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Impact of Salinity Stress on Seed Quality Parameters and its Mitigation through Seed Quality Enhancement in Blackgram Seeds (*Vigna mungo* L.)

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ABSTRACT: The Purpose of this study was to determine the impact of salinity stress on seed quality parameters and its mitigation through seed quality enhancement in blackgram seeds (*Vigna mungo* L.). The lab experiment was conducted during 2020-2021 in seed testing laboratory Department of Genetics and Plant Breeding, NAI, SHUATS, Prayagraj, Uttar Pradesh. Salinity stress on blackgram seeds on enhancement of seed quality parameters. The were given a treatment Panchagaya (3% and 6%), Bejamrita (25% and 50%), Coconut water (8% and 10%), KNO_3 (3grm and 6gm) in seed quality parameters under the various Salinity Stress condition of with three levels S_0, S_1 and S_2 (0 mM, 100 mM, 150mM) with Shaker –II variety of Blackgram. The result revealed that treatments recorded significant variation with the untreated control. The treatment combination T_8S_0 of 6gm KNO_3 for 12 hours at 0 mM NaCl performed well with seedling. Germination of Percentage 95.50%, Shoot length as 10.025 cm as follows as Root length 12.788 cm, Seedling length 22.803 cm, Shoot-Root ratio 0.684, Fresh weight 2.600 g, Dry weight 0.425 g, Seedling Vigour index –I 2,281.982, Seedling Vigour index–II 40.675, showed these supremacy on increased activity which protect the plant under salinity condition.

Keywords: *Black gram, Organic priming, Inorganic priming, Salinity Stress.*

INTRODUCTION

Black gram (*Vigna mungo* L.) belonging to leguminoseae family, with chromosomal number 2n=2x=22 and is an essential nutritious pulse crop with a special place in Indian agriculture. Self-pollinated (Autogamy), *Vigna mungo* probably originated in South Asia. In India, Blackgram is commercially produced in Maharashtra, Andhra Pradesh, U.P., Madhya Pradesh, Tamilnadu, Rajasthan, Gujarat, Karnataka, Jharkhand and West Bengal. Urd bean residues contain about 10-11% moisture, 24% protein, 1.4-1.6% fat, 3.2% minerals, 16% dietary fibers, 59.69-63.0% carbohydrates, 154mg/100g calcium, 385mg/100g phosphorus, 9.1mg/100g iron, 347k.cal/100g calorific value, it has the highest concentration of phosphoric acid among pulses (5-6%). (Source: DPD, Govt. of India, pulses in India: Ritrospect and prospects, 2018). Seed priming is a pre-sowing method for affecting seed development by alternating pre-germination metabolic activity prior to radicle emergence, which improves fast, uniform emergence and plant performance high vigour and better yields (Mc Donald, 2000).

It's also a natural disinfectant and pest repellent, and it's one of the main elements of Panchagavya (an organic crop booster prepared and sprayed by Indian farmers) (Tharmaraj *et al.,* 2011). It is used as a foliar spray, soil application along with irrigation, as well as seed treatment (Natarajan, 2002). Bejamrita is a naturally available preservative based on seed treatment that protects the crop against damaging soil and seed borne diseases during the early stages of germination and establishment .In India, using bijamritha is a common practice. Organic manures are formed to contain necessary nutrient in previous experiments, resulting in enhanced crop growth and production (Vyankatrao, 2017). In that mostly coconut water, are used for seed priming. These plants contain compounds that cause pre-germinative phenomena, reducing germination time and enhancing seedling vigour. Low amounts of KNO_3 have been shown in previous research to help mitigate the negative effects of NaCl on seed germination in some grass species (Neid and Biesboer 2005). Because K+ is involved in a variety of plant activations. The K+/Na+ ratio has been suggested as useful biomarker for Wheat salinity tolerance, (Zheng *et al.,* 2008).

Salinity can affect germination by producing an osmotic potential that inhibits water absorption or by the harmful effects of ions on embryo survival (Houle *et al.,* 2001). Salts absorb and hold water to the point that is no longer readily accessible in the soil, resulting in a rise in the osmotic pressure of the soil solution. Salt stress can result in considerable decreases in germination rate and final germination percentage, which can lead to uneven stand establishment and lower yield.

Salt stress hampered the agricultural productivity by lowering yield of various crops in arid and semi-arid region of the world. Salt stress greatly influenced the germination of blackgram seed. The germination rate determines the crop productivity by optimizing the germination factor.

MATERIAL AND METHODS

The current research was conducted during the year 2020-2021 at Department of Genetics and Plant Breeding, NAI, SHUATS (Uttar Pradesh). The lab experiment was evaluated using CRD (Completely Randomized Design) three salinity levels goes through laboratory conditions. Seeds treated with T_0-Control, T_1-Panchagavya (3%), T_2- Panchagavya (6%), T_3-Bijamrita (25%), T_4- Bijamrita (50%), T_5- Coconut water (8%), T_6- Coconut water (10%), T_7- KNO_3 (3g) and T_8- KNO_3 (6g) 12 hours of soaking after that, primed seeds were allowed to dry to their original moisture content in the shade to evalveture the parameters at three different salt levels: 0 mM, 100mM and 150 mM of NaCl. Germination percentage, Shoot length, Root length, Seedling length, Shoot-root ratio, Seedling fresh weight, Seedling dry weight, Seedling Vigour Index- I and seedling vigour index – II are some of the seed quality characteristics.

Table 1: Analysis of variance for different seedling growth parameters in blackgram under salinity stress.

Sr. No.	Characters	Mean sum of square			
		Salinity stress (df=2)	Treatments (df=8)	Interactions (df=16)	Error (df=81)
1.	Germination %	6,388.731*	129.475*	24.836*	1.284
2.	Shoot length	231.122*	5.384*	2.622*	0.979
3.	Root length	863.941*	3.741*	1.680*	0.883
4.	Seedling length	1,957.355*	17.103*	4.193*	1.763
5.	Shoot-Root ratio	10.609*	0.808*	0.923*	0.352
6.	Seedling fresh weight	18.405*	0.764*	0.046*	0.021
7.	Seedling dry weight	0.532*	0.059*	0.010*	0.005
8.	Vigour index – I	20,631,521.604*	256,154.669*	30,000.586*	16,845.577
9.	Vigour index – II	5,575.030*	553.407*	90.657*	43.114

* Significant at 5% level of significance.

Methodology:

Germination%: At the end of 7th day of sowing, the no. of normal seedling in each replication was conducted and the germination was calculated and expressed in percentage.

$$\text{Germination (\%)} = \frac{\text{No. of seeds germinated}}{\text{No. of seeds put for germination}} \times 100$$

Shoot (Plumule) length (cm): On the seventh day after the germination test, ten normal seedlings will be chosen at random from each replication in each salinity level and treatment. From the tip of the main leafs to the base of the hypocotyl, the length of the shoot will be measured.

Root length (cm): The root length will be measured using the same 10 seedlings that were used to measure the shoot length. The length of the root from the tip of the primary root to the base of the hypocotyl.

Seeding length (cm): The sum of shoot and root length will be considered as seedling length.

Shoot-Root ratio: On the seventh day after germination, ten normal seedlings will be randomly picked from each replication in each salinity level, and each treatments ratio of shoot length to root length will be assessed separately.

Seedling Fresh Weight (g): For recording seedling fresh weight are weighed with help of electronic balance.

Seedling Dry Weight (g): Seedlings are dried for 24 hours in an 800°F hot air oven to record their dry weight.

Seedling Vigour Index-I: germination Percentage × Total seedling length as cm.

Seedling Vigour Index- II: germination Percentage × seedling dry weight as g.

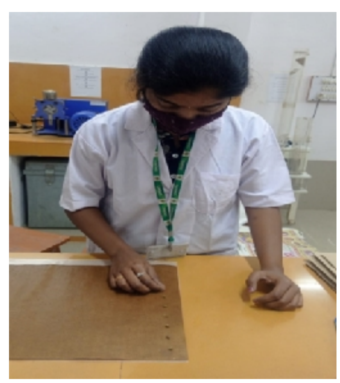


Fig. 1. Placing the seeds for Germination using between paper method.

Fig. 2. Keeping for germination in germination room.

RESULT AND DISCUSSION

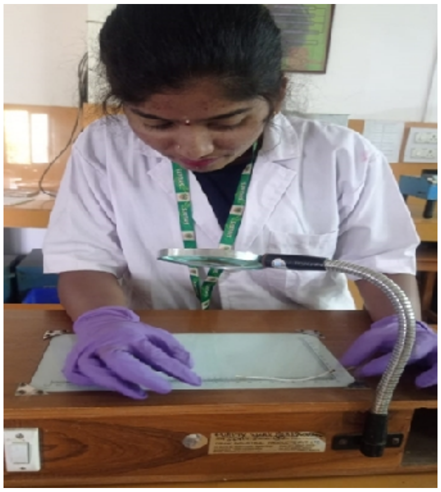
According to the findings, all of the studied traits where affected by the treatments and salinity stress and all seed quality parameters, such as germination percentage, shoot length, root length, seedling length, shoot-root ratio, seedling fresh weight, seedling dry weight, seedling vigour index-I and seedling vigour index-II showed a completely significant difference between control and primed seeds.

In Table 2, the data penetrating that significantly higher germination % in (S_0-95.50), (S_1-94.00), (S_2-77.00) reported in T_8 6g of KNO_3 followed by T_7 3g of KNO_3 (S_0-95.00, (S_1-93.25), (S_2-75.25) Kaya *et al.*, (2006) reported by positive effects of hydro priming & priming along with KNO_3. Bocian and Holubowicz (2008) were also reported that priming with KNO_3 enhanced seed germination of tomato.

Table 2: Comparison between overall mean of different treatments under different salinity levels in urd bean.

Sr. No.	Treatments	Salinity levels	Germination %	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Shoot-Root Ratio	Seedling Fresh Weight (g)	Seedling Dry Weight (g)	Vigour Index – I	Vigour Index - II
1.	**T_0**	S_0	89.500	8.452	12.210	20.663	1.039	1.875	0.200	1,849.450	17.925
		S_1	88.250	6.143	5.353	11.495	1.828	0.990	0.098	1,014.113	8.608
		S_2	60.250	4.070	1.200	5.270	3.137	0.555	0.055	317.845	3.318
2.	**T_1**	S_0	91.250	9.430	12.753	22.183	0.746	1.950	0.250	2,024.550	22.875
		S_1	89.500	6.273	4.375	10.648	1.464	1.020	0.100	953.388	8.950
		S_2	61.250	4.550	1.688	6.238	2.658	0.630	0.068	382.920	4.138
3.	**T_2**	S_0	92.250	8.215	12.093	20.308	0.952	2.000	0.300	1,872.725	27.725
		S_1	90.500	5.685	4.588	10.273	1.311	1.200	0.150	930.983	13.600
		S_2	64.000	4.358	2.275	6.633	1.914	0.723	0.073	424.923	4.643
4.	**T_3**	S_0	93.000	9.465	11.255	20.720	1.089	2.175	0.325	1,925.960	30.300
		S_1	90.750	7.168	5.700	12.868	1.263	1.200	0.175	1,167.900	15.925
		S_2	69.250	3.735	2.068	5.803	1.843	0.820	0.075	403.355	5.198
5.	**T_4**	S_0	94.000	9.921	11.420	21.341	0.884	2.350	0.325	2,005.877	30.675
		S_1	91.250	7.215	4.623	11.838	1.705	1.325	0.200	1,081.015	18.300
		S_2	70.750	3.563	2.605	6.168	1.420	0.893	0.085	436.193	6.015
6.	**T_5**	S_0	94.250	9.445	11.970	21.415	0.788	2.400	0.350	2,018.022	33.000
		S_1	92.000	7.453	5.675	13.128	1.324	1.550	0.275	1,207.935	25.325
		S_2	72.250	4.173	1.875	6.048	2.731	0.915	0.090	437.350	6.510
7.	**T_6**	S_0	94.750	9.435	10.143	19.578	0.937	2.425	0.375	1,856.450	35.575
		S_1	92.750	7.505	5.058	12.563	1.158	1.675	0.350	1,165.845	32.500
		S_2	73.750	1.820	1.950	3.770	1.293	0.943	0.093	277.690	6.830
8.	**T_7**	S_0	95.000	9.475	12.168	21.643	0.780	2.500	0.400	2,056.035	38.050
		S_1	93.250	7.743	5.508	13.250	0.938	1.800	0.375	1,235.500	35.000
		S_2	75.250	5.617	3.250	8.868	1.526	0.975	0.095	743.135	7.153
9.	**T_8**	**S_0**	**95.500**	**10.025**	**12.788**	**22.803**	**0.684**	**2.600**	**0.425**	**2,281.982**	**40.675**
		S_1	**94.000**	**7.925**	**6.558**	**14.483**	**0.716**	**1.950**	**0.400**	**1,361.153**	**37.675**
		S_2	**77.000**	**6.430**	**3.725**	**10.155**	**0.731**	**1.023**	**0.150**	**888.475**	**11.650**
	Grand Mean		84.648	6.863	6.476	13.339	1.378	1.499	0.217	1,197.07	19.561
	SE (d)	(S)	0.267	0.233	0.221	0.313	0.140	0.034	0.016	30.592	1.548
		(T)	0.463	0.404	0.384	0.542	0.242	0.059	0.028	52.987	2.681
	SE (M)	(S)	0.189	0.165	0.157	0.221	0.099	0.024	0.011	21.632	1.094
		(T)	0.327	0.286	0.271	0.383	0.171	0.042	0.020	37.467	1.895
	CD @5%	(S)	0.532	0.465	0.442	0.624	0.279	0.068	0.032	60.982	3.085
		(T)	0.922	0.805	0.765	1.080	0.483	0.117	0.056	105.624	5.344

The germination % of primed with KNO_3 were more than unprimed seeds by Afkari (2010). Significantly higher shoot length were recorded in T_8 6g of KNO_3 (S_0-10.02), (S_1-7.92) and (S_2-6.43) followed by T_7 3g of KNO_3 (S_0-9.47), (S_1-7.74) and (S_2-5.61). Farooq *et al.*, (2015) reported that reduction in shoot length might be caused by a reduced number of elongated cells and the reduced right of cell elongation and this happen due to lower transport rate of essential ions like NO_3- due to salinity that reduce the N compounds and increased Na+ in plant under high salinity (Hamid *et al.,* 2008). Significantly higher radicle length in T_8 6g of KNO_3 (S_0-12.78), (S_1-6.58) and (S_2-3.72) followed by T_7 3g of KNO_3 (S_0-12.16), (S_1-5.50) and (S_2-3.25) Kaya *et al.*, 2006 found that the difference in radicle length between priming treatments at the salinity levels of 4 and 8 dsm i.e., primed seeds showed a significant superiority over unprimed once.



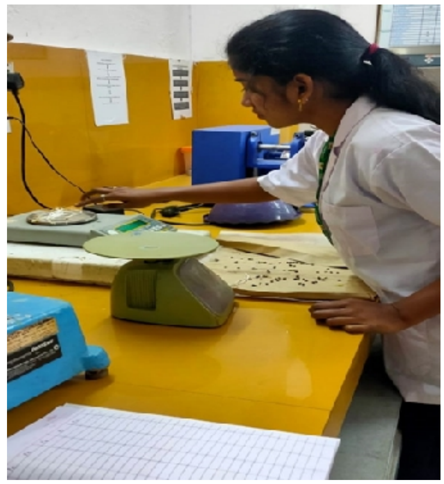


Fig. 3. (A). Recording the Seedling length using Purity work boa. **(B).** Recording fresh weight of the seedling on the day final count.

Significantly highest shoot-ratio in T_0 control (S_0-1.03), (S_1-1.82) and (S_2-3.13) followed by (S_0-0.68), (S_1-0.71) and (S_2-0.73) due to the application of saline water by Reddy *et al.,* (2013), the shoot and root length of blackgram progressively decreased. Significantly higher fresh weight were recorded T_8 6g of KNO_3 (S_0-2.60), (S_1-1.95) and (S_2-1.02) followed by T_7 3g of KNO_3 (S_0-2.50), (S_1-1.80) and (S_2-0.97) Aloui *et al.*, *(*2014), hypothesised that the decreases in seedling fresh weight was related to a decrease in seedling water absorption for a lowering osmotic potential under salinity condition. Significantly higher dry weight of seedling were recorded in T_8- 6g of KNO_3 (S_0- 0.42), (S_1-0.40), (S_2-0.15) followed by T_7 3g of KNO_3 (S_0-0.40), (S_1-0.37), (S_2-0.09) Islam *et al.,* (2011) were revealed that the in comparison to the control, stem dry weight dropped as salt increased. Seedling vigour index-I was much greater reported in T_8 6g of KNO_3 (S_0-2, 281.98), (S_1-1361.15), (S_2-888.47) followed by T_7 3g KNO_3 (S_0-2056.03), (S_1-1235.50), (S_2-743.13). According to Cokkizgin, 2012, the seedling vigour index raise as the NaCl content decreased, indicating that higher NaCl concentrations damage seedling. Khajeh-Hosseini *et al.*, (2003), in soybean, Saroj and Soumana (2014), in *Vigna* Spp. Found similar trends. Significantly higher seedling vigour index – II were recorded in T_8 6g of KNO_3 (S_0-40.67), (S_1-37.67), (S_2-11.65) followed by T_7 3g KNO_3 (S_0-38.05), (S_1-35.00), (S_2-7.15) Hassan *et al.,* (2016) in wheat the cellular toxicity of NaCl in seedlings and reduction of chlorophyll content under saline condition which may also effects the seedling vigour index–II.

A. Germinated Seedlings under S_o (Control)

B. Germinated Seedlings under S_1 (Salinity stress of 100mM NaCl),

C. Germinated Seedlings under S_2 (Salinity stress of 150mM NaCl).

CONCLUSION

From the present investigation it is concluded that the seed treatment enhanced all the seed quality parameters under salinity stress in blackgram seeds when compared to control. It was also revealed that seed treatment with 6g of KNO_3 is easy and effective approach to enhance the seed quality parameters under salinity stress.

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FUTURE SCOPE

The further investigation needs to conduct for the field trial in the research farm using salt effected soils in the different region of the country as the balckgram variety used in this study Shekhar-II which is widely recommended in the different states in the India.

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