Original Research Article

Repercussion of seed treatment with bio-fertilizers, bio- stimulants, botanicals on plant growth &yield attributes traits of black mustard (*Brassica nigra L.*)

ABSTARCT

The present experiment was conducted in field at Department of Genetics and Plant Breeding. Naini Agriculture Institute, SHUATS, UP. to investigate the " Repercussion of seed treatment with bio-fertilizers ,bio- stimulants , botanicals on plant growth & yield attributes traits of black mustard (*Brassica nigra L*) . The experimental material comprised of Thirteen (12+1) treatments including control. The seed of mustard variety NDR 8501 were treated with three different concentrations of each biofertilizer viz., Neem leaf extract, Tulasi leaf extract, Rhizobium,Vermiwash for a duration of 8hours. The experimental was conducted in Randomized Block Design (RBD) with two replications during the *rabi* season, 2021-22. The data were recorded from five randomly selected plants for each treatments in all the replications for thirteen characters. Analysis of variance showed significant differences among the seed treatments for all characters indicating that the seed treatment with biofertilizers has adequate variability to support the improvement the seed yield of mustard. It is concluded that all the characters under study were significantly affected by the influence of the application of biofertilizers. Among all the biofertilizers used under the study, seed treatment with the application of vermiwash at 15% for a duration of 8 hours gave the significant difference in comparision to other treatments as well as over the control.

Key Words: Black mustard, Biofertlizers , Botanicals etc.

Introduction

Mustard seeds are the small round seeds of various mustard plants. The seeds are usually about 1 or 2 mm in diameter. Mustard seeds may be colored from yellowish white to black. There are more important herbs in many regional foods. The seeds can come from three different plants; black mustard, and white mustard. The mustard seeds are known in Hindi/Urdu as sarson and in Punjabi as Sarron.These are used as a spice in Northern India and Nepal. The seeds are usually roasted until they pop. They are also planted to grow saag (greens) which are stir - fried and eaten as a vegetable preparation, sarson ka saag. Mustard seeds generally take 3 to 10 days to germinate if placed under the proper conditions, which include a cold atmosphere and relatively moist soil. Mature mustard plants grow into shrubs. Mustard grows well in temperate regions. Major producers of mustard seeds include Canada, Hungary, Great Britain, India, Pakistan and the United States. Brown and black mustard seeds return higher yields than their yellow counter parts. Mustard seed is used as a spice. Grinding and mixing the seeds with water, vinegar, or other liquids creates the yellow condiment known as prepared mustard. The seeds can also be pressed to make mustard oil, and the edible leaves can be eaten as mustard greens. Mustard is most often used at the table as a condiment on cold and hot meats. As a condiment, mustard averages about 5 kcal per teaspoon. Some of the many vitamins and nutrients found in mustard seeds are selenium and omega 3 fatty acid (Park et. al., 2018). “Because of its antibacterial properties and acidity, mustard does not require refrigeration for safety; it will not grow mould, mildew, or harmful bacteria. The potential of B. junceae as a natural source of the antioxidant alpha-tocopherol has been described” (Yusuf and Sarin, 2007). “Allyl isothiocyanate has antimicrobial and antifungal activity, and the antibacterial effect of mustard flour and oil has been evaluated for application in the processed meat industry for its inhibitory effect on Escherichia coli and salmonella” (Olivier et.al., 1999).Mustard seeds, white and brown, are nearly globular in shape, finely pitted, odorless when whole, and pungent-tasting. White mustard seeds are light yellow in colour and about 2.5 mm (0.1 inch) in diameter. Brown mustard seeds are about the same size but are a darker yellow in colour. Mustard's nutritional profile boasts a plentiful supply of essential minerals including calcium, iron, manganese, phosphorus and zinc. In addition to being a very good source of omega-3 fatty acids, it also supplies tryptophan, phosphorus, iron and protein. Mustard seeds are also a very good source of selenium.

"Mustard belongs to Brassicaceae Family and consists of 2n of 36. Mustard is a broadleaf, cruciferous, cool-seasoned annual oilseed crop produced primarily for the condiment market. Mustard is a one of the most important oil-seed crop in India. Out of the total mustard production of India, Indian mustard accounts for 75-80% and contributes 24.2% of the total edible oil pool of the country"(DRMR, 2013). The major mustard growing states of India are Rajasthan, U.P, Gujarat, M.P, Assam, Bihar, Orissa, Haryana, Punjab and west Bengal. The present area, production and yield of nine oilseeds in India is around 26.48mha30.94mt and 1168kg/ha respectively, and mustard sown area in India is 6.36 mha which has a production of 8.03 mt . The average productivity of mustard in India is 1262kg/ha. (According to directorate of economics and statistics, department of agriculture and cooperation, 2012-2013). Mustard is grown for its oil rich seeds. Apart from extracting oil, seeds are also used directly in the preparation of almost all Indian curries particularly in a process called tadka. The mustard seed gives edible oil which is used as cooking medium in north India. "Salinity is one of the most important abiotic constraints limiting crop productivity; 10 percent of world's arable land area is estimated to be salt-stressed" (Kaouther et al., 2012). "In mustard, salinity is one of the most important abiotic stresses limiting crop production in arid and semiarid regions, where soil salt content is naturally high and precipitation can be insufficient for leaching. Salinity affects many morphological, physiological and biochemical processes, including seed germination, Plant growth, and water and nutrient uptake. Different types of bio fertilizers as being used as seed treatments to manage resistance capability and germination" (Munns and Tester, 2008). Accumulation in soil affects plant growth to different degrees. Some researchers have indicated that the reason for germination failure was the inhibition of seed water uptake due to a high salt concentration. In the present study, an attempt is being made to identify the best bio fertilizer pre sowing seed treatments that hastens the seedling growth and influence better field performance.Using Botanicals results increase in growth and yield of crops and also reduces the aphid population in mustard.

Material and Methods

The present experiment was carried out at the Field Experimentation Centre of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P during *Rabi*, season 2021-22. The site of experiment is located at 25.87^0 N latitude, 81.51^0 E longitude and 98 meter above the sea level. The experimental material for present investigation comprised of thirteen (12+1) treatments including control. The seeds for this experiment were collected from local maket of Prayagraj. The seed of mustard variety NDR 8501 were treated with three different concentrations of each biofertilizer viz., Neem leaf extract, Tulasi leaf extract, Rhizobium, Vermiwash for duration of 8hours. The experimental was conducted in Randomized Block Design (RBD) with two replications during the *rabi* season, 2021-22. The spacing of 30 cm within rows and 10 cm between the plants was followed. All recommended agronomical cultural practices were carried out to raise a good crop. Observation were recorded based on five randomly selected plants in each genotype in each replication for all important characters viz., Plant height (cm), Number of primary branches per plant, Number of siliquae per plant, Number of seeds per siliqua, Biological yield per plant (g), test weight, Harvest index (%), Seed yield per plant (gm) and Seed yield per plant (g) except days to 50% flowering where the observations recorded on plot basis. The standard procedure was followed to record the observations.

Statistical analysis:

The analysis of data was worked out to test the signification tests. It was done according to the procedure of RBD for each character as per methodology suggested by **Fisher (1936).** The total variance and degree of freedom were partition into three components viz. treatment, Replication and error. The data were subjected to analysis of variance adopting standard statistical methods. Analysis of variance was carried out according to the procedure of Randomized Block Design (RBD) for each character as per methodology advocated by Panse and Sukhatme, (1967).

Result and Discussion

Analysis of variance (Table-1) revealed that the differences among fourteen treatments were significant for growth and yield, *viz.*, field emergence percentage, days to 50% flowering, plant height 30 DAS, plant height 60 DAS, plant height 90DAS, number of branches per plant, Number of secondary branches per plant, Number of siliquae per plant ,number of seeds per siliqua, 1000 seed weight, seed yield per plant, seed yield per plot, Biological yield and harvest index. This indicates that there is a ample scope for selection of superior biofertilizer for the improvement of yield of mustard.

Table 1: Mean sum of squares for different characters in Mustard

S. No.	Characters	Mean sum of squares	
		Treatments (df=12)	Error (df=24)
1	Field emergence	21.49	1.10
2	Days to 50% flowering	4.70	1.00
3	Plant height at 30DAS	101.14	2.86
4	Plant height at 60DAS	0.40	0.018
5	Plant height at 90DAS	0.64	0.02
6	Number of primary branches per plant	0.80	0.008
7	Number of secondary branches per plant	0.49	0.01
8	Number of siliquae per plant	90.45	1.42
9	Seeds per siliqua	2.34	0.06
10	1000 seed weight	0.18	0.011
11	Seed yield per plant	0.18	0.002
12	Seed yield per plot	14.54	0.10
13	Biological yield	63.53	0.67
14	Harvest index	0.083	0.012

***,** significant at 5 and 1% level, respectively**

Table 2: Mean Influence of Bio Fertilizers treatments on for different characters in Mustard

S.No.	Treatment	Field emergence	Days to 50% flowering	Plant height 30DAS	Plant height at 60 days	Plant height at 90 days
T_0	Control	85.43	51.67	22.60	56.50	98.77
T_1	Rhizobium at 5%	87.13	49.67	25.57	61.30	107.77
T_2	Rhizobium at 8%	90.73	48.33	29.60	64.87	110.57
T_3	Rhizobium at 10%	93.27	49.33	33.37	71.50	113.70
T_4	Neem leaf extract at 5%	87.67	50.67	24.90	58.77	102.90
T_5	Neem leaf extract at 10%	90.00	48.33	26.33	61.43	104.30
T_6	Neem leaf extract at 15%	92.00	50.33	28.37	65.73	107.70
T7	Vermiwash at 8%	88.13	48.33	28.17	67.43	111.07
T_8	Vermiwash at 10%	92.17	49.33	30.73	71.13	116.83
T_9	Vermiwash at 15%	93.27	50.00	33.13	73.20	117.50
T_{10}	Tulasi leaf extract at 5%.	86.00	50.33	24.77	60.27	104.13
T_{11}	Tulasi leaf extract at 10%.	88.00	52.33	26.90	63.63	106.07
T_{12}	Tulasi leaf extract at 15%.	88.67	49.00	28.77	66.97	108.63
	Grand Mean	89.42	49.81	27.93	64.82	108.45
	Range	S	S	S	S	S
	SE(d)	0.60	0.57	0.47	0.47	0.75
	C.D@(5%)	1.76	1.68	1.37	1.39	2.20

The mean values, standard error of the difference (SEd±), the critical difference (C.D.) at 5% and range of 13 treatments for various characters are presented in Table 2-4 which revealed a wide range of variation for all treatments studied and are discussed as below.

The observations on field emergence of mustard were statistically analyzed. A range of 93.27-85.43% was recorded for field emergence. The mean value for this parameter was 89.42%. The maximum field emergence (93.27%) was observed with T9 (Vermiwash at 15%) and minimum field emergence (85.43%) was observed with control. A range of 52.33-48.33days recorded with 49.81days as mean value for days to 50% flowering. The maximum days to 50% flowering (52.33days) observed with T_O (control). Minimum days to 50% flowering (48.33 days) flowering recorded for T8 (Vermiwash at 10%) and T_1(Rhizobium at 8%). However it was at par to T9 (Vermiwash at 15%).
A range of 33.13-22.6 cm was recorded for plant height 30DAS. The mean value for this parameter was 27.93cm**.** The maximum plant height (33.13) was observed with T9 (Vermiwash at 15%) and minimum plant height (22.6) was observed with control. A range of 73.20-56.50cm was recorded for plant height at 60DAS. The mean value for

this parameter was 64.82 cm. The maximum plant height (73.20) was observed with T9 (Vermiwash at 15%) and minimum plant height (56.50) was observed with control. A range of 117.50-98.77 cm was recorded for plant height at 90DAS. The mean value for this parameter was 108.45cm. The maximum plant height (117.50) was observed with T9 (Vermiwash at 15%) and minimum plant height (98.77) was observed with control (Table-2). A range of 6.87-5.43 was recorded for number of primary branches per plant. The mean value for this parameter was 6.01. The maximum number of primary branches per plant (6.87) was observed with T9 (Vermiwash at 15%) and minimum number of primary branches per plant (5.43) was observed with control. A range of 10.27-8.87 was recorded for number of secondary branches per plant. The mean value for this parameter was 9.32. The maximum number of secondary branches per plant (10.27) was observed with T9 (Vermiwash at 15%) and minimum number of secondary branches per plant (8.87) was observed with control. A range of 80-60 was recorded for number of siliqua per plant. The mean value for this parameter was 7.76. The maximum number of siliqua per plant (80) was observed with T9 (Vermiwash at 15%) and minimum number of siliqua per plant (60) was observed with control. A range of 13.63-10.5 was recorded for seeds per siliqua. The mean value for this parameter was 11.96. The maximum number of seeds per siliqua (13.63) was observed with T9 (Vermiwash at 15%) and minimum number of seeds per siliqua (10.50) was observed with control. Observations of test weight of mustard were statically analysed. A rage of 4.81-4.57g with 4.69g as mean value was recorded for test weight. The maximum test weight (4.81) observed with T_9(vermiwash at 15% ;). Minimum test weight (4.57) recorded for T_O (control) (Table-3). The observations on seed yield per plant of mustard was statistically analysed.A range of 2.54-1.63 was recorded for seed yield per plant. The mean value for this parameter was 2.08. The maximum seed yield per plant (2.54) was observed with T9 (Vermiwash at 15%) and minimum seed yield per plant (1.63) was observed with control. A range of 53.43-37.10g with 44.29g mean value was recorded for seed yield per plot. The maximum seed yield per plot (53.43) observed with T9 (vermiwash at 15%;). Minimum seed yield per plot (37.10) recorded for TO (control).A range of 8.94-8.03g with 8.48g mean value was recorded biological yield. The maximum biological yield (8.94) observed with T_9(vermiwash at 15%;). Minimum biological yield (8.03) recorded for T_O (control). Observations of harvest index of mustard were statically analysed. A rage of 28.44-20.28% with 24.51% mean value was recorded for harvest index. The maximum harvest index (28.44) observed with T_9 (vermiwash at 15%;). Minimum harvest index (20.28) recorded for T_O (control) (Table-4).

Table 3: Mean Influence of Bio Fertilizers treatments on for different characters in Mustard

S.No.	Treatment	primary branches per plant	number of secondary branches per plant	Days to Maturity	Number of siliquae per plant	Seeds per siliqua	1000 seed weight
T_0	Control	5.43	8.87	131.33	60	10.50	4.57
T_1	Rhizobium at 5%	5.64	9.20	129	69	11.33	4.67
T_2	Rhizobium at 8%	5.97	9.41	128.33	74	12.07	4.68
T_3	Rhizobium at 10%	6.44	9.61	130	76	12.60	4.70
T_4	Neem leaf extract at 5%	5.45	8.99	129	65	11.20	4.62
T_5	Neem leaf extract at 10%	5.70	9.12	128.33	70	11.53	4.66
T_6	Neem leaf extract at 15%	5.96	9.18	129	72	11.96	4.69
T7	Vermiwash at 8%	6.67	9.39	128	71	12.47	4.70
T_8	Vermiwash at 10%	6.80	9.97	129.33	78	13.40	4.79
T_9	Vermiwash at 15%	6.87	10.27	128.67	80	13.63	4.81
T_{10}	Tulasi leaf extract at 5%.	5.48	8.96	129.33	65	11.31	4.65
T_{11}	Tulasi leaf extract at 10%.	5.77	9.11	132.67	69	11.63	4.71
T_{12}	Tulasi leaf extract at 15%.	5.95	9.19	129.67	71	11.88	4.76
	Grand Mean	6.01	9.32	129.43	70.76	11.96	4.69

	Range	S	S	128-132.67	S	S	S
	SE(d)	0.05	0.059	0.69	0.69	0.14	0.016
	C.D@(5%)	0.15	0.17	2.01	2.01	0.41	0.04

Table 4: Mean Influence of Bio Fertilizers treatments on for yield characters in Mustard

S.No.	**Treatment**	Seed yield per plant	Seed yield per plot	Biological yield	Harvest index
T_0	Control	1.63	37.10	8.03	20.28
T_1	Rhizobium at 5%	1.88	41.47	8.24	22.78
T_2	Rhizobium at 8%	1.99	45.37	8.39	23.72
T_3	Rhizobium at 10%	2.16	47.90	8.56	25.23
T_4	Neem leaf extract at 5%	1.89	39.20	8.29	22.80
T_5	Neem leaf extract at 10%	2.00	42.60	8.40	23.81
T_6	Neem leaf extract at 15%	2.11	44.17	8.51	24.79
T7	Vermiwash at 8%	2.33	48.27	8.73	26.71
T_8	Vermiwash at 10%	2.43	49.70	8.83	27.55
T_9	Vermiwash at 15%	2.54	53.43	8.94	28.44
T_{10}	Tulasi leaf extract at 5%.	1.92	39.93	8.34	22.97
T_{11}	Tulasi leaf extract at 10%.	2.06	42.33	8.46	24.32
T_{12}	Tulasi leaf extract at 15%.	2.17	44.40	8.57	25.35
	Grand Mean	2.08	44.29	8.48	24.51
	Range	S	S	S	S
	SE(d)	0.019	0.47	0.02	0.18
	C.D@(5%)	0.056	1.38	0.08	0.54

Among the different bio fertilizer treatments, Vermiwash at 15% gave highest field emergence and control contributed lowest field emergence .Among the various seed biofertilizer treatments, control contributed long period to days to 50% flowering. Treatment with bio fertilizer Vermiwash at 15% found to give highest plant height .This experiment provided mustard seeds treated with Vermiwash at 15% was best for the number of primary branches per plant, number of secondary branches per plant, number of siliqua per plant ,number of seeds per siliqua and test weight. Among the different bio fertilizer treatments Vermiwash at 15% found highest seed yield per plant seed yield per plot ,biological yield and harvest index while control contributed lowest for all these parameters.Thus, among all the biofertilizers used under the study, seed treatment with the application of vermiwash at 15% for duration of 8 hours significantly affected all the character under study (Fig.1). **Geetha and Balamurugan (2021)** reported that the seeds pelleted with Azospirillum enhanced the germination by 13.3% over control. **Kalita *et al*.,(2019)** reported that seed treatment with biofertilizers in combination with different levels of chemical fertilizers was found to be superior over recommended dose of NPK. Application of Azotobacter and PSB in combination with 75 and 50% NPK and FYM @2 t ha-1 were found as viable and feasible option for getting higher yield and economic return from cultivation of toria in hill zone of Assam. **Hadiyal *et al.,(*2017)** reported that Seed inoculation with azotobacter spp. + PSB spp. (each @ 10 ml/kg seed) promoted growth parameters viz., number of primary & secondary branches per plant; yield attributes viz., number of silique per plant and number of seed per siliquae and ultimately higher seed and stover yield with higher net returns of 86629 Rs/ha and B: C ratio 3.40 over control (no inoculation).**Singh et al. (2014)** reported that seed inoculation with either of the bacteria significantly increased the number of branches, pods/plant, seeds/pod and yield of seed and stover yield. **Singh and Dutta (2016)** reported that

mustard and rapeseeds gave good response to Azotobacter growth and development, seed yield and oil yield. Incidence of some diseases of mustard and rapeseeds could be reduced by inoculating with Azotobacter.

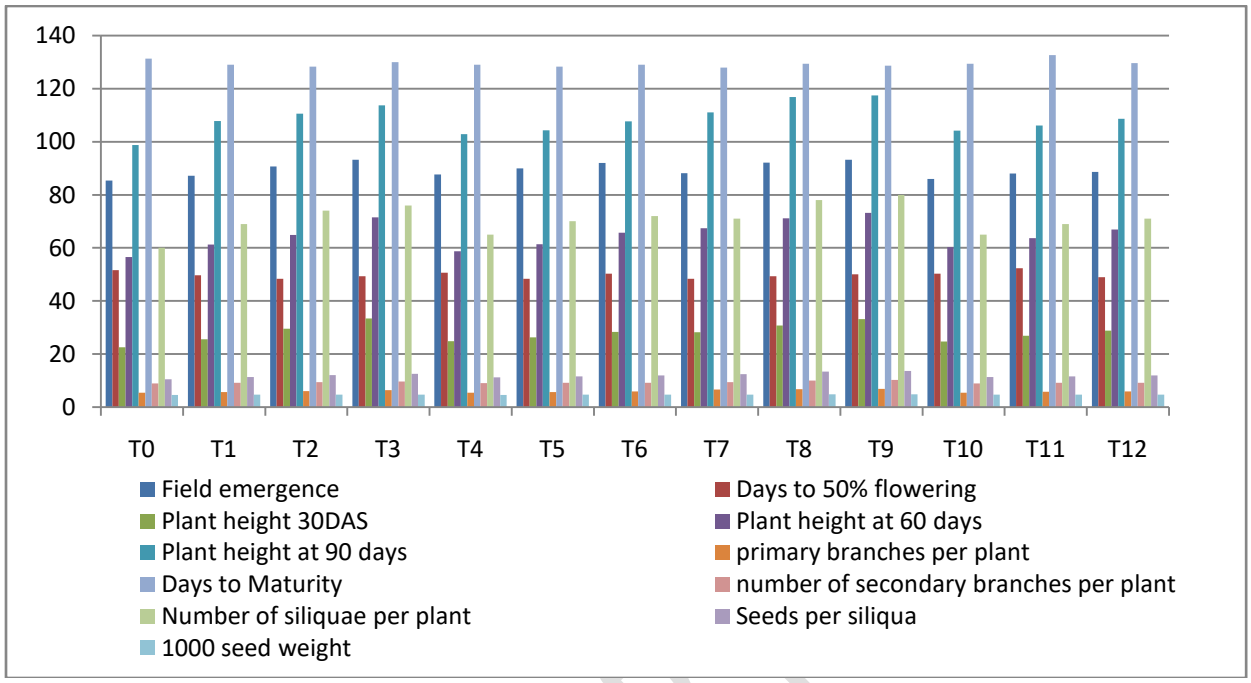

Fig.1 Comparison of seed treatment with Vermiwas at 12% with Control in Black Mustard for various characters.

Conclusion:

On the basis of experimentation, it is concluded that all the characters under study were significantly affected by the influence of the application of biofertilizers. Among all the biofertilizers used under the study, seed treatment with the application of vermiwash at 15 % for duration of 8 hours gave the best results.

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