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Effect of seed hardening treatment and foliar application on yield parameter of black gram [*Vigna mungo* L.]

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Abstract
A Field experiment was conducted during the *kharif* season of 2017 at the main research field of department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Science, Allahabad U.P. (India) A study was conducted on Effect of seed hardening treatment and foliar application on yield parameter of black gram [*Vigna mungo* (L.)] (MASH-338) during Kharif 2017. An attempt was made to identify a suitable and effective chemical for seed hardening and foliar improving the seed yield and quality. The chemicals and botanical treatment used for seed hardening and foliar application were T_0 (Control), T_1 (2% KNo3), T_2 (2% KCl), T_3 (2% CaCl2), T_4 (2% KH2Po4), T_5 (5% Gulmohar (Delonixelata) leaf extract), T_6 (5% Curry leaf (Murrya koenigii) leaf extract), T_7 (5% Papaya (Carica papaya) leaf extract), T_8 (5% Neem (Azadirachta indica) leaf extract). Seed hardening with T_2 (2% KCl) improved the seed quality and yield parameters, compared to control. Seed hardening with T_2 (2% KCl) and foliar application improved the seed yield and quality parameters, compared to control.

Keywords: Black gram, seed hardening, foliar application, yield parameter, seed germination, vigour index

Introduction
Pulses are the most important legume crop in India because of their high quality protein Black Gram (*Vigna mungo* L. Hepper) popularly known as urd bean or mash, is a grain legume domesticated from V. Mungo var. Silvestre's it belongs to the family Leguminosae with chromosome number 2n = 22 black gram is reported to be originated in India. In India alone, it occupies about 3.27 million hectare and annual production of urdbean in India is about 1.86 million tones. Urd is highly prized pulse and cultivated under a wide range of predominantly rainfed farming system in dry and intermediate agro ecological zones on marginal lands with low moisture and fertility conditions. Besides it is a important protein source for people in the cereal-based society because it is rich in phosphoric acid among pulses, rich in source of vegetable protein (20-25%) with some essential minerals and vitamins for the human body.

Hardening with chemical treatments is one of the methods of pre-sowing treatment to the seeds, which results in modifying the physiological and bio-chemical nature of seed so as to get the character that favours drought resistance. It induces early germination, better root and seedling growth, reduces seedling mortality, increases crop population and thereby enhances the yield potential of the crop varieties.

Hardening with botanical treatment is an affordable and effective way to optimize early growth and yield potential. It is also one of the lowest financial investments through which a grower can make to maximize productivity and improve the bottom line.

Pulses are most susceptible for imbibitional injury due to the delicate seed coat character, which is the genetic hindrances in seed management practices through hardening. The low productivity in pulses is due to the reason that pulses are grown mostly in marginal and rainfed areas and the main constraint in raising the productivity of pulses in dry lands are the inadequate soil moisture and poor fertility status of the soil. Seed hardening imparts drought tolerance, increases seed germination followed by better and quicker seedlings emergence. Seed priming/hardening is a common practices followed to enhances seed performance with respect to rate and uniformity of germination.

When availability of moisture becomes scarce, application of fertilizers through foliar spray resulted in efficient absorption.

Though foliar spray is not a substitute to soil application but it Certainly be considered as a supplement to soil application and availability of soluble fertilizers make the task easy. Applications of nutrient elements through foliar spray at appropriate stages of growth become important for their efficient utilization and better performance of the crop as a balanced fertilization with nutrients in plant nutrition is very important in the production of high yield with high quality seeds. Foliar application of nutrient and growth regulator at pre-flowering and flowering stage was seen on reduction in flower drop percentage in black gram. It has been well established that the fertilizer elements which are absorbed through roots can also be absorbed with equal efficiency through foliage. The extracts obtained from some crop and tree residues have been reported to play roles in crop growth and yield. Hence, a study was undertaken in black gram vari. MASH-338 with the objective to evaluate the effect of hardening treatment and foliar application on yield parameter.

Material and Method

The present investigations were conducted during the kharif season of 2017 at the main research field of department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Science, Allahabad U.P. (India) to study the effect of seed hardening treatment and foliar application on yield parameter of black gram. Freshly harvested bulk seeds of black gram var. Mash-338 were utilized in this study. The experiment consists of treatments viz., T0 (Control), T1 (2% KNo3), T2 (2% KCl), T3 (2% CaCl2), T4 (2% KH2Po4), T5 (5% Gulmohar (Delonix elata) leaf extract), T6 (5% Curry leaf (Murrya koenigii) leaf extract), T7 (5% Papaya (Carica papaya) leaf extract), T8 (5% Neem (Azadirachta indica) leaf extract).

Pre conditioned seed were soaked for 4 hours in chemical treatment 2% and leaf extract 5% at 1/3 volume of seed. Soaked seeds were dried in shade for 6 hours. Then the following foliar spray treatment given during flowering time adopting randomized block design (RBD) with three replications. The plot size was 1×1 m2 and crop was raised with the spacing of 30×10 cm.

Observation on seed yield and growth parameters viz. Plant height (cm), Number of branches per plant, Number of leaves per plant, Days to 50 per cent flowering, Number of pods per plant, Pod weight per plant(g), Number of seeds per pod, Number of seeds per plant, Seed yield per plant (g), Test weight (g) were recorded.

After harvest standard germination tests for seeds obtained from control and treated plots were carried out between two layers of moist filter paper according to international seed testing association rules to evaluate treatment effect on seed germination capacity. The working sample, consisting of 400 pure seeds from each treatment, were counted using an electronic seed counter and tested in a completely randomized design (CRD) in four replicates of 100 seeds.

Observations on seed quality parameter viz., Germination (%) ISTA, 2011, Root length (cm), Shoot length (cm), Seedling length (cm), Seedling fresh weight (mg), Seedling dry weight (mg), Vigour Index I (SVI), Vigour Index II (SVI), were recorded. The data were statistically analysed using ANOVA.

Results and Discussion

The present investigation entitled “Effect of seed hardening treatment and foliar application on yield parameter of black gram]” Mash-338 was carried out during kharif 2017 at the field experimentation center, Department of Genetics and Plant Breeding, Sam Higginbottom university of Agriculture, Technology and sciences, Allahabad (U.P). Seed hardening brought about significant improvement in different yield attributes. Increase in this parameter could be ascribed to the improvement in plant growth, vigour and production of sufficient photosynthesis during later part of growth period due to seed hardening application.

Data was recorded for growth parameters in the field showed significant differences among different treatments for growth parameters. Days to 50% flowering ranged from 40.33 to 52.00 with mean value of 49.11. T0 control recorded high value days to 50% (52.00). Present investigation shows that treatment T2 (2% KCl) exhibited lowest mean value for days to 50% flowering (40.33). Similar findings were reported by in black gram. Plant height ranged from 51.80 cm to 62.60 cm with a grand mean of 57.33 cm. significantly highest plant height (62.60 cm) was observed in treatment T2 (2% KCl). Whereas minimum plant height was found in treatment T0 (Control). The increase in plant height might be due to stimulation of cell elongation, cell division and enlargement as reported by These findings are in accordance with the results reported by No. of branches per plant ranges from 2.67 to 4.07 with a grand mean of 3.41. Significantly highest no of branches per plant (4.07) was observed in treatment T2 (2% KCl) and treatment T3 (2% CaCl2) was found to be at par with treatment T2 (2% KCl) whereas minimum No. of branches per plant (2.67) was found in treatment T0 (Control). Similar findings were reported by in black gram.

Number of leaves per plant ranges from 19.00 to 28.67 with a grand mean of 23.83. Significantly highest no of Number of leaves per plant (28.67) was observed in treatment T2 (2% KCl). Whereas minimum No. of branches per plant (19.00) was found in treatment T0 (Control).

Higher number of leaves was recorded with seed hardening with KCl due to increase in cell division, cell enlargement as well as induce more extensive and denser network of veins and ribs. These results are conformity with the findings of in chick pea and in rice.

Data was recorded for yield parameters in the field showed significant differences among different treatments for yield parameters. Number of pods per plant ranges from 19.53 to 28.80 with a grand mean of 24.70. Significantly highest Number of pods per plant (28.80) was observed in treatment T2 (2% KCl). Whereas minimum Number of pods per plant (19.53) was found in treatment T0 (Control). Similar findings were reported by Kumar (2018) in black gram.

Pod weight per plant ranges from 10.74 to 15.84 with a grand mean of 13.58. Significantly highest Pod weight per plant (15.84) was observed in treatment T2 (2% KCl). Whereas minimum Pod weight per plant (10.74) was found in treatment T0 (Control). Similar findings were reported by Lakshmi (2017) in black gram. Number of seeds per pod ranges from 5.05 to 7.49 with a grand mean of 6.23. Significantly highest Number of seeds per pod (7.49) was observed in treatment T2 (2% KCl). Whereas minimum Number of seeds per pod (5.05) was found in treatment T0 (Control). Similar findings were reported by in black gram. Number of seeds per plant ranges from 107.07 to 170.67 with a grand mean of 137.72.Significantly highest Number of seeds per plant (170.67) was observed in treatment T2 (2% KCl). Whereas minimum Number of seeds per plant (107.07) was found in treatment T0 (Control). Similar findings were reported by in black gram. Seed yield per plant ranges from

2.68 to 4.27 with a grand mean of 3.44. Significantly highest Seed yield per plant (4.27) was observed in treatment T2 (2% KCl). Whereas minimum Seed yield per plant (2.68) was found in treatment T0 (Control).The increase in seed yield with respect to seed hardening treatments was probably due to maximum water absorbing capacity of seeds, more intense photosynthetic activity as well as more tissue hydration and thereby, enabling the plant to resist soil moisture stress more efficiently recorded by Similar findings have been reported by in black gram. Test weight ranges from 33.87 to 41.83 with a grand mean of 37.94 significantly highest Test weight (41.83) was observed in treatment T2 (2% KCl). Whereas minimum Test weight (33.87) was found in treatment T0 (Control). Similar findings were reported by in black gram.

Data was recorded for yield parameters in the laboratory showed significant differences among different treatments for seed quality parameters. Germination percentage ranges from 86.00 to 97.50 with a grand mean of 93.83. Significantly highest Germination percent (97.50) was observed in treatment T2 (2% KCl). Whereas minimum Germination percent (86.00) was found in T0 control. The improvement in germination as well as vigour might be due to chemical treatment which could have altered the membrane system as reported by in cotton. Root length ranges from 6.28 to 8.24 with a grand mean of 7.12. Significantly highest Root length (8.24) was observed in treatment T2 (2% KCl). Whereas minimum root length (6.28) was found in treatment T0 control. Similar findings were reported by in black gram. Shoot length ranges from 5.54 to 8.21 with a grand mean of 6.81. Significantly highest shoot length (8.21) was observed in treatment T2 (2% KCl). Whereas minimum shoot length (5.54) was found in treatment T0 control. Similar findings were reported by in black gram. Seedling length ranges from 11.82 to 16.45 with a grand mean of 13.94. Significantly highest seedling length (16.45) was observed in treatment T2 (2% KCl).

Whereas minimum seedling length (11.82) was found in treatment T0 control. Seedling fresh weight from 0.97 to 1.38 g with a grand mean of 1.21. Significantly highest seedling fresh weight (1.38 g) was observed treatment T2 (2% KCl). Whereas minimum seedling fresh weight (0.97) was found in treatment T0 control. Similar findings were reported by in black gram. Seedling dry weight ranges from 0.10 to 0.17 with a grand mean of 0.14. Significantly highest seedling dry weight (0.17) was observed in treatment T2 (2% KCl). Whereas minimum seedlings dry weight (0.10) was found in treatment T0 control.

Vigour Index I ranges from 973.90 to 1590.05 with a grand mean of 1280.39. Significantly highest Vigour Index I (1590.05) was observed in treatment T2 (2% KCl). Whereas minimum Vigour Index I (973.90) was found in treatment T0 control. Similar findings were reported by Sathiya (2016) [5] in black gram. Vigour Index II ranges from 8.08 to 16.10 with a grand mean of 11.94. Significantly highest vigour Index II (16.10) was observed in treatment T2 (2% KCl). Whereas minimum vigour Index II (8.08) was found in treatment T0 control.

Table 1: Effect of different seed hardening treatment on growth and yield parameters.

Treatments	Days to 50 per cent flowering	Plant height (cm)	Number of branches per plant	Number of leaves per plant	Number of pods per plant	Pod weight Per plant (g)	Number of seeds per pod	Number of seeds per plant	Seed yield Per plant (g)	Test weight (g)
T_0	52.00	51.80	2.67	19.00	19.53	10.74	5.05	107.07	2.68	33.87
T_1	42.33	59.27	3.67	25.53	26.40	14.52	6.58	148.53	3.71	39.41
T_2	40.33	62.60	4.07	28.67	28.80	15.84	7.49	170.67	4.27	41.83
T_3	43.67	59.93	3.93	27.00	27.40	15.07	6.88	155.40	3.89	40.12
T_4	45.33	57.27	3.33	23.53	24.80	13.64	6.08	135.40	3.39	38.76
T_5	49.67	54.87	3.00	21.47	22.67	12.47	5.83	122.20	3.06	35.58
T_6	48.00	55.47	3.13	22.07	23.13	12.72	5.89	127.13	3.18	36.62
T_7	47.67	56.47	3.33	22.67	23.93	13.16	6.01	131.53	3.29	36.87
T_8	46.00	58.27	3.53	24.53	25.60	14.08	6.29	141.53	3.54	38.46
F_{test}	S	S	S	S	S	S	S	S	S	S
C.D (5%)	0.61	0.74	0.21	0.55	0.44	0.24	0.27	5.52	0.14	2.15
C.V	0.76	0.75	3.64	0.15	1.03	1.03	2.48	2.32	2.32	3.27
S Ed (±)	0.21	0.35	0.10	0.26	0.21	0.11	0.13	2.60	0.07	1.01

Table 2: Effect of different seed hardening treatment on seed quality parameters

Treatments	Germination percentage	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling Fresh weight (g)	Seedling Dry weight (g)	Vigour Index I	Vigour Index II
T_0	86.00	6.28	5.54	11.82	0.97	0.10	973.90	8.08
T_1	95.50	7.17	7.38	14.55	1.30	0.15	1389.23	13.85
T_2	97.50	8.24	8.21	16.45	1.38	0.17	1590.05	16.10
T_3	96.00	7.50	7.17	14.67	1.32	0.15	1395.76	14.16
T_4	94.25	7.45	6.81	14.26	1.21	0.13	1294.15	12.30
T_5	92.25	6.60	5.94	12.54	1.13	0.10	1109.18	9.46
T_6	93.25	7.18	6.51	13.69	1.15	0.12	1208.60	10.50
T_7	94.50	6.73	6.58	13.31	1.18	0.13	1216.96	11.34
T_8	95.25	6.95	7.18	14.13	1.24	0.14	1345.71	12.86
F_{test}	S	S	S	S	S	S	S	S
C.D (5%)	2.33	0.78	0.81	1.38	0.08	0.01	135.45	1.37
C.V	1.27	8.83	8.11	7.22	4.62	8.78	7.35	8.24
S Ed (±)	0.94	0.37	0.47	0.65	0.03	0.01	64.18	0.78

Conclusion

On the basis of present investigation it may be concluded that treatment T2 (Seed hardening with 2% KCl) showed superior performance in terms of growth & yield attributes. Maximum seed quality characters were observed in T2 treatment.

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