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INFLUENCE OF SEED PRIMING ON SEED GERMINATION AND SEEDLING VIGOUR OF DRY DIRECT SOWN RICE (*Oryza Sativa* L.)

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ABSTRACT

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A laboratory experiment was conducted in completely randomized design and replicated thrice with six popular aerobic rice genotypes *i.e.* MTU 1010, MTU 7029, JGL 20171, NLR33671, MTU 1075 and MTU 1112, at S.V. Agricultural College, Tirupati. Rice seeds were subjected to different concentrations of gibberillic acid *viz.,* 200,500 and 1000 ppm and combination of both gibberillic acid and KNO_3 treatments *i.e.* GA_3 (200 ppm,500 ppm,1000 ppm + KNO_3@3%), KNO_3@3% and a control (Hydropriming/ Water soaking), in order to know the effect of seed priming on seedling vigour performance under direct seed method. Various physiological observations such as germination percentage, seedling length (cm) and seedling vigour index (SVI) were measured in all six genotypes.

KEYWORDS: Gibberllic acid, KNO_3, Seedling Vigour Index (SVI).

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal food crop of the developing world and the staple food of more than half of the world's population. Globally rice is grown over an area of 161.83 million ha with an annual production of 717.8 m t (IRRI, 2017). Irrigated rice is the major consumer of fresh water. Of late water has become the most crucial resource for agriculture especially in Asia and becoming increasingly scarce due to competition from domestic and industrial requirement. It was estimated that by 2025, about 15-20 million hectares of irrigated rice will be affected due to water scarcity which threatens the productivity. Combining the growing demand for food with increasing water scarcity, rice producers in Asia need to produce more rice with less water.

A major challenge in rice production is therefore to save water while maintaining or even increasing the grain yield (Yang and Zhang, 2010). Many water-saving technologies are currently used in rice production, including alternate wetting and drying irrigation, the rice intensiûcation system, aerobic rice and the ground cover rice production systems (GCRPSs). Among these aerobic rice is gaining popularity as a strategy for water saving agriculture.

Aerobic rice can achieve yields of 4-6 tons per hectare with 50 – 70 per cent less water compared to lowland rice it does not require flooded wetland (Qu *et al*., 2012). In aerobic rice production, the seeds are direct-seeded in aerobic soil without any standing water layer, which minimizes water use and boosts up water productivity by eliminating continuous seepage and percolation, reducing evaporation and eliminating wetland preparation (Nie *et al*., 2012; Singh *et al*., 2008). Lack of 'head start' and the absence of standing water layer to suppress weeds make aerobic rice highly vulnerable to weeds, causing severe yield loss (Zhao *et al*., 2007) than other rice ecosystems. Season-long weed infestation in aerobic rice may cause yield reduction up to 80 per cent or complete failure of crop in extreme cases (Jayadeva *et al*., 2011; Sunil *et al*., 2010).

Seedling vigour is a physiological trait and a sign of potential seed germination, seedling growth and tolerance to adverse climatic factors. On the other hand, it signiûcantly improves the speed, uniformity and the ûnal percentage of germination, and leads to ideal ûeld appearance with good potential grain yield under direct-seeded conditions (Foolad *et al*., 2007).

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Therefore, the aerobic rice cultivars should have seedling vigour *i.e.* the capacity of early seedling establishment, quick crop growth and yield stability. Identiûcation of strong weed competitive rice cultivar is a feasible solution to inhibit the growth of weeds and it is a cost-effective and safe tool for weed management (Zhao *et al*., 2006).

Seed priming is a viable option to attain this target. Seed priming, which is also called seed hardening, is a physiological seed enhancement method. It is a pre sowing treatment in which seeds are soaked in an osmotic solution that allows them to imbibe water and go through the first stages of germination, but does not permit radicle protrusion through the seed coat. Subsequently, the seeds can be dried to attain their original moisture content and stored or planted using conventional techniques.

Hence a study was undertaken to through light on effect of seed priming with GA_3 and KNO_3 either alone or in combination on improvement of seedling vigour.

MATERIALS AND METHODS

0.1, 0.25 and 0.5 g each of GA_3 (gibberellic acid, HIMEDIA) was dissolved separately 500 ml each in DDW (Double Distilled Water) along with 1.5 g KNO_3 in each case to prepare a series of solutions that gives GA_3 @ 200 ppm + KNO_3 @ 3 % , GA3 @ 500 ppm + KNO3 @ 3 % , GA_3 @ 1000 ppm + KNO_3 @ 3 %. Three per cent KNO_3 was prepared by dissolving 1.5 g of KNO_3 in 500 ml of DDW. Seeds were soaked in the respective solutions for 24 h and re dried over night (about 12 h).Well filled and uniform seeds of different varieties were placed on moistened filter paper in glass Petri plates (9 cm diameter) uniformly. After the seeds were placed in the Petri plates, they were moistened in the beginning and at regular intervals with the solutions mentioned above. On 10^{th} day after soaking germination percentage, shoot and root lengths (cm) and SVI were recorded.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds kept for germination}} \times 100$$

$$\text{SVI} = (\text{Shoot length} + \text{Root length}) \times \text{Germination percentage}$$

RESULTS AND DISCUSSION

Germination percentage:

As the genotypes selected for the experiment were all proven for their suitability under dry direct sown condition were possessed with good germination capacity. After 5 DAT (Days After Treatment) all the varieties showed a reasonably high germination percentage (89.14 to 91.92). However by 10 DAT varieties responded to the treatments positively and recorded further improvement in germination. GA_3 @ 500 ppm + KNO_3 @ 3% (T_6) and GA_3 @ 1000 ppm + KNO_3 @ 3% (T_7) recorded significantly high germination percentage. It explained the positive influence of seed priming with GA_3 and KNO_3 on seed germination. These results are in corroboration with Farooq *et al*., (2005) (Table 1).

Seedling length

Unlike germination, where only protusion of radicle is an important consideration, seedling length is a reflection of rapid cell division and cell expansion. Faster metabolic turn out in the seed leads to faster growth of the seedling. Thus a clear difference among varieties, treatments and their interaction was observed at 10 DAT.

Thus from the data it was clearly found that MTU 1010 out performed compared to other varieties, except JGL 20171 which recorded highest seedling length at 5 DAT.

Among treatments T_6(GA_3 @ 500 ppm + KNO_3 @ 3%) recorded better results. Interaction effect vividly explained the combined influence of variety and treatment on seedling length. Role of seed priming with GA_3 resulted in faster increase of seedling length was reported earlier by Helms *et al*.,1990 and Kumar *et al*., 2015(Table 2).

Seedling vigour index

Seedling vigour index is a general projection which explains the ability of the seedling to perform better under adverse growing conditions. Higher SVI shows ability of the genotype to come up well under aerobic dry direct sown condition. High SVI assures early vigour and

early biomass accumulation in the initial stages of crop growth which is highly essential to compete with weeds during the first 15 to 30 days of crop growing period under aerobic condition.

The data revealed a synergistic role of GA_3 and KNO_3 in promoting SVI compared to hydropriming (control) and osmopriming (KNO_3).

The result clearly explained the role of seedling length in early seedling vigour. Further the interaction effect was observed to be significantly high in V_1T_6(499.69 ,1352.0 and 1885.08) at all the stages. Such influence of GA_3 and KNO_3 on seedling vigor index was also suggested by

Table 1. Influence of different seed priming treatments and varieties on germination percentage at 10 days after treatment

S. No	VARIETY	T1	T2	T3	T4	T5	T6	T7	T8	MEAN
1	**MTU 1010**	88.87	86.63	93.30	91.10	91.10	100.00	93.30	88.87	**91.65**
2	**MTU 7029**	93.30	88.87	86.63	91.10	88.87	100.00	93.30	86.63	**90.25**
3	**JGL20171**	91.10	86.63	86.63	88.87	91.10	93.30	93.30	86.63	**89.70**
4	**NLR33671**	86.63	88.87	86.63	91.10	88.87	93.30	91.10	86.63	**89.98**
5	**MTU 1075**	91.10	93.30	86.63	88.87	86.63	100.00	93.30	86.63	**90.81**
6	**MTU 1112**	88.87	86.63	86.63	91.10	93.30	100.00	93.30	88.87	**91.09**
	MEAN	**89.98**	**88.49**	**87.74**	**90.36**	**89.98**	**97.77**	**92.93**	**87.38**	
T_1: Control T_2:GA_3@ 200 ppm @ T_3: GA_3@ 500 ppm T_4: GA_3@ 1000 ppm T_5: GA_3@ 200ppm + KNO_3 @3% T_6:GA_3@ 500ppm+ KNO_3 @ 3% T_7:GA_3@1000ppm+ KNO_3 @ 3										

	V	T	VXT
C.D.	NS	5.312	NS
SE(d)	2.314	2.672	6.545
SE(m)	1.636	1.889	4.628

Table 2. Influence of different seed priming treatments and varieties on seedling length at 10 days after treatment

S. No	VARIETY	T1	T2	T3	T4	T5	T6	T7	T8	MEAN
1	MTU 1010	8.55	9.74	9.95	11.32	11.62	13.52	11.14	9.80	**10.71**
2	MTU 7029	7.78	8.53	7.70	10.23	10.95	13.56	10.00	8.32	**9.63**
3	JGL20171	7.55	8.71	8.21	10.87	11.73	13.91	10.90	6.60	**9.81**
4	NLR33671	7.78	8.85	7.49	11.73	11.41	13.35	9.77	7.35	**9.72**
5	MTU 1075	6.99	8.01	7.72	9.11	12.42	12.68	10.48	7.93	**9.42**
6	MTU 1112	6.99	8.01	7.50	9.57	10.41	13.11	10.59	7.27	**9.18**
	MEAN	**7.61**	**8.64**	**8.09**	**10.47**	**11.42**	**13.36**	**10.48**	**7.88**	

T_1: Control T_2:GA_3@ 200 ppm @ T_3: GA_3@ 500 ppm T_4: GA_3@ 1000 ppm T_5: GA_3@ 200ppm + KNO_3@3% T_6:GA_3@ 500ppm+ KNO_3@ 3% T_7:GA_3@1000ppm+ KNO_3@ 3% T_8: KNO_3@ 3%

	V	T	VXT
C.D.	0.192	0.221	0.542
SE(d)	0.096	0.111	0.273
SE(m)	0.068	0.079	0.193

Table 3. Influence of different seed priming treatments and varieties on seedling vigour index at 10 days after treatment

S. No	VARIETY	T1	T2	T3	T4	T5	T6	T7	T8	MEAN
1	MTU 1010	759.55	843.54	928.87	1031.74	1060.84	1352.00	1037.80	868.81	**985.39**
2	MTU 7029	726.48	760.09	667.75	932.82	973.71	1263.94	933.18	723.56	**872.69**
3	JGL20171	687.34	754.14	713.39	968.91	1068.18	1296.77	1016.84	572.54	**884.76**
4	NLR33671	675.16	785.31	647.75	1069.12	1011.39	1335.33	892.20	636.29	**881.57**
5	MTU 1075	637.21	747.55	667.88	811.20	1074.41	1268.33	975.95	687.33	**858.73**
6	MTU 1112	619.40	695.68	649.44	871.54	970.63	1310.67	988.65	646.02	**844.00**
	MEAN	**684.19**	**764.39**	**712.51**	**947.55**	**1026.53**	**1304.51**	**974.10**	**689.09**	

T_1: Control T_2:GA_3@ 200 ppm @ T_3: GA_3@ 500 ppm T_4: GA_3@ 1000 ppm T_5: GA_3@ 200ppm + KNO_3@3% T_6:GA_3@ 500ppm+ KNO_3@ 3% T_7:GA_3@1000ppm+ KNO_3@ 3% T_8: + KNO_3@ 3%

Factors	V	T	VXT
C.D.	48.718	56.254	NS
SE(d)	24.504	28.295	69.308
SE(m)	17.327	20.008	49.008

REFERENCES

Farooq, M., Basara S. M. A., Saleem, B. A., Nafees, M and Chishti, S. A. 2005. Enhancement of tomato seeds germination and seedling vigour by osmopriming. *Pakistan Journal of Agricultural Sciences*. 42(3-4): 36-41.

Foolad, M., Subbiah, P., Zhang, L. 2007. Common QTL affect the rate of tomato seed germination under different stress and non stress conditions. *International Journal of Plant Genomics*. 1–10.

Helms, R. S., Dilday, R. H and Carlson, R. D. 1990. Using GA 3 seed treatment in direct seeded rice in southern U.S.A. In: *Direct Seeded Flooded Rice in the Tropics: Selected Papers from International Rice Research Conference*. Pp 113-14. International rice research institute, Manila, Philippines.

RI, 2017. http://ricestat.irri.org

adeva, H.M., Bhairappanavar, S.T., Hugar, A.Y., Rangaswamy, B.R., Mallikarjun, G.B., Malleshappa, C and Naik, D.C. 2011. Integrated weed management in aerobic rice (*Oryza sativa* L.). *Agriculture Science Digest*. 31(1):58–61.

umar, S.P.J., Prasad, S.R., Banerjee, R and Thammineni, C. 2015. Seed birth to death: dual functions of reactive oxygen species in seed physiology. *Annals of Botany*. 1-2

.Nie, L., Peng, S., Chen, M., Shah, F., Huang, J., Cui, K and Xiang, J. 2012. Aerobic rice for water-saving agriculture. *A review of Agronomy and Sustainable Development.* 32:411–418.

Qin, Y., Liu, S., Guo, Y., Liu, Q and Zou, J. 2010. Methane and nitrous oxide emissions from organic and conventional rice cropping systems in Southeast China. *Biology and Fertility of Soils.* 46: 825-834.

Qu.*et al.,* Tao, M.B., Tao.Y.Y., Liu, M.J., Shen, K.R and Lin, S. 2012. Ground cover rice production system increases yield and nitrogen recovery effi--ciency. Agronomy Journal. 104.1399-1407.

Singh, A.K ., Pal, S., Datta, S.P., and Rattan, R.K . 2008. Diagnosis and amelioration of iron deficiency under aerobic rice. *Journal of Plant Nutrition*. 31(5):919-940.

Sunil, C.M., Shekara, B.G., Kalyanmurthy, K.N and Shankaralingapa, B.C. 2010. Growth and yield of aerobic rice as influenced by integrated weed management practices. *Indian Journal of Weed Science*. 42(3):180-183.

Yang, J and Zhang, J. 2010. Crop Management Techniques to enhance harvest index in rice. *Journal of Experimental Biology*. 61(12):3177-3189.

Zhao, D.L., Atlin, G.N., Bastiaans, L and Spiertz, J.H.J. 2006. Cultivar weed competitiveness in aerobic rice: Heritability, correlated traits, and the potential for indirect selection in weed-free environment. *Crop Science*. 46:372–380.

Zhao, D.L., Bastiaans, L., Atlin, G.N and Spiertz, J.H.J. 2007. Interaction of genotype 9 management on vegetative growth and weed suppression of aerobic rice. *Field Crops Research.* 100:327-340.