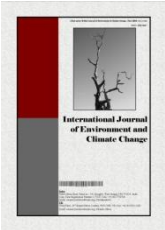

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Influence of Different Seed Treatment on Growth, Yield and Seed Quality Parameters of Mustard (*Brassica junicea*) Var.(sulabh-3777)

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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 experiment was conducted in the central research field at the department of Genetics and Plant Breeding, Sam Higginbottom University Of Agriculture, Technology & Sciences and college, Prayagraj (U.P) during Rabi season 2020-2021. In order to standardize the suitable pre-sowing seed treatment of Mustard (Variety-Sulabh-3777) laid by Randomized block design(RBD). Influence of different seed treatment on growth, yield and seed quality parameters of mustard were evaluated by Viz T0- Control, T_1-Hydropriming(-0.3Mpa) for 3Hrs, T_2-KNO_3 1% for 12Hrs, T_3-Nacl - 1% for 12Hrs, T_4-KH_2PO_4 -1% for 12Hrs, T_5- Electromagnetic (200Guass) for 30Mins, T_6-PEG_{6000} (0.15 Mol.) for 3Hrs, T_7- Neem leaf Extract- 5% for 12Hrs, T_8-Tulasi Leaf Extract-5% for 12Hrs , T_9-Recommended NPK, $_{10}$-Recommended NPK+FYM, T_{11}-Azotobacter, T_{12}-Azotobacter + 50% NPK+ FYM. To find out influence of different seed treatment on growth, yield and seed quality parameters of mustard showed that significant treatment field emergence (%), plant height (30,60,90 DAS), days to 50% flowering, number of branches per plant, number of siliquae per plant, number of

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seeds per siliquae, seed yield per plant (g), seed yield per plot (g), biological yield (g), harvest index. The study helps to improve the quality to improve seed with help of seed various botanicals, chemicals and biofertilizers priming treatment which are cost effective and economic, non- toxic, ecofriendly sources.

Keywords: Bio priming; Electromagnetic; RBD (Randomized Block Design) Halo and Osmo priming; leafs extracts; mustard seed.

1. INTRODUCTION

Mustard (*Brassica juncea L*.) is the most important oilseed crop after groundnut accounting around 25 percent of total oilseed production. mustard are one of the most important oilseed crops in India, belonging to the brassica genus of the family Crucifera. There are four species of oilseeds in Brassica: B. compostris (B. rape), B. juncia (Indian mustard), *B. napus* (winter and spring rape) and B. carinata (Ethiopian mustard). The three monogenomic diploids are B. rapa (AA, 2n = 20), B. nigra (BB, 2n = 16), and B. oleracea (CC, 2n = 18). The three allopolyploids are B. juncia (AABB, 2n = 36), *B. napas* (AACC, 2n = 38), and B. carinata (BBCC, 2n = 34), which are the result of hybridization between different monogenomic diploids. *B. juncia* (brown mustard, 2n = 4 × = 36; gene AABB) is B. rapa and .It is well-suited for cultivation in arid regions and grows as a major oilseed crop in the Indian subcontinent during the winter [1]. Among various oilseeds, rapeseed-mustard (*Brassica* sp.) is second and third important edible oil-seed crop of India and the world respectively. In India, rapeseed-mustard is grown in 5.96 million ha with a production of 8.32 million tonnes and productivity of 1397 kg ha-1 during 2017-18 . Rajasthan, Madhya Pradesh, Gujarat, Haryana, Uttar Pradesh, Jharkhand, Assam, Bihar and West Bengal are some major rapeseed-mustard producing states of this country.

Nutrients management is one of the most important agronomic factor that affects the Indian mustard. But Application of all the needed nutrients through chemical fertilizer had deleterious effect on soil fertility leading to unsustainable yields, while integration with organic manures and bio-fertilizers would be able to maintain soil fertility and sustain crop productivity. Further, decomposition of organics in the soil leads to different types of biological reactions which are helpful in preventing various disease causing pathogens [2]. Improvement in these parameters due to organic manures might be due to supply of plant nutrients including micronutrients, improvement in soil physical and biological properties and increased availability of nutrients. which improved vegetative growth and ultimately increased plant height and number of primary & secondary branches per plant. The similar results were found by De and Sinha [3], Yadav et al. [4] and Kansotia et al. [5] Crop yield is function of several yield components on complementary interaction between vegetative and reproductive growth of the crop. The present findings are within the close vicinity of those reported by Yadav et al. [6] , Mahboobeh and Jahanfar (2012) , Meena et al. [7] and Solanki et al. [8]. Azotobacter chroococum non–symbiotic nitrogen fixing agro – microbe having potential to fix combined quantities of atmospheric nitrogen in rizospere of non –legumes. Azotobacter synthesizes various growth hormones, antifungal substances and siderophores that favourably affect crop growth [9].

Seed priming enhanced α-amylase activity and total sugar concentration which helped seeds to achieve high germination and vigour and as a result, better stand establishment was ensured which ultimately accelerated crop growth. Better root proliferation and stress tolerance of plant under seed priming through KH2PO4 or PEG 6000 increased nutrient and moisture uptake from soil and helped to attain robust plant which subsequently expressed high photosynthetic efficiency, resulting in its elevated growth. Moreover, improvement of sucrose metabolism might be another reason for such improvement in growth by seed priming through above said chemicals. These results might be due to the fact that elevated growth of plant under seed priming through KH2PO4 or PEG 6000 and consequent mobilizations of proteins, amino acids, soluble sugar and other assimilates from source (vegetative part) to sink (reproductive organs) helped the rapeseed-mustard to achieve high yield contributing parameters and yield. Most researchers reported that crop seeds treated with different magnetic fields could increase the rate of seed germination and seedling growth

especially maize and fruits tree species [10, 11,12, 13]. Recently, specific studies have been addressed to test if physical methods, including ionization and/or application of ultraviolet rays, electric fields, and magnetic fields are able to improve the quality of the seed. Germination improvement of maize seeds under different intensities of magnetic field has been reported in other studies [14, 15]. Positive effects of magnetic field are attributed to paramagnetic properties of atoms in plant cells and pigments like chloroplasts [16].

Among the magnetic field applications ranging from 0 to 150 mT, maximum positive effect on wheat was attributed to 100 mT treatment; however, 150 mT treatment caused inhibitory effects on germination traits [17]. In another study on the effect of pre-sowing magnetic field application on muskmelon, germination percent as well as length of root and stem were increased by 14.6%, 36.4%, and 22.8%, respectively [18,19]. magnetic field treatment in order to improve germination and seedling growth of *Festuca arundinacea* Schreb and *Lolium perenne* L., it was found that magnetic field significantly decreased the time of germination (e.g. 10% compared to the control); however, root characters of treated seedlings increased significantly compared to the control (Carbonnel et al., 2008) [20]. Salinity and drought may delay the onset, reduce the rate, and increase the dispersion of germination events, leading to reductions in plant growth and final crop yield. Salinity and drought stress are important environmental factors that affect different development stages of crops, especially germination stage. The objective of the present investigation was to evaluate the effect of NaCl and PEG-induced osmotic stress on the germination and early seedling growth of wild mustard (*Sinapis arvensis* L.), a commercially important weed for providing raw material for biodiesel energy [21, 22] Kayacetin et al., 2016, According to Ayaz et al. [23], decrease of seed germination under conditions of salt stress is due to occur of some metabolically disorders. It seems that, decrease of germination percentage is related to reduction in water absorption into the seeds at imbibitions and seed turgoscence stages. NaCl and PEG treatments inhibited seed germination and seedling growth properties in wild mustard.

Polyethylene glycol and KNO3 solutions increased the fresh and dry weight of roots in maize at 2% and 5% concentration primed for 12 h and 18 h. In addition they also increased the vigour index [24]. Final emergence, emergence index, plant height, leaf area, stover dry weight, total dry weight, individual cob weight, cob yield, cob number and number of grains per cob were observed to indicate almost same kind of response to priming treatments in increasing the final yield [25]. Research on priming has proved that crop seeds primed with water germinated early, root and shoot development started rapidly, grew more vigorously and seedling length was also significantly greater than non-primed seeds. It could also improve the performance of crop by alleviating the effect of salts under saline soil conditions [26]. Soaking seed in water overnight before sowing can increase the rate of germination and emergence even in soil conditions where moisture content is very low [27]. Osmopriming has been shown to activate processes related to cell cycle. In wild rye (Leymuschinensis) seeds, for example, priming with 30% PEG for 24 h resulted in increase in the activity of superoxide dismutase (SOD) and peroxidase (POD) and a rapid increase in the respiratory intensity, which were associated with an increase in germination vigor [28]. The precise mechanisms by which application of this simple technique can achieve sometimes quite dramatic improvements in plant growth and seed yield in saline or nonsaline conditions remain unclear. Some researchers have considered hydro-priming a key technology that is simple and cost effective, the impact of which is very high in terms of enhanced yield [29]. Hydro-priming plays an important role in the enzymatic activities of the wheat, maize, rice, and other vegetable seeds. In seed of some plant species, trypsin-like proteolytic enzymes, which are produced during seed development, are important during germination. The activity of such enzymes, however, is often prevented by trypsin inhibitors, which may be present in the seed and play regulatory roles in protein mobilization during germination. A number of studies have shown a significant improvement in seed germination, seedling emergence and establishment, and final crop yield in salt affected soils in response to halopriming. Khan et al. [30] evaluated the response of seeds primed with NaCl solution (1 mM) at different salinity levels 0, 3, 6 and 9 dSm-1 in relation to early growth stage and concluded that seed priming with NaCl has been found to be better treatment as compared to non-primed seeds. In case of hot pepper for improving the seedling vigour and stand establishment under salt- stressed conditions.

Priming with NaCl and KCl was helpful in removing the deleterious effects of salts [31]. Rice seed treated with a mixed salt solution germinated more speedily than unprimed seed under salt-stress conditions [32]. Sedghi et al. [33] results indicated that with increasing salinity, germination traits such as germination percent, rate and plumule length decreased, but seed priming with GA3 and NaCl showed lower decrease. In all of the salinity levels, primed seeds possessed more germination rate and plumule length than control. The highest radicle fresh and dry weight in pot marigold was seen at 7.5 dSm-1 salinity stress level. Bajehbaj, [34] evaluated the effects of NaCl priming with KNO3 on the germination traits and seedling growth of four *Helianthus annuus* L. cultivars under salinity conditions and reported that germination percentage of primed seeds was greater than that of un-primed seeds. Salehzade et al. [35] conducted to enhance the germination and seeding growth of wheat (*Triticum aestivum* L.) cvZarin seeds using different Osmopriming treatments. Seeds were osmoprimed with polyethylene Glycol (PEG-8000), solution for 12 h. The osmotic potential of the all solutions were-0.3,-0.6, -0.9 MPa. During Osmopriming operation all solutions aerated with aquarium pump. The control seeds were not treated. Osmopriming treatments improved germination and seedling vigor than that control. The Objectives of this study is to evaluate the effect of botanicals, chemicals and Biofertilizers on growth, yield and yield attributes traits and to find out suitable pre- sowing treatment for mustard crop.

2. MATERIALS AND METHODS

The experiment was conducted in post graduate central research farm, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during rabi season 2020. The experimental was carried out in department of genetics and plant breeding, SHAUTS. The experimental materials comprising of were grown under randomized block design (RBD) with thirteen treatments and three replications. The experimental field was divided into 3 blocks of equal size and treatments are T0- Control, T_1-Hydropriming(- 0.3Mpa) for 3Hrs, T_2-KNO_3 1% for 12Hrs, T_3- Nacl -1% for 12Hrs, T_4-KH_2PO_4 -1% for 12Hrs, T_5- Electromagnetic (200Guass) for 30Mins, T_6- PEG_{6000} (0.15 Mol.) for 3Hrs, T_7- Neem leaf Extract- 5% for 12Hrs, T_8-Tulasi Leaf Extract-5% for 12Hrs , T_9-Recommended NPK, $_{10}$- Recommended NPK+FYM, T_{11}-Azotobacter, T_{12}- Azotobacter + 50% NPK+ FYM The data was analysed statistically as per randomized block design Analysis of variance was carried out according to the procedure of Randomized Block Design (RBD) for each character as per methodology advocated by (Fisher, 1963) [36].

3. RESULTS AND DISCUSSION

The mean performance of field emergence ranged from 72% to 86.33 %with mean value of 81.36 %. Significantly maximum percentage of field emergence (86.33%) was recorded T5-PEG6000 and it was followed by T1- KNO3 (85.56%), T6- Hydropriming (82.66%) and T11-Azotobacter (82.0%). Whereas minimum field emergence was recorded under Control (72%). Mean performance of plant height ranged from 24.33 cm to 33 cm with mean value of 29.36 cm. Significantly, maximum height of plant (84.09 cm) was recorded by T5- PEG6000 and it was followed by T8- Tulasi Leaf Extract (80.13 cm), T3- KH_2PO_4 (76.05 cm) and T10- Recommended NPK+FYM(75.8cm). Minimum plant height was recorded under Control (62.33 cm) .The mean performance of plant height ranged from 73.65 cm to 92.33 cm with mean value of 80.92 cm. Significantly, maximum height of plant (92.33 cm) was recorded by T5- PEG6000and it was followed by T8- Tulasi Leaf Extract (88.37 cm), T6- Hydropriming (81.11 cm) and T9-Recommended NPK (80.46 cm). Minimum plant height was recorded under Control (73.65 cm).The mean performance of plant height ranged from 115.4 cm to 133.5 cm with mean value of 123.49 cm. Non Significantly, maximum height of plant (133.5 cm) was recorded by T5-PEG6000 and it was followed by T8- Tulasi Leaf Extract (129.66 cm), T10-Recommended NPK+FYM (126.23cm) and T3- KH2PO4 (123.56cm). Minimum plant height was recorded under Control (115.4 cm).The mean performance of number of branches per plant ranged from 7.13 to 11.6 with mean value of 9.82 Significantly, maximum number of branches (11.6) was recorded by T5- PEG6000 and it was followed by T2- NACL (10.6), T6- Hydropriming (9.7) , T8- Tulasi Leaf Extract (9.43),. Minimum number of branches was recorded under Control (7.13). The mean performance of Days to 50% flowering per plant ranged from 48.69 to 40.19 with mean value of 43.76 Significantly, maximum days to 50% flowering (48.69) was recorded by

T0-Control and it was followed by T1- KNO3 (47.26), T8- Tulasi Leaf Extract (47.28) and T11-Azotobacter (41.78).Minimum was recorded under T5- PEG6000 (40.19). The mean performance of number of siliquae per plant ranged from 40.93 to 80.93 with mean value of 67.17. Significantly, maximum number of siliquae (82.93) was recorded by T5-PEG6000and it was followed by T8- Tulasi Leaf Extract (12.73), T4- Electromagnetic (76.86). T7-Neem leaf Extract (70.46) and Minimum number of siliquae per plant was recorded under Control (40.93). The mean performance of number of seeds per siliquae ranged from 7.73 to 15.93 with mean value of 11.28. Significantly maximum number of seeds per siliquae (15.93) was recorded by T5- PEG6000and it was followed by T8- Tulasi Leaf Extract (12.73), T12-Azotobacter + 50% NPK+ FYM (11.53), T6-Hydropriming, T7- Neem leaf Extract (11.4) and Minimum number of seeds per siliquae was recorded under Control (9.00).The mean performance of seed yield per plant ranged from 1.62 g to 4.75 g with mean value of 3.26 g. Significantly, maximum seed yield per plant (4.75 g) was recorded by T5-PEG6000% and it was followed by T8-Tulasi Leaf Extract (4.1 g), T10-Recommended NPK+FYM (3.67 g) and T3- KH2PO4 (3.42 g).

Minimum seed yield per plant was recorded under Control (1.62 g).The mean performance of seed yield per plot ranged from 34.81 g to 53.72 g with mean value of 55.26 g. Significantly, maximum seed yield per plot (55.26) was recorded by T5- PEG6000 and it was followed by T8- Tulasi Leaf Extract (49.96), T3- KH2PO4 (47.8), and T2- NACL (4.86). Minimum seed yield per plot was recorded under Control (34.8). The mean performance of biological yield ranged from 185.10 g to 237.04 g with mean value of 213.35 g. Significantly, maximum biological yield (237.04 g) was recorded by T5- PEG6000 and it was followed by T9- Recommended NPK (235.12 g), T7- Neem leaf Extract (229.08 g), and T11- Azotobacter (230.42 g). Minimum biological yield was recorded under control (185.11). The mean performance of harvest index ranged from 18.80% to 22.66% with mean value of 20.61%. Significantly, maximum harvest index (23.76%) was recorded by T12-Azotobacter + 50% NPK+ FYM and it was followed by T4- Electromagnetic (23.31%) T6-Hydropriming, Minimum harvest index was recorded under Control (18.79%).

Table 1. Analysis of variance for 13 quantitative characters in Mustard

Sr. No	Characters	Mean sum of squares		
		Treatment	Replication	Error
1.	Field Emergence (%)	64.77*	54.17	14.34
2.	Plant Height (30days)	6.83*	69.79	5.46
3.	Plant Height (60days)	20.64*	71.30	4.59
4.	Plant Height (90days)	3.80*	63.47	8.31
5	Number of Branches / Plants At 60das	3.83*	4.55	1.01
6	Days To 50% Flowering	14.33	14.08	8.47
7.	No. Of Siliqua Per Plant	3.26*	265.35	14.11
8	No.Of Seeds Per Siliqua	1.51*	10.01	0.90
9	Seed Yield Per Plant	0.05*	1.51	0.07
10	Seed Yield Per Plot	8.33*	79.99	2.42
11.	Biological Yield	1.31*	922.74	18.99
12.	Harvest Index	0.10*	1.09	0.05

**Significant at 5% level of significance*

Table 2. Effect of treatment on mean performance of mustard growth and yield parameters

Sl. no	Treatment	Field Emergence	Plant Height			Days to 50% floweerintg	Number of branches/ plant at 60das	Number of siliqua /plant	No of Seeds/ siliqua	Seed Yield/ plant	Seed Yield /plot	Harvest Index	Biological yield
			30 days	60 days	90 days								
1.	T_o	72	62.83	73.65	115.4	48.69	7.13	40.93	7.73	1.62	43.8	185.10	18.79
2.	T_1	85.5	72.66	79.71	125.9	42.26	9.33	64.53	9.66	2.95	45.06	189.58	23.76
3.	T_2	76.5	74.12	77.36	123.30	44.93	10.66	65.8	11.4	3.22	46.86	203.08	23.08
4.	T_3	83.5	76.05	79.71	123.56	42.98	9.8	67.26	11.26	3.42	47.8	208.5	21.25
5.	T_4	84.2	74.11	18.36	122.29	42.98	8.46	68.53	11.33	3.15	42.66	200.8	23.31
6.	T_5	86.33	84.09	92.23	133.5	40.19	11.6	82.93	15.93	4.75	55.26	237.04	19.86
7.	T_6	82.66	71.59	81.11	122.14	44.16	9.7	65.26	11.4	3.06	42.2	212.45	23.31
8	T_7	79.2	73.04	80.32	122.18	42.83	11.26	70.46	11.4	3.07	40.53	229.08	17.84
9.	T_8	79.66	80.13	88.37	129.66	47.28	9.43	76.86	12.73	4.1	49.49	212.41	20.46
10	T_9	86.9	74.45	80.46	121.4	41.78	8.6	69.4	10.4	3.00	41.93	235.12	17.67
11	T_{1o}	80.6	75.8	80.70	126.23	43.41	10.83	67.6	10.86	3.67	40.8	199.82	17.52
12	T_{11}	82.06	73.38	78.03	120.82	44.09	10.26	66.8	11.06	3.28	40.73	230.42	18.79
13	T_{12}	78.43	74.34	80.02	118.99	44.93	10.66	66.9	11.53	3.21	40.33	230.18	23.76
Grand Total		3173.70	966.5	1052.03	1605.7	615.72	127.72	873.26	146.69	42.5	568.42	2773.58	64.03
F Test		S	S	S	S	S	S	S	S	S	S	S	S
SE(m)		2.2	2.2	1.2	1.7	0.29	0.6	2.2	0.5	0.2	0.9	2.5	0.5
CV		4.7	3.14	2.64	2.3	1.16	10.3	6.3	8.4	8.2	3.6	7.3	4.4
C.D		6.4	3.94	3.6	4.9	0.86	1.7	5.0	1.6	0.5	2.6	2.0	1.5

4. CONCLUSION

The study helps to improve the quality to improve seed with help of seed various botanicals, chemicals and biofertilizers priming treatment which are cost effective and economic, non-toxic, ecofriendly sources. The seeds of Mustard (Sulabh-3777) were treated with T_5- PEG_{6000} 0.3Mpa(100ml of water 5gms of seeds) enhanced the Field emergence percentage, Plant height (cm), Number of branches per plant, Number of siliquae per plant, Number of seeds per siliquae, Seed yield per plant, Seed yield per plot, Biological yield, Harvest index followed by T_8 –Tulasi leaf extract @ 5% for 12 hrs and T_9 - Recommended NPK @ 2% for 6 hrs as compare**d** to control (untreated) seeds. Osmopriming seeds (with PEG) increase in protein and α-amylase activity after ascorbate priming treatment. The positive effect of PEG application on increased germination percentage can be explained by the increased activity of key enzymes such as amylase and protease.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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