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Influence of Salinity on Morpho-Physiological Responses in Growth, Yield and Yield Attributing Traits on Mustard (*Brassica juncea* L.) cv:-Varuna (T-59)

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A B S T R A C T

The present experiment was conducted in field at Department of Genetics and Plant Breeding, Naini Agriculture Institute, SHUATS, UP. To investigate the "effect of Influence of salinity on morpho-physiological responses in growth, yield and yield attributing traits on mustard (*Brassica juncea* L.) CV: -Varuna (T-59)". Mustard seeds are treated with the different salts like NaCl, KCl, and MgCl2 with different concentration. They are NaCl treated with 150mM NaCl, 250mM NaCl, 350m MNaCl, 450mM NaCl and $MgCl_2$ treated with 10 mM $MgCl_2$, 20mM $MgCl_2$, 30 mM $MgCl_2$, 40 mM $MgCl_2$ and KCl treated with 3mM KCl, 5mM KCl, 7mM KCl, and 10mM KCl. Among all the salt treatment $MgCl_2$ performed best results in field parameters like field emergence, days to 50% flowering, plant height 30DAS, plant height 60DAS, plant height 90DAS, number of branches per plant, leaf area per plant, leaf area index, leaf dry weight, number of siliqua per plant, number of seeds per siliqua, seed yield per plant, seed yield per plot, test weight, biological yield, harvesting index. In $MgCl_2$- (10 mM $MgCl_2$ performed best results in field parameters). NaCl is followed by $MgCl_2$ and atlast KCl (according to the results performed in the field conditions.). The field performance results are decreasing while increasing the salts concentration. Therefore salts concentration is inversely proportional to the crop yield.

Introduction

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 average productivity of mustard in India is 1262kg/ha. (According to directorate of economics and statistics, department of agriculture and cooperation, 2012-2013).

Rapeseed and mustard is the third most important edible oil source in world after soybean and palm but it is the top ranking oilseed crop of that covers

50.74% of the total oilseed production. Out of 2.85 million hectares of the coastal and offshore landmass, about 0.83 m ha are affected by different degrees of salinity. Therefore, there was a great opportunity to adopt the salt tolerant rapeseed and mustard varieties in the coastal belt. (Islam *et al.,* 2001)

The oil content of the mustard seeds ranges from 35-48% and 37-42% protein in cake (according to NIIR, board; Verma *et al.,* (2018). Mustard oil play a very important role in human nutrition. Each gram of oil/fat supplies 9 kilocalories of energy (Alam *et al.,* 2014). The main essential fatty acids of vegetable oils are linoleic and linolenic acids. Fatsandoils are used to synthesis phospholipid, which are important components of active tissues viz., brain, nerve and liver of human beings.

Accumulation of salts 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. 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. Salinity has deleterious effects on growth and development of plants by inducing various biochemical and physiological changes (Munns and Tester, 2008). In Pakistan, nearly 10 million ha area is badly affected by salinity, i.e., 12.9 percent of country's land (Hussain *et al.,* 2013).

Rhoades *et al.,* (1992) reported a 14% reduction in yield with each increasing unit of salinity. The harmful implications of salinity arise presumably because of induction of osmotic stress, ionic imbalance and subsequent oxidative stress (Tester and Davenport, 2003). Furthermore, higher concentration of salts under saline conditions causes severe ion toxicity by depositing high concentration of Na^+, which inhibits cell division and expansion, lowers calcium and potassium contents, and causes membrane instability and increased respiration rate. Soil salinity affects the growth of plants by altering water relations as a result of salt accumulation in the intercellular spaces (Zhang *et al.,* 2006), injurious effects of toxic ions (Saboora and Kiarostami, 2006), osmotic stress (Almodares *et al.,* 2007) and reduced water-use efficiency (Grewal, 2010).

The growth and yield of the crop have been declining over the recent years due to increase in soil salinity. If salinity increased yield and germination, seed quality parameters decreased in mustard crop (Phour *et al.,* 2020). If the salinity decreased yield contributing traits, germination percentage, seedling growth parameters and seed vigour increased.

Materials and Methods

The field experiments was conducted during Rabi season 2019-2020. Department of Genetics and plant breeding, Naini Agriculture Institute SHUATS, Prayagraj, (UP). The statistical designs applied was carried out with Randomized Block Design (RBD) with 13 treatments and 3 replications. This seeds are treated with different salts are given below thirteen treatment.

T_0 = Control, T_1=150 mM NaCl, T_2 = 250 mM NaCl, T_3 =350 mM NaCl, T_4 =450 mM NaCl, T_5 =10 mM $MgCl_2$, T_6 =20 mM $MgCl_2$, T_7 =30 mMMg Cl2m, T_8 =40 mMMg Cl2, T_9 =3 mM KCl, T10 = 5mM KCl, T11= 7 mM KCl, T12= 10 mM KCl,

NaCl Treatment

Units-1molar=1000 milliMolar

NaCl molar weight=58.44 g/mol

In first treatment the seeds are treated with 150mMNaCl for 12hours. For preparing 150mMNaCl we have required 8.766gm NaCl/lit water to prepare 150mM NaCl solution.

In the same way in the second, third, fourth treatment we have taken 250mM, 350 mM, 450 mM of NaCl for 12 hours respectively that means for taking of 250 mM, 350 mM, 450 mM of NaCl we

required 14.61gm of NaCl/lit water,20.454 gm of NaCl/lit water, 26.298 gm of NaCl /lit water is required respectively.

MgCl2 molar weight=95.21gm/lit solution

In fifth treatment the seeds are treated with 10mM MgCl2 for 12hours. For preparing 10mM MgCl2 we have required 0.95gm MgCl2/lit water to prepare 10mM MgCl2 solution. In the same way in the sixth, seventh, eighth treatment we have taken 20 mM, 30 mM, 40 mM of MgCl2 for 12 hours respectively that means for taking of 20 mM,30 mM,40 mM of MgCl2 we required 1.90gm of MgCl2/lit water, 2.85 gm of MgCl2/lit water, 3.808 gm of MgCl2 /lit water is required respectively.

KCl molar weight =74.55gm/lit solution

In nineth treatment the seeds are treated with 3mM KCl for 12hours. For preparing 3mM KCl we have required 0.22gm KCl/lit water to prepare 3mM KCl solution. In the same way in the tenth, eleventh, twelveth treatment we have taken 5 mM, 7 mM, 10 mM of KCl for 12 hours respectively that means for taking of 5 mM, 7 mM, 10 mM of KCl we required 0.37 gm of KCl/lit water,0.52 gm of KCl/lit water,0.75 gm of KCl/lit water is required respectively.

Results and Discussion

The result shown in this table indicate the parameters i.e., field emergence (%),days to 50% flowering, plant height 30, 60, 90 DAS, number of branches per plant, leaf area per plant, leaf area index, leaf dry weight, number of silique per plant, number of seeds per silique, seed yield per plot, test weight, biological yield, harvesting index. In this experiment the best performed seed treatment is T5-MgCl2-10 mM for 12 hours when compared to other treatments and control, followed by T6-MgCl2-20 mM for 12 hours.MgCl2 treated plant got best results followed by NaCl treated seeds and atlast KCl treated seeds. Rajabi *et al.,* (2020) conducted an experiment of seed salinity treatment with sorghum cultivars for yield and yield contributing traits. They used five different salinity source10 mM $MgCl_2$. They were statistically analysed these data and 10 mM $MgCl_2$ seed salinity contributed earliness flowering. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Takahama *et al.,* 2019 conducted an experiment of seed salinity treatment with leaf vegetables cultivars for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum plant height. Their results were similar to our study of 10 mM $MgCl_2$ treatment for mustard seeds. Rouphael *et al.,* (2018) conducted an experiment of seed salinity treatment with vegetable crops for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum leaf area. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Shahidi *et al.,* (2018) conducted an experiment of seed salinity treatment with vegetable crops for yield and yield contributing traits.

They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum leaf area index. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Farhadi-Machekposhti *et al.,* (2017) conducted an experiment of seed salinity treatment with sunflower for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum leaf dry weight. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Wu *et al.,* (2016) conducted an experiment of seed salinity treatment with quinona for yield and yield contributing traits. They were statistically analyzed these data and 10 mM $MgCl_2$ contributed maximum number of siliqua per plant. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Parihar *et al.,* (2015) conducted an experiment of seed salinity treatment with mustard for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum number of seeds per siliqua.

Table.1 Mean performance of Field parameters on mustard

S.No	Treatments	Field emergence (%)	Days to 50% flowering	Plant height at 30 DAS	Plant height at 60 DAS	Plant height at 90 DAS	No. of branches per plant	Leaf area (cm^2)	Leaf area index	Leaf dry weight (g)	No. of siliquae per plant	No. of seeds per siliquae	Seed yield per plant (g)	Seed yield per plot (g)	Test Weight (g)	Biological yield (Kg/ha)	Harvest Index (%)
01	T_0	73.00	59.11	25.01	110.02	140.23	5.23	270.26	0.90	0.79	156.04	10.23	18.76	656.60	4.09	90.24	18.96
02	T_1	86.00	52.34	28.11	129.60	159.81	7.78	320.25	1.05	1.01	173.65	12.75	22.98	804.30	5.84	104.25	22.04
03	T_2	85.00	54.67	27.63	124.65	154.86	7.21	311.24	1.04	0.96	171.65	12.49	21.63	757.05	5.14	104.11	20.78
04	T_3	84.00	54.89	27.34	120.02	150.23	6.98	309.56	1.03	0.94	170.26	12.46	21.29	745.15	5.02	103.10	20.65
05	T_4	82.00	55.23	27.14	119.02	149.23	6.78	304.11	1.01	0.92	168.94	12.28	20.12	704.20	5.01	99.26	20.27
06	T_5	**91.00**	**47.60**	**30.21**	**144.14**	**174.35**	**8.61**	**358.26**	**1.19**	**1.12**	**189.56**	**14.25**	**26.24**	**918.40**	**6.68**	**105.66**	**24.83**
07	T_6	90.00	48.63	29.86	142.15	172.36	8.24	333.65	1.11	1.07	186.23	14.11	24.36	852.60	6.23	103.26	23.59
08	T_7	89.00	49.64	29.41	134.02	164.23	8.21	330.14	1.08	1.04	180.25	13.86	23.53	823.55	6.01	102.24	23.01
09	T_8	87.00	50.23	28.14	138.41	168.62	8.09	328.21	1.06	1.02	182.37	13.78	23.01	805.35	5.98	101.36	22.70
10	T_9	81.00	56.12	26.46	118.53	148.74	6.55	295.26	0.98	0.91	165.73	12.11	19.65	687.75	4.93	98.65	20.06
11	T_{10}	79.00	57.62	26.14	116.08	146.29	6.23	288.63	0.94	0.88	163.27	11.65	19.44	680.40	4.86	96.21	19.56
12	T_{11}	78.00	57.98	25.31	114.35	144.56	6.48	281.36	0.96	0.84	162.89	11.64	19.29	675.15	4.56	97.48	19.23
13	T_{12}	75.00	58.61	25.25	122.90	153.11	6.45	278.63	0.93	0.81	160.91	11.19	19.21	672.35	4.23	95.66	19.06
Grand Mean		83.08	54.05	27.39	125.6	155.89	7.14	308.43	1.02	0.95	171.67	12.52	21.50	752.53	5.28	100.11	21.13
F test		**S**	**S**	**S**	**S**	**S**	**S**	**S**	s	**S**	**S**	**S**	**S**	S	**S**	**S**	**S**
SE(d)		0.43	0.60	1.12	1.24	1.34	1.23	1.32	0.01	0.61	4.68	2.31	0.24	2.52	0.29	3.11	1.01
CD at 5%		0.74	3.03	3.26	2.64	3.93	3.01	3.86	0.02	0.98	7.32	4.98	0.71	7.35	0.85	9.07	2.91
C.V,		2.56	1.19	2.10	2.86	2.98	2.65	1.76	8.09	5.21	13.00	16.68	8.61	15.73	1.70	3.46	2.40

Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Sehrawa *et al.,* (2015) conducted an experiment of seed salinity treatment with mung bean for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum seed yield per plant. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Dhingra *et al.,* (2014) conducted an experiment of seed salinity treatment with cluster bean for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum seed yield per plot.

Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Tabatabaei *et al.,* (2014) conducted an experiment of seed salinity treatment with sesame for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum biological yield. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds. Tsegay *et al.,* (2014) conducted an experiment of seed salinity treatment with pea for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum harvest index.

Their results were similar to our study of 10mM $MgCl_2$ seed salinity treatment for mustard seeds. Ambika *et al.,* (2014) conducted an experiment of seed salinity treatment with wild oat for yield and yield contributing traits. They were statistically analysed these data and 10 mM $MgCl_2$ contributed maximum1000 seed weight. Their results were similar to our study of 10 mM $MgCl_2$ seed salinity treatment for mustard seeds.

The present study concluded that MgCl2 treated mustard seeds has given best results compared to NaCl, KCl. Among various seed treatments T5-MgCl2 10mM for 12 hours performed the best results. It is followed by T6-MgCl2 20Mm for 12 hours. The present study showed that MgCl2 is best and followed by NaCl and atlast KCl. This experiment gives conclusion that concentration of salts increases the yield of crop decreases.MgCl2 at 10mM gives high field emergence, plant height, number of branches, seed yield, biological yeild etc.

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