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EFFECT OF SEED HARDENING AND COATING ON RICE CULTIVARS

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Abstract

Rice (*Oryza sativa* L. 2n=2x=24) is the most important cereal crop cultivated widely in many parts of the world. Seed germination is the initial and critical stage affected by stress in direct sown rice under rainfed conditions. Pre-sowing hardening or imbibitions and drying back of seeds is one of the methods which results in modifying the physiological and biological nature of seed so as to get the characters that are favorable for saline and drought resistance. Genetically and physically pure seeds of four rice cultivars *viz.,* ADT 37, ADT 39, Ponmani and KKL 99001 were formed the basic material for this study. For seed treatment three chemicals namely, $CaCl_2$(1%), KCl (1%) and KH_2PO_4 (1%) along with cow urine were used. Neem leaf power @ 150 g / kg of seed was used for coating. In field experiment, the treatment T_5 (KH_2PO_4, 1%) + neem leaf powder coating @ 150 g/kg) recorded significantly superior mean value for almost all the characters studied for all the genotypes. The seed hardening-cum- coating treatment improved germination of seeds along with grain yield / plant, it indicating the importance of this treatment for grain yield in rice under coastal saline condition. The hardening treatment (KH_2PO_4 1%) (T_1) presented statistically significantly superior for six characters number of productive tillers / plant, number of grains / panicle, 100 grain weight, single plant yield, seed yield / plot and seed yield / ha. The treatment (T_8) cow urine 1 per cent neem leaf powder coating @ 150 g / kg showed significant improvement for two character panicle length and harvest index. Among these nine treatment (four hardening and four hardening-cum-coating with control) (T_5) hardening with coating presented significant improvement for both laboratory and field experiment for all the characters.

Keywords: Saline resistances, Drought resistances.

Introduction

Rice (*Oryza sativa* L. 2n=2x=24) is the most important cereal crop cultivated widely in many parts of the world. Rice provides 21 per cent of global human per capita energy and 15 per cent per capita portions. Asia accounts for 60 per cent of the global population, about 92 per cent of global rice consumption. Expanding the area under rice cultivation is not an option for increasing rice production in many areas due to the pressure of urbanization, industrialization, crop diversification and other economic factors (Tyagi and Mohanty, 2008). Seed germination is the initial and critical stage affected by stress in direct sown rice under rainfed conditions. Pre-sowing hardening or imbibitions and drying back of seeds is one of the methods which results in modifying the physiological and biological nature of seed so as to get the characters that are favorable for saline and drought resistance. The present study was conducted, to study the effect of seed hardening treatment on seedling quality in rice, to study the effect of seed hardening treatment on growth and yield parameter in rice, to study the effect of seed hardening-cum-coating treatment on seedling quality in rice and to study the effect of seed hardening-cum-coating treatment on growth and yield parameter in rice.

Materials and Methods

Genetically and physically pure seeds of four rice cultivars *viz.,* ADT 37, ADT 39, Ponmani and KKL 99001 were formed the basic material for this study. For seed treatment three chemicals namely, $CaCl_2$(1%), KCl (1%) and KH_2PO_4 (1%) along with cow urine were used. Neem leaf power @ 150 g / kg of seed was used for coating.

The seeds of ADT 37, ADT 39, Ponmani and KKL 99001 were subjected to following seed hardening and hardening-cum-coating treatments. They are, To- Untreated, T_1- (1%) KH_2PO_4(Hardening), T_2- (1%) KCI (Hardening), T_3- (19%) $CaCl_2$ (Hardening), T_4- (1%) Cow urine (Hardening), T_5- (1%) KH2PO Neemleaf powder @ 150 g / kg (Hardening Coating), T_6 - KCI + Neem leaf powder @ 150 g / kg (Hardening Coating), T_7 - (1%) $CaCl_2$+ Neem leaf powder @ 150 g / kg (Hardening Coating), T_8 - (1%) Cow urine, Neem leaf powder @ 150 g / kg (Hardening + Coating).

Laboratory Evaluation

The Laboratory evaluation was conducted at seed technology laboratory of the Department of Genetics and Plant Breeding. The seeds of ADT 37, ADT 39, Ponmani and KKL 99001 were subjected to the hardening treatment as follows. The seeds were first soaked in chemical solution at seed to solution ratio of 1:0.5 with periodical stirring of seeds for 12h (Joseph and Nair, 1989). The hardened seeds were then used for seed coating. Seeds of all the four rice cultivars

were coated with neem leaf power @ 150 g / kg of seed. To ensure proper coating gum was used as adhesive at 0.1 g / kg seed. The treated seeds were shade dried to reduce the moisture content to 10 per cent and then the seeds were subjected to evaluation in laboratory. There are five observations were recorded in laboratory evaluation, germination percentage (ISTA, 1999), root length, shoot length, dry weight of seedling (g) and vigour index.

Field experiment

The field experiment was conducted at the Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, during the season, Samba 2016. The trial was conducted in Randomized Block Design replicated thrice. The treated seeds were sowed in raised nursery bed. Twenty three days old seedlings were transplanted to the main field at the rate of one seedling per hill with the spacing at 30cm between rows and 20cm within plants. Recommended cultural practices were followed. Observations were recorded for 10 biometrical traits from five randomly selected plant in each replication. Days to 50 per cent flowering, Plant height, Number of productive tillers/plants, Panicle length, Number of grains/panicle, 100 grain weight, Harvest index (%), Single plant yield, Seed yield/plot and Seed yield/ha.

Results and Discussion

The seed of ADT 37, ADT 39, Ponmani and KKL 99001 subjected to eight seed treatments including four seed hardening treatments, four hardening-cum-coating treatments and keeping untreated seeds as control.

In laboratory experiment, the traits *viz.*, germination percentage, root length, shoot length, dry weight of seedling and vigor index were studied. In field evaluation ten traits *viz,.* days to 50 per cent flowering, plant height, number of productive tillers/plant, panicle length, number of grains/panicle, 100 grain weight, harvest index, single plant yield, seed yield/plot and seed yield/hectare were observed.

Effect of seed hardening and hardening-cum coating for seedling quality traits in rice (Laboratory experiment)

The commonest calamity of the Indian cultivator is the failure of the monsoon which in its extreme manifestation was called drought. Water balance of a plant was upset by drought and as a consequence, the physiological functions influencing growth and yield are disarranged.

Pre-sowing hardening or imbibition and drying back of seeds was one of the methods which results in modifying the physiological and biochemical nature of seed as to get the character that are favorable for drought resistance. Pre-sowing hardening of crop sceds with water and solutions of growth regulating compounds to induce early germination, better seedling establishment and enhance yield of crop varieties has been employed by many workers Joseph and Nair, 1989; Vanangamudi and Kulandaivelu, 1989; Paul and Choudhury, 1993; Rangasamy *et al*, 1993]

Muhammad Farooq (2009) opined that osmohardening seeds (kcl) performed better than all other treatments. Osmohardening Cacil and ascorbate priming in rice improved nursery seedling vigor and resulted in improved growth, yield and quality of transplanted rice. Kathiravan *et al.,* (2008) recorded that seedling quality traits *viz.,* root length, shoot length, number of leaves and stem girth were highest in seed treated with KCI @ 1 percent for 24 hr when compared to control in *Jatropha curas* Linn.

Hence, the study was formulated to evaluate the effect of seed hardening and hardening-cum-coating technique on seedling quality in rice in ADT 37, ADT 39, Ponmani and KKL 99001 varieties with hardening treatments of 1 per cent KH_2PO_4, 1 percent KCI, 1 per cent $CaCl_2$ and 1 per cent cow urine and hardening-cum-coating treatments, 1 per cent KH_2PO_4 + Neem leaf powder coating @ 150g/kg, 1 per cent KCI Neem leaf powder coating @ 150g/kg, 1 per cent $CaCl_2$ Neem leaf powder coating @ 150g/ kg and 1 per cent of cow urine + Neem leaf powder coating @ 150g/kg along with untreated control. For the character germination percentage (treatments T_1, T_5, and T_8) recorded significantly superior performaance in all the four genotypes.

Seed hardening-cum-coating with neem leaf powder recorded higher rate of germination probably because germination involves hydration and imbibition as the first step and during soaking, seeds would become physiologically advanced by carrying out some of the initial of germination. Subsequent improvement in step germinability hardened seed could be due to the fact that such advanced seed would retain viability to carry on where they left off upon germination Joseph and Nair, 1989).

Seed hardening with chemicals along with coating with neem leaf powder (T_5 and T_8) enhanced the seedling parameters *viz,* root length and shoot length for all the rice cultivars. The improvement in root and shoot length of seedling due to treatment might probable due to enhanced metabolic activity, earlier in germination and seedling growth (Kamalam and Nair, 1989). Vanagamudi and Kulandivelu (1989) in Sorghum and Shanmugasundaram and Kannaiyan (1989) in Cumbu, Arjunan and Srinivasan (1989) in groundnut, Rangasamy *et al.,* (1993) in cowpea and Bhaskaran (1995) and Nagaraj (1996) in rice. The laboratory evaluation of seeds hardened with chemicals followed by coating with neem leaf powder (T_5 and T_8) showed significant improvement in dry matter production and seedling vigour in all the four rice cultivars

The vigor index of seedling can be improved by hardening and coating treatment probably because of enhancement in germination and seedling growth. Shanmugasundaram and Kannaiyan (1989) in Cumbu, Paul and Choudhury (1993) in wheat, Rangasamy *et al.,* (1993) in Sorghum and groundnut, Nagaraj (1996) in rice obtained increased root: shoot ratio and vigor index due to hardening treatments.

The treatments T_5 and T_8 registered superior performance for all the five seedling characters in all the four rice cultivars. Hence these two treatments were adjudged as best treatments in improving seedling vigour in rice.

Effect of seed hardening and hardening-cum-coating on seed yield in rice (Field Experiment)

The seeds of four rice cultivars ADT 37, ADT 39, Ponmani and KKL 99001 were submitted to following seed treatments *viz.,* T_1 (1 per cent KH_2PO_4), T_2 (1 per cent KCl), T_3 (1 per cent $CaCl_2$), T_4 (1 per cent Cow urine), T_5 (1 per cent KH2PO4 + Neem leaf powder coating @ 150g/kg), T_6 (1 per cent KCI + Neem leaf powder coating @ 150g/kg), T_7 (1per cent $CaCl_2$ + Neem leaf powder coating @ 150g/kg) and T_8 (1 per cent cow urine + Neem leaf powder coating @ 150g/kg) were evaluated for days to 50 per cent flowering, number of productive tillers per plant, plant height [cm], panicle length [cm], number of grains per panicle, 100 grain weight [g], harvest index, single plant yield (g), seed yield per plot [kg] and seed yield per hectare [kg].

For the character, days to 50 per cent flowering, among the nine treatments T_5 and T_8s showed significant value in desirable direction for all four cultivars. These results are in conformity with finding of Akram *et al.,* (1993) and Bhaskaran (1995). The traits, number of products tillers / plant, T_1 and T_5 recorded significant superior value for all the four cultivars. Singh and Chatterjie (1980) in dry land rainfed rice noted that plants grown from pretreated seed significantly outscored those from untreated seeds in plant height, population per unit area and number of tillers per unit area. The increase in number of productive tiller may be due to increase in dry matter content of shoots. Activity to leaves must also favorably influence the growth made by plants. Seed hardened with KH_2PO_4 (1 per cent) (T_5) followed by coating with Neem leaf powder significantly increased the plant height. It is possible that the bio nutrients available in the coated seeds could improve the growth resulting in higher plant height. Similar results were reported by Kannaiyan (1987) in pearl millet and Rangaswamy (1986) in Sorghum.

The treatment T_5 and T_8 were showed significantly superior value for the trait panicle length for all the four cultivars. A similar observation where recorded in improvement of plant height and panicle length by seeds treatment by Akram *et al.,* (1993) and Bhaskaran (1995) in rice. For the trait, number of grains/panicle, the treatments T_1 and T_5 registered superior values for all the cultivars. T_1 and T_5 are showed significant value for the traits 100 grain weight for all the cultivar. Similar results were reported by Aleshin *et al.,* (1989) in rice and Kannaiyan (1987) in pearl millet.

Harvest index recorded superior significant value in all the rice cultivar in the treatments T_5 and T_8. Harvest index was significantly higher in case of seed hardening followed by coating with neem leaf powder. Similar effects were in sorghum was reported by Jegathembal (1996), considered variation in seed size exists in seeds produced from same plant.

For the characters single plant seed yield / plot and grain yield / ha, the treatments T_1 and T_5 recorded significantly higher value for all the four cultivars. The hardened and coating treatments might have improved the growth of the plant during earlystages with increased vigor and associated stronger root system which in turn derived the available soil moisture and nutrients enabling better growth resulting in higher yield (Jagathambal, 1996). Similar results were reported by Chanu (1994) and Bhaskharan (1995) in rice. The manifestation of seed yield and recovery of resultant seeds through the usage of hardened and coated seeds under direct sowing of rice could be attributed to better germination, higher tiller production, plant growth and seed weight.

Seed treatment studies were carried out under coastal saline condition with four rice cultivars, ADT 37, ADT 39, Ponmani and KKL 99001 to achieve the following objectives, to study the effect of seed hardening and hardening-cum-coating treatment on seedling quality and yield parameters in rice. For laboratory and field experiment the cultivar were subjected to four seed hardening (T_1, T_2, T_3 and T_4) treatment the hardened seeds were coated with neem leaf powder @ 150 g/kg (T_5, T_6, T_7 and T_8) with one untreated control. The results of the laboratory and field studies are summarized below.

Hardening with KH_2PO_4 (1%) (T_1) recorded significant improvement for the traits, germination percentage, dry matter production and vigor index for all four cultivars. Among the hardening-cum-coating treatment, T_5 (KH_2PO_4, 1%) + neem leaf powder coating @ 150 g / kg) and T_8 (cow urine + neem leaf powder @ 150 g / kg) recorded superior performance for all the five traits in laboratory studies in all four rice cultivars. The treatments T_5 (KH_2PO_4 1%) + neem leaf powder coating 150 g / kg) and T_8 (cow urine 1% + neem leaf powder @ 150 g / kg) induced early flowering in all the rice cultivars under field condition. Since earliness in flowering is related to drought escape mechanism in rice by attaining early maturity, these treatment could help in overcoming abiotic stress situation in rice. The treatment T_1 [KH_2PO_4] (1%), T_5 [KH_2PO_4] (1%) and neem leaf powder coating @ 150 g / kg) recorded significant grain yield / plant in all the four rice cultivars indicating the importance of these treatment, it enhancing grain yield in rice. Among the eight treatments, the treatment T_8 ranked third preceded by T_1. The treatment T_5, ranked first among all the eight treatments.

In field experiment, the treatment T_5 (KH_2PO_4, 1%) + neem leaf powder coating @ 150 g/kg) recorded significantly superior mean value for almost all the traits studied for all the cultivars. Hence, it might concluded that seed hardening-cum-coating treatment improved germination of seeds along with grain yield / plant, it is indicating the importance of this treatment for grain yield in rice under coastal saline condition. The hardening treatment (KH_2PO_4 1%) (T_1) presented statistically significantly superior for six characters number of productive tillers / plant, number of grains /

panicle, 100 grain weight, single plant yield, seed yield / plot and seed yield / ha. The treatment (T_8) cow urine and1 per cent neem leaf powder coating @ 150 g / kg showed significant improvement for two character panicle length and harvest index. Among these nine treatment (four hardening and four hardening-cum-coating with control) (T_5) hardening with coating presented significant improvement for both laboratory and field experiment for all the traits.

Table 1: Ranking of various seed hardening and hardening–cum-coating treatments of rice genotypes in laboratory experiment

Treatment	Germination(%)				Root length(cm)				Shoot length(cm)				Dry matter production(mg)				Vigour Index			
	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001
T_0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T_1	*	*	*	*	-	-	-	-	-	-	*	*	*	*	*	*	*	*	*	*
T_2	*	-	-	*	-	-	-	-	-	-	*	-	-	*	-	*	-	-	-	-
T_3	*	-	-	-	-	-	-	*	-	-	-	-	-	*	-	*	-	-	-	-
T_4	-	-	-	-	-	-	-	*	-	-	-	-	-	*	-	-	-	-	-	-
T_5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
T_6	-	-	-	-	-	-	-	*	-	-	-	-	-	*	*	*	-	-	-	-
T_7	-	-	-	*	-	-	-	-	-	-	-	-	-	-	-	*	-	-	-	-
T_8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Table 2: Ranking of various seed hardening and hardening –cum-coating treatments of rice genotypes in field experiments (growth parameter)

Treatment	Days to 50% flowering				No. of productive tillers/plant				Plant height(cm)				Panicle length (cm)				No. of grains/panicle			
	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001
T_0	-	-	-	-	-	-	-	-	*	*	*	*	-	-	-	-	-	-	-	-
T_1	-	*	*	-	*	*	*	*	-	-	*	-	-	-	-	*	*	*	*	*
T_2	-	*	*	-	-	-	-	-	-	*	*	-	-	*	*	*	-	*	*	-
T_3	-	-	-	-	-	-	-	-	-	*	*	-	-	-	-	*	-	-	-	-
T_4	-	-	-	*	-	-	-	-	*	*	-	-	-	-	*	*	-	-	-	*
T_5	*	*	*	*	*	*	*	*	-	-	-	-	*	*	*	*	*	*	*	*
T_6	-	-	-	-	-	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-
T_7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T_8	*	*	*	*	-	-	*	*	-	-	-	-	*	*	*	*	*	*	*	-

Table 3: Ranking of various seed hardening and hardening-cum-coating treatments of rice genotypes in field experiment(yield parameters).

Treatment	100 grain weight(g)				Harvest index				Single plant yield (g)				Seed yield /plot(kg)				Seed yield/hectares (kg)			
	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001	ADT 37	ADT 39	Ponmani	KKL 99001
T_0	-	-	-	-	-	-	-	*	-	-	-	-	-	-	-	-	-	-	-	-
T_1	*	*	*	*	-	-	*	*	*	*	*	*	*	*	*	*	*	*	*	*
T_2	-	-	-	-	-	-	*	-	-	-	*	-	-	-	-	-	-	-	-	-
T_3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T_4	-	-	-	-	-	-	-	-	-	-	*	-	-	-	-	-	-	-	-	*
T_5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
T_6	-	-	-	-	-	-	-	-	-	-	-	-	*	*	*	-	-	-	*	-
T_7	-	-	-	-	-	-	-	-	-	-	-	-	*	-	-	-	*	-	-	-
T_8	*	-	-	-	*	*	*	*	*	-	*	-	*	-	*	-	*	-	*	-

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