity and lastly production of mustard. The application of vermicompost adds plant nutrient and growth regulators. It increases soil water retention, microbial population, soil aeration, porosity, mineralization and consequently more release of available nutrients. Vermicompost application improves physical, chemical and biological properties of soil. Vermicompost is eco-friendly product which also increase soil fertility”. [13]

The application of poultry manure that contains the primary nutrients nitrogen, phosphorus, and potassium, as well as some the minor elements of sulphur, are crucial for mustard output and quality. Because of the depletion of soil fertility caused by the intensive cropping system and the cultivation of high yielding crop varieties, the soil-plant system is deficient with multiple nutrients, making it difficult for the "Plants" to produce higher yields. In such a case, crop output cannot be sustained over the long term with the application of just one or two key nutrients. Moreover, a crucial element of crop production technique is required in the use of balanced fertilization. The only way to increase the productivity of any crop, including mustard, is to combine the application of inorganic, organic, and biofertilizer. Vermicomposting is a convenient and environmentally beneficial method of recycling kitchen and agricultural wastes. Vermicompost is the term for the manure-like substance expelled by earthworms via their anus. Earthworms serve as an excellent natural bioreactor for aerobic bacteria, which proliferate rapidly and engage in competition with other aerobic bacteria and fungus.

Materials and Methods

The present investigation entitled “Effect of different levels of NPK, Vermicompost and Sulphur on growth and yield attributes of Mustard (*Brassica juncea* L.) *var. Giriraj*” was carried out at research site of Department of Soil Science and Agriculture Chemistry at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj Uttar Pradesh during *Rabi* season of the year 2023-24. The soil of experimental plot was alluvial in texture, low in available nitrogen (238.3 kg ha^{-1}), medium in available phosphorous (21.4 kg ha^{-1}) and low in available potassium (141 kg ha^{-1}). The soil was moderately acidic in reaction having pH

6.8. This soil was favourable for normal growth of the crop. Nine number of treatments and three number of replications held in 24 number of plots.

The treatments were T_1- 0 % @ (NPK) + 0% @ VC + 0% @ Sulphur, T_2- 0% @(NPK)+50 % @ VC+50% @ Sulphur, T_3- 0% @(NPK) +100% @VC +100% @ Sulphur, T_4 – 50% @(NPK) + 0% @ VC+ 0% @ Sulphur, T_5- 50% @ (NPK) + 50% @VC +50% @ Sulphur, T_6 - 50% @ (NPK) +100% @VC +100% @ Sulphur, T_7- 100% @(NPK) +0% @VC +0% @ Sulphur, T_8 -100% @ (NPK)+50% @VC +50% @ Sulphur and T_9 - 100% @ (NPK) +100% @VC +100 % @ Sulphur. "The gross and net plot size was 2.1 m x 2.1m and 2.0 m x 2.0 m, respectively. Sowing was done on 11th November 2023 and spacing 45 cm X 60 cm. The recommended dose of fertilizer was applied as per treatments application through Urea, DAP and MOP. Sulphur was also applied as per treatments. Recommended practices and plant protection measures were undertaken as per recommendation. The crop was harvested on 5th March, 2024". [13]

Results and Discussion

Growth Characters

Data regarding effect of various treatments on growth and yield characters such as plant height, number of branches, number of leaves plant^{-1}, number of silique plant^{-1}, test weight and seed yield is presented in Table: 1.

Plant height (cm)

Data regarding effect of various treatments on mean plant height (cm) was recorded periodically during the various growth stages of crop. The plant height increased very fast during 60-90 DAS and slowed down during 30-50 DAS and remained constant up to harvest.

The maximum plant height 28.91, 67.42 and 124.01 cm were recorded at 30, 60 and 90 DAS, respectively with (T_9) 100% @ (NPK) +100% @ VC + 100 % @ S which was followed by (T_8) 100% @ (NPK) +50% @ VC + 50% @ S and (T_7) 100% @ (NPK) +0% @ VC + 0% @ S and it was found significantly superior over rest of the treatments at 30, 60 and 90 DAS. "The lowest plant height was observed with control (T_1) 0% @ (NPK) + 0 % @ VC + 0% @ S. Increase in plant height with application of RDF and vermicompost *i.e.*, organic and inorganic sources might be due to higher nutrient supply, rigid conversion of carbohydrates into protein which in turn elaborated into protoplasm". [13] These results corroborate with the findings of Kumar *et al*., (2018) and Haque and Ali (2020)

Number of branches plant-1

"Different treatments influenced on mean number of branches plant^{-1} at various growth stages of crop. Different treatments significantly affected on number of branches plant^{-1}. Maximum increase in number of branches was observed during 30-60 DAS". [13]

Thereafter, number of branches increased slowly. Application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) recorded significantly maximum number of branches (3.5, 6.58 and 12.28 plant^{-1}) and which was followed by (T_8) 100% @ (NPK) +50% @ VC + 50% @ S and (T_7) 100% @ (NPK) +0% @ VC + 0% @ S and it was found significantly superior over rest of the treatments at 30, 60 and 90 DAS and found significantly superior over rest of the treatments. The significantly lower number of branches plant^{-1} at 30, 60 and 90 DAS were 1.36, 3.78 and 5.35, respectively observed with treatment control (T_1) 0% @ (NPK) + 0 % @ VC + 0% @ S at various growth stages of crop. The increase in growth under these treatments might be attributed due to the combined effect of organic and inorganic fertilizers with which the crop was ultimately favored with better environment for proper growth and development. Such types of Results were also confined by Sharma *et al.,* (2017) and Singh *et al.,* (2018).

Number of leaves plant^{-1}

Different levels of NPK, vermicompost and S significantly affected on number of leaves plant^{-1}. The highest increase in number of leaves was observed during 30-60 DAS. Thereafter, number of leaves increased slowly rate up to 90 DAS and remained constant up to harvest. Application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) recorded significantly maximum number of leaves (3.5, 6.58 and 12.28 plant^{-1}) and which was followed by (T_8) 100% @ (NPK) +50% @ VC + 50% @ S and (T_7) 100% @ (NPK) +0% @ VC + 0% @ S and it was found significantly superior over rest of the treatments at 30, 60 and 90 DAS and found significantly superior over rest of the treatments. The significantly lower number of leaves plant-1 at 30, 60 and 90 DAS were 1.36, 3.78 and 5.35, respectively observed with treatment control (T_1) 0% @ (NPK) + 0 % @ VC + 0% @ S at various growth stages of crop. From inorganic and organic fertilizers association, availability of nutrient elements was more due to which plant produced more leaves. The number of functional leaves plant^{-1} was gradually increased up to 90 DAS and decreased thereafter. At harvest, leaves were absent due to leaf senescence. Results were in conformity with the findings of Sharma *et al.*, (2017) and Singh *et al.*, (2018).

Number of silique plant^{-1}

The highest number of silique plant^{-1} (168.67) were recorded with application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_3) closely followed by (T_8) 100% @ (NPK) +50% @ VC + 50% @ S, (T_6) 50% @ (NPK) +100% @ VC +100% @ S. The treatment of control (T_1) 0% @ (NPK) + 0 % @ VC + 0% @ S recorded the significantly lowest number of silique plant^{-1} (132.87). The result of the present investigation is in accordance with the findings of Kumar *et al.*, (2016), Sharma *et al.*, (2017) and Haque and Ali (2020).

Test weight (g)

Test weight (g) of mustard significantly affect by different levels of NPK, Vermicompost and S at harvest. The maximum test weight (4.24g) were recorded with application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_3) closely followed by (T_8) 100% @ (NPK) +50% @ VC + 50% @ S (4.11 g), (T_6) 50% @ (NPK) +100% @ VC +100% @ S (3.94 g). The treatment of control (T_1) 0% @ (NPK) + 0 % @ VC + 0% @ S recorded the significantly minimum test weight (3.04).

Seed yield (q ha^{-1})

The effect of different levels of NPK, Vermicompost and S on seed yield (q ha^{-1}) of mustard (*Brassica juncea* L.) var. Giriraj was significantly affected. The highest seed yield (19.90 q ha^{-1}) recorded with application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) and it was statistically at par with (T_8) 100% @ (NPK) +50% @ VC + 50% @ S (18.95 q ha^{-1}). The lowest seed yield (8.90 q ha^{-1}) was recorded with the treatment (T_1) application of 0% @ (NPK) + 0 % @ VC + 0% @ S. The treatments gave immediate supply of nutrients to crop from NPK and S at early stage and slow, continuous supply of nutrients from vermicompost throughout crop growth period. This resulted into sufficient biomass production and improvement in yield parameters resulting in maximum seed yield. Positive response of crop in terms of NPK and S and vermicompost were also reported by Similar findings were reported by Khambalkar *et al.*, (2012), Kansotia *et al.*, (2015), Dhruw *et al.*, (2017), Sharma *et al.*, (2017), Singh *et al.*, (2017), Manoj Kumar *et al.*, (2018) and Yadav *et al.*, (2023).

Economics of Mustard Cultivation

Data regarding on economics of different treatments such as gross return, net return and B:C ratio is presented in Table: 1.

Gross returns (₹ ha^{-1})

Data in Table 1 revealed that the gross return (₹ ha^{-1}) is influenced by different levels of NPK, Vermicompost and S. The different levels of NPK, Vermicompost and S influenced significantly on the gross return. The application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) recorded significantly highest gross returns (₹ 112435 ha^{-1}) fallowed by T_8 application of 100% @ (NPK) +50% @ VC + 50% @ S (₹ 107068 ha^{-1}). The lowest gross returns of (₹ 50285 ha^{-1} was recorded by the treatment T_1 (control) application of 0% @ (NPK) + 0 % @ VC + 0% @ S.

Net returns (₹ ha^{-1})

Data revealed that the net return (₹ ha^{-1}) is influenced by different levels of NPK, Vermicompost and S. The different levels of NPK, vermicompost and S influenced significantly on the net return. The application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) recorded significantly highest net returns (₹ 181143 ha^{-1}) fallowed by T_8 application of 100% @ (NPK) +50% @ VC + 50% @ S (₹ 76708 ha^{-1}). The lowest net returns of (₹ 25352 ha^{-1} was recorded by the treatment T_1 (control) application of 0% @ (NPK) + 0 % @ VC + 0% @ S. Present findings result was in line with the results obtained by Khambalkar *et al.,* (2012), Kansotia *et al.,* (2015), Dhruw *et al.,* (2017), Sharma *et al.,* (2017), Singh *et al.,* (2017), Manoj Kumar *et al.,* (2018) and Yadav *et al.,* (2023).

Benefit: Cost ratio

Data regarding B: C ratio as influenced by various levels of NPK, Vermicompost and S. The application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) recorded higher B:C ratio (2.59) followed by 100% @ (NPK) +0% @ VC + 0% @ S(T_7) and 100% @ (NPK) +50% @ VC + 50% @ S (T_8). The lowest B:C ratio (1.02) was recorded by the treatment T_1 (control) application of 0% @ (NPK)+ 0% @VC + 0% @ S.

Conclusion

On the basis of present investigation, it can be concluded that, the application of 100% @ (NPK) +100% @ VC + 100 % @ S (T_9) recorded significantly higher growth, yield and yield attributes which was found at par with (T_8) 100% @ (NPK) +50% @ VC + 50% @ S (T8) and found significantly superior over rest of the treatments. Significantly highest (seed yield-19.90 q ha^{-1}), gross return (112435 ₹ ha^{-1}), net return (81143 ₹ ha^{-1}) and B:C ratio (2.59) was recorded with the application of T_9 (100% @ (NPK) +100% @ VC + 100 % @ S) which was found.

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1.

2.

3.

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Table 1. Effect of different levels of NPK, Vermicompost and S on growth, yield and economics of Mustard (*Brassica juncea* L.) var. Giriraj

Treatment	Plant height (cm)			No. of branches			No. of leaves			Siliqua per plant	Test weight (gm)	Seed yield (q ha^{-1})	Gross returns (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS						
T_1	18.71	59.98	109.81	1.36	3.78	5.35	6.91	31.53	70.89	132.87	3.04	8.90	50285	25352	1.02
T_2	20.11	61.08	109.88	1.70	3.85	6.15	7.77	30.79	70.96	124.94	3.21	11.34	64071	38206	1.48
T_3	21.84	61.92	110.38	1.70	3.98	6.55	9.51	32.19	70.89	119.07	3.37	11.88	67122	40324	1.50
T_4	23.77	62.82	116.05	1.83	4.25	7.01	10.04	32.13	72.36	142.41	3.44	14.58	82377	55197	2.03
T_5	24.37	63.95	115.58	1.96	4.12	7.41	10.64	33.73	71.76	144.21	3.61	15.10	85315	57203	2.03
T_6	26.57	63.96	118.58	2.16	4.78	7.61	10.44	35.86	72.62	148.01	3.71	16.60	93790	64745	2.23
T_7	27.04	64.88	121.25	2.83	5.32	9.81	11.57	34.33	73.69	157.34	3.94	18.45	104243	74816	2.54
T_8	27.37	65.02	122.88	2.96	5.65	10.48	12.16	35.46	74.36	158.54	4.11	18.95	107068	76708	2.53
T_9	28.91	67.42	124.01	3.50	6.58	12.28	12.84	36.13	75.96	168.67	4.24	19.90	112435	81143	2.59
S.Ed.(±)	**0.243**	**0.326**	**0.483**	**0.012**	**0.203**	**0.044**	**0.054**	**0.174**	**0.374**	**0.749**	**0.019**	**0.401**	-	-	-
C.D.@ 5%	**0.727**	**0.978**	**1.449**	**0.037**	**0.610**	**0.133**	**0.163**	**0.522**	**1.121**	**2.245**	**0.057**	**1.202**	-	-	-