

Original Research Article

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Response of Naturally Aged Paddy Seed to Halo, Hormonal and Hydropriming

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ABSTRACT

Quality seed of paddy has tremendous contribution to the Indian economy. But ageing process during storage reduces germination (< 80.0%) and viability so that the seeds could not meet the minimum seed certification standards. Priming that is an easiest, economical and environmentally friendly method could be adopted by farmers and seed producing organisations to increase germination to the level of minimum seed certification standards. The objective of the present investigation was to increase germination and viability of naturally aged paddy breeder seeds by following the priming treatments. Naturally aged breeder seeds of four different varieties of paddy were primed with GA₃ (100 ppm), KNO₃(2%), KCl (2%) and tap water for 24 hours. Laboratory as well as field tests were carried out in a completely randomised design with five replications. Experimental results revealed that priming of naturally aged paddy seeds with GA₃, KCl and H₂O increased germination by 8.3 %, 11.2% and 11.4% respectively as compared to unprimed seeds except KNO₃ which had a detrimental effect on germination. All the priming treatments have positive effects on germination energy, shoot length, root length, seedling length, seed vigour indices and field emergence except KNO₃. Efficacy of priming treatments was expressed in terms of germination stability index (GSI) and the highest was achieved by hydro priming followed by hormonal priming GA₃ and halo priming agent KCl. It is concluded that hydro priming may be the best treatment in accelerating the germination of naturally aged paddy seeds up to a minimum seed certification standard particularly for the seeds having germination above 70% but below 80%. Further, it is a simple and inexpensive approach that could be easily adopted by farmers and the seed producing organizations.

Keywords

Paddy, Priming,
Halo-priming,
Hormonal-priming,
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Stability Index,
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Introduction

Quality seed is the fuel for agricultural development. The response of all other inputs depends on quality of seeds to a large extent i.e. direct contribution of quality seed alone to the total production is about 15 – 20 % depending upon the crop and it can be further raised up to 45% with efficient management

of other inputs. Seed ageing is a main problem of seed quality deterioration expressed as the loss of seed vigour and/or viability and it brings a great financial loss to the seed producing organizations.

In paddy when germination percentage decreases below 80%, it is declared as non-seeds. If the germination percentage could be

increased through any technology to a level to satisfy the minimum seed certification standards then a great loss to the national economy can be saved. Priming is a simple technique for enhancing seed quality. It is a technique which involves uptake of water by the seed followed by drying to initiate the early events of germination up to the point of radicle emergence. The primed seed can be a technological tool to provide excellent seedling performance in the field (Leubner, 2000) by reversing some of the ageing induced deteriorative events (Taylor *et al.*, 1998). This technique is followed to enhance seed quality notably with respect to rate and uniformity of germination thereby improving seedling stand and enabling better crop establishment (Job *et al.*, 2000).

Materials and Methods

Priming is the process of controlled hydration of seeds to a level that allows pre-germination activities but does not permit primary root protrusion. The experiment was conducted at the Department of Seed Science and Technology, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar. Fresh and old paddy breeder seeds (harvested in rabi, 2014 and declared as non-seeds) of variety IR 36, IR 64, MTU 1010 and Jyotirmayee belonging to early and mid-early maturity group were collected from BSP-NSP Crops, OUAT, Bhubaneswar. Priming treatments used for the present investigation were hormonal priming: GA₃ (100 ppm); halo priming: KNO₃ (2%) & KCl (2%); hydro priming: tap water and non-primed or dry seeds as control. Seeds were soaked in solutions at ambient temperature for 24 hours then removed and rinsed with distilled water for three times and re-dried to original moisture content (13%) under shade. These seeds were then sealed in polythene bags and stored in refrigerator for further use. Observations were recorded on germination

percentage, germination energy (%), Shoot-Root ratio, Seedling length and seedling dry weight. Germination energy (%) was the germination percentage of first 3 days (Bam *et al.*, 2006). Laboratory as well as field tests were carried out in a completely randomised design with five replications. Analysis of variance (ANOVA) of laboratory and field data were calculated using SAS 9.3 version. The efficacy of different priming treatments was judged in terms of germination stability index. Germination stability index was calculated as germination percentage of different treatments is ranked variety wise in naturally aged seeds under lab and field conditions. The treatment that has recorded maximum germination is given 1st rank and the treatment that has lowest germination is ranked as 5th. Cumulative rank of a treatment is obtained by adding the ranks of naturally aged seeds under both lab and field conditions. Average of the cumulative rank gives germination stability index (GSI). Higher value of GSI indicates low efficiency and lower value of GSI indicates higher efficiency.

Results and Discussion

Effect of halo, hormonal and hydro priming agents on seed quality parameters of naturally aged of paddy breeder seeds were estimated.

Germination

Germination is an important physiological parameter amongst the seed quality parameters which is generally used to predict the planting value of seeds. Analysis of variance indicated significant differences among the treatments in respect of germination of four varieties. In the present study the response of naturally aged breeder seeds of four high yielding rice varieties to halo, hormonal and hydro priming is presented in (Table 1).

It was observed that IR 36 recorded maximum germination under hydro priming (67.20%) followed by potassium chloride (KCl) and GA3 and these priming treatments gave significantly higher germination than control. KNO3 gave significantly lower germination than control. In case of IR 64, KCl gave significantly the highest germination (70.80%) followed by hydro priming (66.40%) and GA3 (60.40%) as compared to dry seeds (51.60%). The minimum was being recorded with KNO3 (20.40%) which was significantly lower than control. In variety MTU 1010, hydro priming produced the highest germination (73.20%) followed by GA3 and KCl and the lowest was observed with KNO3 (53.60%) as compared to control (61.20%). In case of Jyotirmayee, KCl resulted in significantly higher germination than control. Hydro priming and GA3 were at par with control whereas KNO3 produced significantly negative effect. This result clearly indicated variation in priming response of four high yielding paddy varieties as well as among the treatments. From the mean effect of treatments across the varieties it was observed that GA3, KNO3, KCl and hydro priming increased germination by 8.3 %, -15.7 %, 11.2% and 11.4% respectively as compared to unprimed seeds.

Variation in response of the varieties to halo, hormonal and hydro priming was depicted in Fig. 1. From the figure it is evident that IR 36 has more positive response followed by IR 64 and MTU 1010 and Jyotirmayee is least influenced by priming treatments. The effect of priming treatments was evaluated by calculating the increase or decrease in germination % over unprimed seeds. Fig. 2 clearly shows that all the priming treatments have positive effect on germination of naturally aged breeder seeds except KNO3, which imposed negative effect on germination for all the varieties.

Germination energy (%)

Germination energy (%) is one of the germination parameters and it is the germination percentage of the first 3 days. Germination energy is also a measure of the speed of germination and hence, assumed as a measure of the vigour of seedling it produced. In variety IR 36 GA3 (100 ppm) and hydro priming showed significant positive effect on germination energy whereas KNO3 and KCl had negative effect as compared to non-primed seeds (Table 2). In IR 64, KCl (2%) recorded maximum significant germination energy and KNO3 (2%) significantly decreased the germination energy as compared to non-primed seeds.

In MTU 1010, hydro priming exhibited significantly highest germination energy followed by GA3 (100 ppm) than control. In Jyotirmayee, all the treatments produced significantly higher germination energy (%) than non-primed seeds. The mean effect indicated positive effect of all the treatments on germination energy (%) except KNO3 as compared to control. The increase in germination energy (%) was 7.4%, 8.9 % and 13.8 % over the varieties when treated with GA3 (100 ppm), KCl (2%) and hydro priming respectively as compared to unprimed seeds.

Shoot: Root ratio

Shoot:Root ratio which is an indicator of seedling vigour is presented in Table 3. IR 36 was found to record maximum shoot:root ratio when treated with GA3 (1.48) followed by KNO3 (2%) and these two treatments significantly enhanced shoot growth as compared to unprimed seeds whereas KCl (2%) and hydro priming reduced shoot growth. In IR 64, all the priming treatments showed positive effect but GA3 (100 ppm) and KCl (2%) produced significantly higher shoot:root ratio as compared to non-primed

seeds. In MTU 1010, significantly higher shoot:root ratio of 1.53 and 1.39 was achieved by GA3 (100 ppm) and KCl (2%) respectively as compared to dry seeds. In Jyotirmayee, all the priming treatments had significantly lower shoot:root ratio as compared to non-primed seeds. The mean effect of the treatments indicated that GA3 had a pronounced effect (1.36) in increasing shoot growth as compared to control and other treatments.

Seedling length

Seedling length of naturally aged paddy breeder seeds of four varieties is presented in Table 4. In IR 36, all the treatments were found to increase seedling length as compared to non-primed seeds. The maximum seedling length was being recorded by GA3 (37.28 cm) followed by KCl (2%) and hydro priming and these three were significantly superior to non-primed seeds. In IR 64, KCl (2%) resulted in maximum seedling length as compared to non-primed seeds. In MTU 1010, both GA3 (100 ppm) and KNO₃ (2%) produced nearly same seedling length (39.62 & 39.54 cm) and were significantly different from non-primed seeds. Jyotirmayee recorded significantly the highest seedling length when treated with GA3 (100 ppm). The mean effect indicated that all the priming treatments had positive effect as compared to dry seeds.

Seedling dry weight

Seedling dry weight of the varieties in response to different priming treatments is given in Table 5. In IR 36, seedling dry weight varied from 8.68 mg to 10.96 mg (KCl 2%). GA3 (100 ppm), KCl (2%) and hydro priming resulted in significant increase in dry weight than non-primed seeds. IR 64 gave the highest seedling dry weight (10.96 mg) than control followed by KNO₃ (2%). Other two treatments had lower dry weight than non-primed seeds. In MTU 1010, KNO₃ (2%),

KCl (2%) and hydro priming dry weight of 10.64, 10.68 and 10.40 mg respectively as compared to non-primed seeds (10.24 mg). In Jyotirmayee all the treatments increased the dry weight in comparison to non-primed seeds. The mean effect reflected positive effect of all the priming treatments on dry weight.

In the present investigation it was observed that germination percentage of aged seeds of paddy increased approximately by 10-12 % through priming. This result suggests that if germination of aged seeds of paddy is higher than 70 %, it may be enhanced to more than 80% through hydro priming. When the germination percentage is below 80.0, it is declared as non-seeds and transferred to foodstuff for selling at lower price causing a great financial loss to the nation. One of the interesting observations of the present study was that priming with KNO₃ reduced germination of naturally aged seeds as compared to control. This may be due to decreased antioxidant activity by KNO₃ on aged seeds. The same finding was observed by Siadat *et al.*, (2012) in maize. Zhu *et al.*, (2010) reported that germination percentage increased by 11.7% for naturally aged F1 seed of rice after primed with 0.5% PVA (polyvinyl alcohol) + 1.0% KNO₃ but Jabbarpour *et al.*, (2014) reported that in wheat except germination other seed quality parameters were significantly improved by 1% KNO₃ and KH₂PO₄ salt priming of seeds. Naturally aged breeder seeds showed lower germination, because poor storage conditions result in the impairment of cell membrane integrity to remain intact and hold up cell contents. Thus, upon rapid uptake of water deteriorated cells rupture to release their contents into the surrounding water. In conclusion, the results of the study have shown that soaking rice in water is a better treatment to increase germination capacity of aged seeds.

Table.1 Germination % of naturally aged paddy breeder seeds

Treatment	V1 (IR 36)	V2 (IR64)	V3 (MTU1010)	V4 (Jyotirmayee)	Mean
GA ₃ (100ppm)	64.80	60.40	70.40	52.00	61.9
KNO ₃ (2%)	28.80	20.40	53.60	48.00	37.7
KCl (2%)	66.00	70.80	60.80	60.80	64.6
Hydro priming	67.20	66.40	73.20	52.40	64.8
Control	48.40	51.60	61.20	52.40	53.4
CD (1%)	4.12	3.96	4.07	2.47	
CV%	5.88	5.77	5.01	3.65	

Table.2 Germination energy (%) of naturally aged paddy breeder seeds

Treatment	V1 (IR 36)	V2 (IR64)	V3 (MTU1010)	V4 (Jyotirmayee)	Mean
GA ₃ (100ppm)	58.80	54.00	65.60	41.60	55.0
KNO ₃ (2%)	20.40	18.00	48.40	40.00	31.7
KCl (2%)	47.60	67.20	57.60	53.60	56.5
Hydro priming	64.80	63.20	72.80	44.80	61.4
Control	48.00	52.40	56.00	34.00	47.6
CD (1%)	2.90	2.97	3.30	2.72	
CV%	4.76	4.58	4.31	4.99	

Table.3 Shoot: root ratio of naturally aged paddy breeder seeds

Treatment	V1 (IR 36)	V2 (IR64)	V3 (MTU1010)	V4 (Jyotirmayee)	Mean
GA ₃ (100ppm)	1.48	1.49	1.53	0.95	1.36
KNO ₃ (2%)	1.07	1.00	1.18	0.80	1.01
KCl (2%)	0.90	1.18	1.39	0.89	1.09
Hydro priming	0.99	1.04	1.21	0.83	1.02
Control	0.93	0.97	1.29	1.14	1.08
CD (1%)	0.08	0.09	0.09	0.06	
CV%	5.64	6.22	5.22	5.51	

Table.4 Seedling length (cm) of naturally aged paddy breeder seeds

Treatment	V1 (IR 36)	V2 (IR64)	V3 (MTU1010)	V4 (Jyotirmayee)	Mean
GA ₃ (100ppm)	37.28	35.50	39.62	35.84	37.06
KNO ₃ (2%)	32.96	31.26	39.54	33.16	34.23
KCl (2%)	36.94	36.78	37.58	33.26	36.14
Hydro priming	34.22	31.62	37.26	34.04	34.29
Control	31.46	34.00	35.08	29.22	32.44
CD (1%)	2.44	2.93	2.36	2.42	
CV%	5.56	6.80	4.91	5.74	

Table.5 Seedling dry weight (mg/plant) of naturally aged paddy breeder seeds

Treatment	V1 (IR 36)	V2 (IR64)	V3 (MTU1010)	V4 (Jyotirmayee)	Mean
GA ₃ (100ppm)	10.40	9.60	9.72	9.16	9.72
KNO ₃ (2%)	8.68	10.08	10.64	9.44	9.71
KCl (2%)	10.96	10.76	10.68	9.52	10.48
Hydro priming	10.40	9.68	10.40	8.64	9.78
Control	9.24	10.20	10.24	8.88	9.64
CD (1%)	0.81	NS	NS	NS	
CV%	6.41	5.85	5.33	4.87	

It is concluded that hydro priming is the best priming treatment in enhancing the germination of naturally aged paddy breeder seeds to a level to satisfy minimum seed certification standards. Further, it is a simple, inexpensive and environmentally friendly approach that could be easily followed by farmers and the seed producing organizations. Therefore, increasing germination percentage of aged seeds by priming technology is a necessary step to prevent resource losses.

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