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Influence of Bio-fertilizer and Organic Seed Treatment on Growth and Yield Attributing Traits of Mustard (*Brassica nigra L.*) Variety (Pusa -21)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The Field experiment was conducted in a Randomized block Design (RBD) with three replications during *Rabi*, 2020-2021 at Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. The genetically pure seeds of Mustard variety Pusa-21 were used for the study. The mustard seeds primed with botanicals and chemicals(Vermiwash, Panchagavya, Azatobactor, NaCl , KNO_3, Neem leaf, Parthenium leaf and FYM) were subjected to study in field experiment of growth and yield parameters were recorded. Objectives of the topic are to evaluate the Influence of bio fertilizer and organic seed treatment on growth, yield and yield attributing traits of mustard crop and to find out the suitable pre-sowing seed treatment for mustard crop. Analysis of variance revealed significant mean sum of squares due to seed priming treatments. The highest germination percent (88.89),plant height (132.53 cm), number of branches(12.60 per plant), yield attributing parameters in mustard as number of silique per plant (292.87), number of seeds per silique (18.73), seed yield per plant (17.73 gm/plant), seed yield per plot (214.33 gm/ plot), biological yield per plot (443.15/ plot), seed yield per hectare (2143.33 kg/

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ha), biological yield per hectare (5140 kg/ ha) and harvest index (41.69) showing better result when treated with treatment vermiwash 5 % for 12 hours. Remaining treatments i.e, treatment with panchgavya 5 % & 3 %, azotobactor 3 % & 2 %, NaCl 0.5 % & 0.1 %, KNO_3 0.5 % & 0.1 %, neem leaf extract, parthenium leaf extract for and fym 2 % for 12 hours recorded the second most effective treatments and observed significantly superior. It concluded that T_8 (vermiwash 5% solution) found superior in all the growth and yield parameters.

Keywords: Vermiwash; panchagavya; azotobactor; growth and yield attributes.

1. INTRODUCTION

Mustard is a crop of rabi season belongs to family of brassicaceae,it is self- pollinated crop and chromosome number 2n=36, origin Southern Mediterranean region. which incorporates broccoli, cabbage, Brussels sprouts, rapeseeds, field rape, canola, Ethiopian mustard and black mustard (*Brassica nigra)*. Indian mustard (*Brassica juncea*) is a could be a shut relative to canola (*B. napus*) and Ethiopian mustard (*B. campestrus*).

It is widely cultivated in tropical and sub tropical areas of the globe. Globally, it is principally cultivated in India, Canada, China, Pakistan, Poland, Bangladesh, Sweden and France whereas in India it is cultivated in states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat, Jharkhand, Assam, Bihar, Punjab and West Bengal. India contributes about 35% area of the total mustard cultivated space of world with 16% of shares in production. Total area under cultivation of mustard crop is about 5.96 million hectare. Major manufacturing states are Rajasthan, Haryana, Madhya Pradesh, UttarPradesh and West Bengal. Total production of mustard in India is about 8.32 million tonnes along with the productivity of 1397 kg/ ha [1]. Mustard oil is one in every of the key edible oils in India. Mustard oil additionally got medicative importance. Residual a part of seeds is employed as oxen feed and in fertilizer. Indian mustard (*Brassica juncea* L.) may be a growing plant which produces a high biomass even in heavy metal polluted soils.

Mustard seed contain regarding 35% to 46% oil and is that third leading supply of oil within the world when soya bean oil and vegetable oil. Mustard seed contain concerning 40-50% supermolecule and is world's second leading sources of organic compound meal when soybean flour. India is that the fifth major mustard manufacturing country and fourth major mustard overwhelming country within the world. Except for extracting oil, seeds are used directly among the preparation of just about all Indian curries notably during a process called “tadka”. India occupies the primary position both in area and production of mustard.

The requirement of vegetable oils and fats are going to be a lot of higher in returning years in view of ever increasing population. India would wish 58 million tonnes of oilseeds by 2020 for maintaining minimum edible oil demand of 12 kg capita-1 annum·1 [2] from this level of 8.2 kg [3]. Among the oilseeds crop, seed and mustard occupy rank next to soybean in land area and production. The inadequate offer of inputs typically results in limit the yield potential of oilseed and mustard [4].

Mustard responds favorably to bio- fertilizers, viz., azotobacter and phosphorus solubilizing being (PSB) [5]**.** Visible of the escalating price of fertilizers and its unwell effects on soil health, there’s a desire to specialize in integrated nutrient offer system which will improve crop production with reduced price of cultivation. Biofertilizers are reported to enhance the yield of Indian mustard [6], which is mainly attributed to better N nutrition through N2 - fixation, enhancement of nutrient availability and uptake and production of growth hormones like indol ethanoic acid, gibberellins etc. [7,8].

Identification of the essential inputs to boost the mustard production is would like of hour. Except for improved varieties and even handed irrigation, use of balanced fertilizers is essential for realizing higher yield. Indian soils are getting deficient in N, P, K in conjunction with S, Zn, and B thanks to intensive cultivation and use of high analysis fertilizers [9]. Beneath such scenario organic manures are often exploited to spice up the soil health condition vis-a-vis production of crops and to enchance fertilizer use potency. However, the use of total organic or inorganic nutrient sources has some limitations [10]. Balanced combination of FYM, biofertilizers and chemical fertilizers facilitate profitable and property production [11]. Hence, a field study

was conducted to assess the response of Indian mustard (*Brassica juncea* L.) to integrated nutrient management

Seed priming is a technique to reduce emergence time, accomplish uniform emergence time, higher algometrical (changes in growth of plant parts over time) attributes and provide requisite exchange several farming and field crops. Varied pre-hydration or priming treatments are been used to increase the speed and synchroneity of seed germination [12]. Common priming techniques embrace hydropriming, halopriming osmopriming. Hydropriming contributes to important improvement in seed germination and seed plant in many plant species. Just like alternative priming techniques, hydropriming typically enhances seed germination and seed plant emergence, though there are exceptions. Throughout priming, seeds are partly hydrous in order that pregerminative metabolic activities proceed, whereas radical protrusion is prevented, then are dried back to the primary moisture level.

2. MATERIALS AND METHODS

The experimental material for present investigation comprised of 12 priming treatments together with management on flavoring. The experiment was conducted in Randomized block design (RBD) with 3 replications.

2.1 Treatments Details

The genetically pure seeds of mustard var. pusa-21 was used for the study. Pusa-21 seeds are very bold type with pearly black colour and were subjected to numerous treatments like,

1) NaCl -0.5%(12hrs),
2) NaCl -0.1%(12hrs),
3) KNO_3 -0.1%(12hrs),
4) KNO_3 -0.5%(12hrs),
5) Azotobactor-2%(12hrs),
6) Azotobactor-3%(12hrs),
7) FYM-2%(12hrs),
8) Vermiwash -3%(12hrs),
9) Panchagavya-5%(12hrs),
10) Panchagavya-3%(12hrs),
11) Parthenium leaf extract-5%(12hrs),
12) Neem leaf extract-5%(12hrs)

along with distilled water and dry seed as control. The seeds were used for numerous spermatophyte characters viz. percent field emergence,plant height, range of branches per plant, number of silique per plant, number of seeds per silique, seed yield per plant, seed yield per plot, biological yield per plot and harvest index.

For the preparation of solution of the vermiwash, to prepare 3% solution of vermiwash, 30 ml vermiwash liquid were taken in a beaker and the chemical were added in 1000 ml. of distilled water with constant stirring. The volume of solution will finally constitute to one litter, and then it became 6% stock solution of vermiwash and so on. after preparation of solution of panchagavya, azactobactor, vermiwash and plant extract, mustard seeds were soaked in required solution for 12 hrs at 25^0C temperature. untreated seed is called as control. after 12 hours of soaking the solution were drained out from the beaker and presoaked were air dried to original weight and then placed for germination in laboratory under controlled condition. after seed treatments seed were sown in field for occurring field observation.

3. RESULTS AND DISCUSSION

3.1 The average Percent Field Emergence at 4,7,10 Days after Sowing

The percent field emergence was ranged between 88.89 to 57.78 percent.

Seed primed in vermiwash 5% for 12 hours resulted in the highest percent field emergence with 82.22 percent and recorded superior treatment among all. Seed soaked in azotobactor 2% for 12 hours was found at par with superior treatment with 82.22 percent, followed by NaCl . 0.5% and panchgavya 5% with 80.00 and 80.00 percent respectively [13,14].

3.2 The Average Plant Height of Mustard at 40, 60 and 90 Days after Sowing (DAS)

The average plant height was ranged between 132.53 to 97.13.

Seed primed in vermiwash 5% for 12 hours resulted in the highest average plant height with 132.53 and recorded superior treatment among all. Seed soaked in panchgavya 3% for 12 hours was found at par with superior treatment with 128.73, followed by azotobactor 2% with 125.00 [15-19].

3.3 The Average Number of Branches in Mustard

The average number of branches was ranged between 12.60 to 6.40.

Seed primed in vermiwash 5% for 12 hours resulted in the highest average number of branches with 12.60 and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours was found at par with superior treatment with 11.73, followed by azotobactor 2% with 11.67 respectively [20,21].

3.4 The Average Number of Silique per Plant in Mustard

The average number of silique per plant was ranged between 292.87 to 179.47. Seed primed in vermiwash 5% for 12 hours resulted in the highest average number of silique per plant with 292.87 and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours was found at par with superior treatment with 281.93 silique per plant, followed by azotobactor 2% with 271.87 silique per plant [22,17].

3.5 The Average Number of Seeds per Silique in Mustard

The average number of seeds per silique was ranged between 18.73 to 10.20 seeds per silique. Seed primed in vermiwash 5% for 12 hours resulted in the highest average number of seeds per silique with 18.73 seeds per silique and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours was found at par with superior treatment with 18.20 seeds per silique, followed by azotobactor 2%, panchgavya 3%, NaCl 0.5%, NaCl 0.1%, neem leaf extract 5% and KNO_3 0.5% with 17.93, 17.87, 17.67, 17.13, 17.07, 16.80 and 16.67 seeds per silique respectively [17].

3.6 The Average Seed Yield per Plant in Mustard

The average seed yield per plant was ranged between 17.73 to 7.69 gm/plant. Seed primed in vermiwash 5% for 12 hours resulted in the highest average seed yield per plant with 17.73 gm/plant and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours was found at par with superior treatment with 16.05 gm/plant, followed by azotobactor 3% with 15.89 gm/plant respectively.

3.7 The Average Seed Yield per Plot in Mustard

The seed yield per plot was ranged between 214.14 to 126.33 gm/ plot. Seed primed in vermiwash 5% for 12 hours resulted in the highest seed yield per plot with 214.14 gm/ plot and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours was found at par with superior treatment with 200.33 gm/ plot, followed by azotobactor 3%, panchgavya 3% and azotobactor 2% with 198.67, 182.33 and 182.00 gm/ plot respectively [14,23,16,22,18,24,25].

3.8 The Biological Yield per Plot in Mustard

The data on biological yield per plot was ranged between 514.00 to 336.00 gm/ plot. Seed primed in vermiwash 5% for 12 hours resulted in the highest biological yield per plot with 514.00 gm/ plot and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours was found at par with superior treatment with 507.33 gm/ plot, followed by panchgavya 3%, azotobactor 3%, neem leaf extract 5%, parthenium leaf extract 5%, NaCl 0.1% and KNO_3 0.1% with 500.00, 484.33, 458.67, 452.00, 444.00 and 443.67 gm/ plot respectively.

3.9 The Seed Yield per Hectare in Mustard

The seed yield per plot was ranged between 2143.33 to 1263.33 kg/ hectare. Seed primed in vermiwash 5% for 12 hours resulted in the highest seed yield per hectare with 2143.33 kg/ hectare and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours was found at par with superior treatment with 2003.33 gm/ plot, followed by azotobactor 3%, panchgavya 3% and azotobactor 2% with 1986.67, 1823.33 and 1820.00 gm/ plot respectively.

3.10 The Biological Yield per Hectare in Mustard

The data on biological yield per hectare was ranged between 5140 to 3260.00 kg/ ha. Seed primed in vermiwash 5% for 12 hours resulted in the highest biological yield per hectare with 5140 kg/ ha and recorded superior treatment among all. Seed soaked in panchgavya 5% for 12 hours

was found at par with superior treatment with 5073.33 kg/ ha, followed by panchgavya 3%, azotobactor 3%, neem leaf extract 5%, parthenium Leaf extract 5%, NaCl 0.1% and KNO_3 0.1% with 5000.00, 4843.33, 4586.67, 4520.00, 4440.00 and 4436.67 gm/ plot respectively.

3.11 The Harvest Index in Mustard

The data on harvest index was ranged between 41.69 to 37.09. Seed primed in vermiwash 5% for 12 hours resulted in the highest harvest index with 41.69 and recorded superior treatment among all. Seed soaked in azotobactor 3% for 12 hours was found at par with superior treatment with harvest index of 41.02 followed by azotobactor 2% and panchagavya 5% 40.90 and 39.49 respectively. The lowest harvest index was recorded in NaCl 0.5% and parthenium leaf extract 5% treatment with 37.09 and 37.09 [17].

The results revealed that among the all treatment used for priming, the seeds primed with vermiwash 5% recorded the most effective results in growth parameters and showed highest emergence percent with 33.33, 62.22 and 88.89 percent after 4, 7 and 10 days after sowing respectively, it also recorded maximum height with 18.87, 98.60 and 132.53 cm at 45, 60 and 90 days after sowing respectively. same treatment i.e., vermiwash 5% recorded maximum number of branches with 12.60 per plant.

Similar results were also recorded in different yield attributing parameters in mustard as number of silique per plant (292.87), number of seeds per silique (18.73), seed yield per plant (17.73 gm/plant), seed yield per plot (214.33 gm/ plot), biological yield per plot (443.15/ plot), seed yield per hectare (2143.33 kg/ ha), biological yield per hectare (5140 kg/ ha) and harvest index (41.69) showing most superior values when treated with treatment vermiwash 5% for 12 hours.

Remaining treatments i.e, treatment with panchgavya 5% & 3%, azotobactor 3% & 2%, NaCl 0.5% & 0.1%, KNO_3 0.5% & 0.1%, neem leaf extract, parthenium leaf extract for and fym 2% for 12 hours recorded the second most effective treatments.

Seed priming is a technique to reduce emergence time, accomplish uniform emergence time, better algometric (changes in growth of plant parts over time) attributes and provide requisite stand in many horticultural and field crops. Various pre-hydration or priming treatments have been employed to increase the speed and synchrony of seed germination [12]. Common priming techniques include hydropriming, halopriming osmopriming. Hydropriming contributes to significant improvement in seed germination and seedling growth in different plant species. Similar to other priming techniques, hydropriming generally enhances seed germination and seedling emergence, although there are exceptions. During priming, seeds are partially hydrated so that pregerminative metabolic activities proceed, while radical protrusion is prevented, and then are dried back to the original moisture level.

The similar results also observed by Dwivedi et al. [26] observed that the treatment T5 (Rec. NPK + Vermiwash) recorded maximum plant height (16.10cm., 115.40cm. and 163.19 cm.) at 30, 60 and 90 DAS, maximum number of branches i.e. 2.46 and 4.13 per plant at 60 and 90 DAS respectively. Also recorded maximum number of fruits per plant, fruit yield per plant and fruit yield per hectare was recorded in treatment T5 (Rec. NPK + Vermiwash).

Similarly, Rathod et al. [27] recorded seed soaking in vermiwash for 8 hours resulted in early highest emergence (33.33 plants /m), higher plant height (36.8 cm), total dry matter production (24.8 g plant-1), required minimum duration for fist (32.2 days) and 50% flowering (45.2 days). This treatment also exhibited maximum number of pods per plant (37.3), pod weight per plant (83.93 g), seed weight per plant (10.48 g), 100 seed weight (19.87 g), seed yield (1341 kg/ ha), haulm yield (3353 kg /ha) and harvest index (28.57).

Francisco et al. [28] recorded that the application 100% vermiwash improved the yield per hectare, root length and yield of mungbean.

Jadhav et al. [29] observed that the treatment T5 (100 % RDF as fertigation and 2% vermiwash) at 15, 30 and 45 DAS had significantly higher plant height (84.10cm), root length (18.37 cm), number of branches-1 (6.80), total number of pods plant-1 (34.48), straw weight plot-1 (0.85 kg), seed weight (1161.33 kg) and straw kg), seed weight (1161.33 kg) and straw weight (2833.73 kg) ha-1, respectively.

Table 1. Mean performance of different treatment for pre growth parameters in mustard (*Brassica nigra L.*)

Tr. No.	Treatment details	Percent field emergence			Plant height			Number of branches
		4 DAS	7 DAS	10 DAS	45 DAS	60 DAS	90 DAS	
T_0	**Control**	8.89	35.56	57.78	12.60	79.73	97.13	6.40
T_1	NaCl	17.78	53.33	68.89	17.00	86.27	118.07	9.40
T_2	NaCl	8.89	48.89	80.00	17.00	89.07	104.93	10.07
T_3	KNO_3	17.78	60.00	66.67	17.07	83.80	113.60	9.80
T_4	KNO_3	11.11	53.33	73.33	16.87	87.93	105.00	10.27
T_5	**Azotobactor**	28.89	60.00	82.22	17.07	95.07	125.00	11.00
T_6	**Azotobactor**	24.44	55.56	75.56	15.40	94.80	111.27	11.67
T_7	**FYM**	15.56	48.89	68.89	16.33	94.00	118.13	10.73
T_8	**Vermiwash**	33.33	62.22	88.89	18.87	98.60	132.53	12.60
T_9	**Panchgavya**	28.89	55.56	80.00	17.27	98.00	112.73	11.73
T_{10}	**Panchgavya**	17.78	48.89	75.56	17.00	92.07	128.73	11.33
T_{11}	**Parthenium leaf extract**	15.56	51.11	73.33	15.80	90.53	106.20	10.67
T_{12}	**Neem leaf extract**	17.78	51.11	71.11	14.00	94.47	116.27	10.87
	SE(m)	1.41	3.18	3.88	0.79	3.04	4.02	0.38
	CD at 5%	4.12	9.29	11.32	2.32	8.88	11.74	1.11
	CV %	12.89	10.47	9.07	8.42	5.79	6.08	6.28

Table 2. Mean performance of different treatment for yield parameters in mustard (*Brassica nigra L.*)

Tr. nu	Treatment details	Number of silique per plant	Number of seeds per silique	Seed yield per plant	Seed yield per plot	Biological yield per plot	Seed yield per hectare	Biological yield per hectare	Harvest Index
T_0	**Control**	179.47	10.20	7.69	126.33	326.00	1263.33	3260.00	38.75
T_1	NaCl	218.40	17.13	12.81	150.33	384.00	1503.33	3840.00	39.15
T_2	NaCl	184.87	17.07	10.81	164.67	444.00	1646.67	4440.00	37.09
T_3	KNO_3	225.07	15.33	11.49	169.67	443.67	1696.67	4436.67	38.24
T_4	KNO_3	229.33	16.67	10.06	143.67	381.00	1436.67	3810.00	37.71
T_5	**Azotobactor**	271.87	17.93	12.05	182.00	439.33	1820.00	4393.33	40.90
T_6	**Azotobactor**	237.60	17.87	15.89	198.67	484.33	1986.67	4843.33	41.02
T_7	**FYM**	232.80	15.53	11.97	163.33	431.33	1633.33	4313.33	37.87
T_8	**Vermiwash**	292.87	18.73	17.73	214.33	514.00	2143.33	5140.00	41.69
T_9	**Panchgavya**	281.93	18.20	16.05	200.33	507.33	2003.33	5073.33	39.49
T_{10}	**Panchgavya**	237.80	17.67	11.13	182.33	500.00	1823.33	5000.00	36.47
T_{11}	**Parthenium leaf extract**	184.13	15.80	13.32	167.67	452.00	1676.67	4520.00	37.09
T_{12}	**Neem leaf extract**	209.27	16.80	10.22	178.67	458.67	1786.67	4586.67	38.95
	SE(m)	17.96	0.73	0.89	11.47	24.27	14.71	242.56	
	CD at 5%	52.43	2.13	2.59	33.48	70.85	334.81	707.99	
	CV %	13.55	7.64	12.39	11.52	9.48	11.52	9.47	

4. CONCLUSION

It is concluded from the present investigation of seed treatments with different kind of priming were found affecting significantly different characters of growth and yield under study in mustard.The treatment T_8 (vermiwash 5% solution) found superior in all the growth and yield parameters followed by T_9 (panchagavya 5% solution), T_5 (azatobactor 3% solution), T_{10} (panchagavya 3% solution), T_6 (azatobactor 2% solution). it can be concluded that seed quality could be improved through pre-soaking treatments with cheap, non-toxic and ecofriendly organic sources. These results have great practical significance, since it indicates the possibility of upgrading the quality of seed with help of simple seed treatment like vermiwash, panchagavya, azatobactor. Looking at the cost of organic substances, these organics are cheaper and easy to be practiced by everyone at rural area.Thus ,Seed priming with vermiwash is useful for improving yield in mustard. Further investigations under field conditions might be needed to clarify the role of bio-fertilizer and organic in mustard and other crops for commercial cultivation by farmers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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