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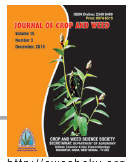

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Influence of different pre-sowing seed priming on plant growth, yield and yielding attributing traits of mustard (*Brassica juncea* L. Czern and Coss)

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ABSTRACT

The experiment was performed at the Department of Genetics and Plant Breeding, Field Experimentation Centre, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.)during rabi 2019 to standardize the suitable mustard-specific treatment for priming (variety Sangam). Eleven different pre-sowing seed priming alongwith control (unprimed) was examined by sampling for 12 hours. viz., T_0-Unprimed (Control), T_1-Distilled water (DH_2O), T_2–Potassium Nitrate (KNO_3) 0.5%, T_3–Potassium dihydrogen phosphate (KH_2PO_4) 0.5%, T_4- Polyethylene Glycol (PEG_{6000}) 5%, T_5–Coconut water2%,T_6-Panchgavya (2%), T_{7-} Manganese sulfate ($MnSO_4$)0.1%,T_{8-} Zinc sulfate ($ZnSo_4$)0.1%, T_9- Naphthaleneacetic acid (NAA) 50 ppm, T_{10}- Indole-3-butyric acid (IBA) 50 ppm, T_{11}- Wood apple leaf extract (5%) and T_{12}- Mint leaf extract (5%). It was found that all pre-sowing seed treatments showed significant differences with control and the highest percentage of field emergence, plant height, and attributes of yield and yield for PEG $_{6000}$ were observed. Pre-sowing seed treatment with PEG_{6000} and $MnSO_4$ showed maximum field emergence of mustard seeds and was found to be lowest in control seeds. Pre-sowing treatment (seed priming) that leads to a physiological condition allowing the seed to germinate more effectively and no costly equipment and chemical requirements could be used as a simple method for overcoming weak germination and seedling establishments and helps to preserve agriculture which is economical, non-toxic, eco-friendly.

Keywords: Mustard seeds (Sangam), pre-sowing seed treatments, growth, yield, PEG_{6000}

Mustard (*Brassica juncea* L.Czern and Coss) is an important oilseed crop belonging to the family cruciferce (Syn. Brassicaceae). The normal amphidiploids that have chromosome no (2n=36) are Indian mustard or brown mustard. It is self-pollinated, but due to insects and other factors, a certain amount (2-15 per cent) of pollination occurs. The place of origin of mustard is China; northeastern India from where it spread through Punjab to Afghanistan (Vaughan, 1997).

India is an oilseed crop paradise. In Indian agriculture, they play a key role.They are important in addition to food crops and inhabited a significant proportion (13 per cent) of the gross crop production of the country. The net value of all agricultural products (10 per cent) is also substantial. Oilseeds have a 5 per cent share with an annual turnover of Rs 60,000 crores in terms of their contribution to the gross national product (Hegde, 2002). As it has vast tracts of arable land and complex agro-climatic conditions, India has the largest number of commercial oilseed varieties. Castor, coco, groundnut, linseed, niger, rapeseed-mustard, safflower, sesame, soybean, and sunflower are the main oilseeds (Hegde, 2002).

Rapeseed-mustard group of crops occupies 22.4 per cent of the total cultivated area under oilseeds (27.2 MHA) and contributes 22.6 per cent to the total production of oilseeds (32.5 MT) in the country (Anonymous, 2011). India ranks second in the area after China and third in production after Canada and China, accounting for roughly 21.7 per cent of total area and 13.4 per cent of global rapeseed-mustard production (Kumar *et al.,*2012). India's current rapeseed-mustard productivity (1257 kg ha^{-1}) is, however, lower than the global average (1856 kg ha^{-1}).

The low oilseed productivity is due to the fact that most of the oilseeds are grown in marginal and rainfed areas.Inadequate soil moisture and low soil fertility status are the key constraints of increasing oilseed productivity levels in drylands. Crop hardening is offered as a pre-sowing treatment to address adverse environmental conditions such as low rainfall and low soil moisture that prevent the germination and establishment of seedlings. Short-term seed hydration before planting significantly helps the establishment of stands, but an additional advantage would be the use of chemicals such as potassium or sodium phosphate. Seed priming/ hardening is a common practice followed to enhance seed performance concerning the rate and uniformity of germination (Hossain *et al.,* 2005).

Pre-sowing seed treatments also initiate the production of essential bio-molecules, stimulate mitochondrial function, and maintain ultra-structures of

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cells that would enable plants to resist adverse conditions of edaphic-c1imate. It is believed that the results of some of these cellular improvements include a more xeromorphic structure with a higher photosynthesis rate, a lower respiration rate, a lower water deficit, the ability to maintain a higher amount of water, and a more effective root system with a higher root shoot ratio and less drought-related yield loss compared to non-hardened plants. Halo-priming was conducted with salt NaCl 5% solution, KCL 5% and $CaCl_2$ 1% solution concentration. Seeds were soaked at 25^0C for 14 hours in Petri plates. After dried at room temperature it was subjected to germination test done at 25^0C for 14 hrs. Four *Helianthus annuus* L. cultivars were evaluated for the results of NaCl priming with KNO_3 on seedling germination and growth. Cultivars under salinity conditions indicated that the percentage of germination of primed seeds was higher than that of unprimed seedsBajehbaj (2010).

For several crops, like cereal seeds, seed priming has been presented promising and produced even unexpected results (Bradford, 1986) in which organic priming with plant extract is used after that drying, such as Neem leaf extract, Curi leaf extract, Tulsi leaf extract for maize. A higher concentration of neem seed kernel this powder (10%w/w) was found effective for maize over a long period (Sharma, 1995).

In order to determine the effect of different priming treatments on the growth, yield and yield attributing characteristics of mustard, the present study was therefore scheduled.

The present experiment was carried out in Randomized Block Design with three replications during *rabi*, 2019 at Field Experimentation Centre, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). After cleaning and grading, the seeds of mustard, variety Sangam were treated with different priming treatments of Distilled water (DH_2O) [T_1], Potassium Nitrate (KNO_3) 0.5% [T_2], Potassium dihydrogen phosphate (KH_2PO_4) 0.5% [T_3], Polyethylene Glycol (PEG_{6000}) 5% [T_4], Coconut water 2% [T_5], Panchgavya (2%) [T_6], Manganese sulfate ($MnSO_4$)0.1% [T_7], Zinc sulfate ($ZnSo_4$)0.1% [T_8], Naphthalene acetic acid (NAA) 50 ppm [T_9], Indole-3-butyric acid (IBA) 50 ppm [T_{10}], Wood apple leaf extract (5%) [T_{11}] and Mint leaf extract (5%) [T_{12}] along with control for 12 hours. Field emergence (%), plant height (cm), number of branches plant^{-1}, number of siliquae plant^{-1}, number of seeds siliquae$^{-1,}$ seed yield plant^{--1} (g), seed yield plot^{-1} (g), biological yield plot^{-1} (g) and Harvest Index was observed.

According to the findings, the treatments had an effect on all of the morphological traits studied, and there was a statistically significant difference between control (non-primed seeds) and primed seeds for all the parameters (Table 1 and 2). The data presented in Table 2 shows the mean performance of 13 treatments for 9 growths, yield, and yielding attributes. The grand mean for all the traits is also depicted in Table 2.

Pre-sowing seed treatment with PEG_{6000} @ 5% recorded maximum field emergence (94.00%) followed by $MnSo_4$ @ 0.1% (93.00) and KNO_3 @ 0.5% (92.67) where lowest was found in control (82.67). The effect of pre-sowing seed priming on field emergence percentage was found to be significant and similar finding was observed by Kumar (2000) and Harri *et al.* (2010).

Maximum plant height (149.78 cm) was observed in pre-sowing seed treatment with PEG_{6000} @ 5% it was followed by $MnSO_4$ @ 0.1% (145.47 cm) and KNO_3 @ 0.5% (141.56 cm), unprimed was of lowest plant height (101.76 cm). The interaction effect of pre-sowing seed treatment on plant height was found to be significant and similar finding was observed by Sarma *et al.* (2014).

Number of branches plant^{-1} (5.80) was observed highest in pre-sowing seed treatment with PEG_{6000} @ 5% it was followed by $MnSO_4$ @ 0.1% (5.60), KNO_3 @ 0.5% (5.40) it was found to be lowest in control (3.20). The interaction effect of pre-sowing seed treatment on branches plant^{-1} was found to be significant and similar finding was observed by Rahmani *et al.* (2007).

Table 1 : Analysis of variance for 11growths and yield attributing traits of mustard.

S.No.	Characters	Mean sum of squares: Treatments (df=12)	Error (df=24)
1.	Field emergence percentage	47.45*	4.70
2.	Plant height (cm)	469.68*	2.38
3.	Number of branches plant^{-1}	2.01*	0.07
4.	Number of siliquae plant^{-1}	260.60*	86.62
5.	Number of seeds siliquae^{-1}	4.77*	3.45
6.	Seed yield plant^{-1}	0.86*	0.07
7.	Seed yield plot^{-1}	215.20*	23.12
8.	Biological yield	1066.24*	152.72
9.	Stover yield (q ha^{-1})	0.04*	0.01
10.	Harvest Index (%)	18.36*	1.10
11.	Oil yield	0.32*	0.02

** Significant at 5% level of significance.*

Number of siliquae plant^{-1} (59.20) was observed statistically superior in pre-sowing seed treatment with PEG_{6000} @ 5% followed by $MnSO_4$ @ 0.1% (50.40), KNO_3 @ 0.5% (49.70) where it was found to be lowest in control (24.00). The interaction effect of pre-sowing seed treatment on siliquae plant^{-1} was found to be significant and similar finding was observed by Omidi *et al.* (2005).

Table 2: Mean performance of mustard (variety Sangam) for growth, yield and yielding attributing characters

Treatments symbols	Field emergence percentage	Plant height (cm)	Number of branches Plant^{-1}	Number of siliquae Plant^{-1}	Number of seeds siliquae^{-1}	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (g)	Biological yield (g)	Stover yield (q ha^{-1})	Harvest index (%)
T_0	82.67	101.76	3.20	24.00	8.90	0.71	28.94	165.66	1.36	17.49
T_1	85.33	122.38	3.80	33.00	10.70	1.06	31.85	153.92	1.21	20.66
T_2	92.67	141.56	5.40	49.70	12.30	2.14	53.01	204.57	1.51	25.91
T_3	91.33	137.45	5.30	46.20	12.20	1.87	48.43	201.35	1.52	24.03
T_4	94.00	149.78	5.80	59.20	12.60	2.54	54.24	203.51	1.49	26.55
T_5	88.00	128.76	4.30	40.20	11.00	1.37	37.13	164.28	1.27	22.60
T_6	89.33	130.59	4.70	42.40	8.60	1.53	44.05	188.61	1.44	23.31
T_7	93.00	145.47	5.60	50.40	12.40	2.24	51.95	201.04	1.48	25.83
T_8	90.67	136.68	5.10	45.20	11.90	1.78	46.96	198.12	1.51	23.66
T_9	87.33	130.38	4.60	40.60	11.30	1.38	42.40	184.50	1.43	22.93
T_{10}	88.67	133.31	4.90	43.30	11.50	1.76	43.47	185.76	1.40	23.24
T_{11}	86.67	127.56	4.10	38.20	10.70	1.18	35.20	162.57	1.27	21.65
T_{12}	84.00	117.61	3.50	29.20	10.60	0.98	33.25	159.88	1.26	20.79
Grand Mean	**88.74**	**131.02**	**4.64**	**41.66**	**11.13**	**1.58**	**42.38**	**182.60**	**1.40**	**22.97**
LSD (0.05)	**3.65**	**2.60**	**0.46**	**15.68**	**3.13**	**0.43**	**8.10**	**20.83**	**0.14**	**1.77**
SEm (±)	**1.25**	**0.89**	**0.16**	**5.37**	**1.07**	**0.15**	**2.78**	**7.13**	**0.50**	**0.61**
SE(d)	**1.77**	**1.26**	**0.22**	**7.60**	**1.52**	**0.21**	**3.93**	**10.09**	**0.70**	**0.86**
C.V.	**2.44**	**1.18**	**5.83**	**22.34**	**16.70**	**16.31**	**11.35**	**6.77**	**6.02**	**4.57**

Legends: *T_0-Unprimed (Control), T_1-Distilled water (DH_2O), T_2–Potassium Nitrate (KNO_3) 0.5%, T_3–Potassium dihydrogen phosphate (KH_2PO_4) 0.5%, T_4-Polyethylene Glycol (PEG_{6000}); 5%, T_5–Coconut water2%,T_6- Panchgavya (2%), T_7- Manganese sulfate ($MnSO_4$)0.1%,T_8- Zinc sulfate ($ZnSo_4$)0.1%, T_9- Naphthalene acetic acid (NAA) 50 ppm, T_{10}- Indole-3-butyric acid (IBA) 50 ppm, T_{11}- Wood apple leaf extract (5%) and T_{12}- Mint leaf extract (5%).*

Maximum number of seeds siliquae^{-1} was observed in pre-sowing seed treatment with PEG_{6000} @ 5% (12.60) followed by $MnSO_4$ @ 0.1% (12.40) and KNO_3 @ 0.5% (12.30) where minimum was found in control (8.90). The interaction effect of pre-sowing seed treatment on seeds siliquae^{-1} was found to be significant and similar finding was observed by Shabbir *et al.* (2013).

Maximum seed yield plant^{-1} was observed in pre-sowing seed treatment with PEG_{6000} @ 5% (2.54g) followed by $MnSo_4$ @ 0.1% (2.24 g) and KNO_3 @0.5% (2.14 g) and unprimed was of lowest seed yield plant^{-1} (0.71 g). Seed yield plot^{-1} was found to be highest in pre-sowing seed treatment with PEG_{6000} @ 5% (54.24 g) followed by KNO_3 @ 0.5% (53.01 g) and lowest in control (28.94 g). The interaction effect of pre-sowing seed treatment on seed yield was found to be significant and similar finding was observed by Radhouane (2007) and Michel and Kaufman (1983).

Biological yield (204.57 g) was observed highest in pre-sowing seed treatment with KNO_3 @ 0.5%, it was followed by PEG_{6000} @ 5% (203.51 g) and KH_2PO_4 @ 0.5% (201.35 g) where it was found to be lowest in control (165.66 g). The interaction effect of pre-sowing seed treatment on biological yield was found to be significant and similar finding was observed by Afzal *et al.,* (2009) and Amjad *et al.* (2007).

Maximum harvest index (26.55%) was observed in pre-sowing seed treatment with PEG_{6000} @ 5% it was followed by KNO_3 @ 0.5% (25.91%) and $MnSo_4$ @ 0.1% (25.83%) unprimed was of lowest harvest index (17.49%). It was found that the interaction impact of pre-sowing seed treatment on harvest index was significant and similar to the findings observed by Asharf and Foolad (2005) and Basra *et al.* (2003).

It is concluded from the present study that the pre-sowing seed priming significantly enhances the emergence and yield traits of mustard seeds in field conditions. Pre-sowing seed treatment with Polyethylene $glycol_{6000}$ (5%) showed the suitable results followed by Manganese sulfate (0.1%), Potassium nitrate (0.5%), Potassium dihydrogen phosphate (0.5%), and Zinc sulfate (0.1%) in the comparison of control. Pre-sowing seed treatment with PEG_{6000} (5%) followed by KNO_3 (0.5%), $MnSO_4$ (0.1%), KH_2PO_4 (0.5%) and ZnSO4 (0.1%) significantly increased the yield and yielding attributes of mustard.

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