Rice Seed Vigorization for Improved Storability and Comparison of Treatment Effectiveness on Field Results in the System of Rice Intensification and Traditional Methods

Satpal Singh

Asst. Professor, School of Agriculture, Graphic Era Hill University, Dehradun Uttarakhand India

Abstract:

The current study aimed to provide a straightforward and low-cost seed invigoration therapy to help our farmers prolong the viability of rice seeds during storage. Pre- and during-storage treatments included both dry and moist (soaking-drying) conditions. In order to standardize a cultivation technique for enhanced field performance and productivity, dry-dressing treatments of seed were performed utilizing finely medicinal formulations, chemicals, and crude plant materials.

Keywords: *Rice Seed Vigorization, Improved Storability, Effectiveness, Traditional Methods.*

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Introduction:

In order to improve their viability and tolerance to different stress factors during storage and germination, rice seedlings may be "vigorized" by being treated with chemicals or other materials. Better crop yields may arise from enhanced storability, accelerated germination, and increased seedling vigour [1].

Rice seeds may be made more vigorous by priming, pre-sowing soaking, or coating. Seeds are "primed" by being submerged in a solution of water and chemicals, such as potassium nitrate or gibberellic acid, for a certain amount of time [2]. Soaking the seeds in water for a certain amount of time before planting is known as pre-sowing soaking, while coating the seeds includes adding a film or layer of different substances to the surface of the seeds before sowing is known as coating [3].

Several aspects must be taken into account when evaluating the efficacy of various vigorization treatments on field outcomes in the system of rice intensification (SRI) and conventional approaches. The kind of rice being grown, the climate in which the seeds will be placed, and the methods of farm management all have a role [4].

Different vigorization treatments have been demonstrated to increase yields in both SRI and conventional rice farming. Pre-sowing soaking, for instance, has been proven to boost plant height and grain output in conventional farming, whereas priming with potassium nitrate has been demonstrated to increase yields in SRI [5-7].

It's important to note that many elements might affect the success of vigorization procedures. Some treatments, for instance, may work better on particular types of rice or in particular climates [8]. The success of vigorization treatments may also be affected by the overall management practices of the rice production system, including water and nutrient management [9, 11].

In conclusion, rice seed vigorization may be a useful tool for increasing crop yields and ensuring long-term viability, whether using SRI techniques or more conventional ways. When evaluating the efficacy of various treatments based on field outcomes, it is necessary to account for the fact that the efficiency of individual therapies might vary depending on a number of circumstances.

Materials And Methods

For this experiment, researchers utilized newly harvested seeds of the rice (*Oryza sativa L.*) varieties "Satabdi" and "Swarna masuri" from the Agricultural Experimental Farm of Calcutta University in Baruipur, South 24-Parganas, West Bengal. Seeds were collected, sorted, washed, and sun-dried for four to five days until their moisture content was 10.5%. The seeds were then placed in the rubber-capped glass container with a 2.5-liter capacity and kept at room temperature in the lab until treatment. The following describes the experiments:

Determination of rice seed under ambient conditions on the decline pattern in vigour and viability

After harvesting, rice seeds were washed, dried in the sun until they had a moisture content of 10.5%, and then stored (in increments of 500 g) in a variety of containers, including a cloth bag, a polythene packet, a metal tin, and glass bottles. Seed samples were taken from each container every a month to assess how well they germinated. After 6 days of germination at 20 1°C, data on germination rate and seedling length were recorded.

Research on traditional methods and systems of rice intensification technology for pre-storage seed invigoration treatments to increase storability and enhance field performance, After sorting seeds into pre-storage and mid-storage lots, they were cleaned and dried. Seeds were stored in 750 ml capacity rubber stoppered glass bottles, with each bottle containing 500 g of seed. Pre-storage seed treatments were administered to harvest fresh seed (1 month old), and mid-storage seed invigoration treatments were administered to 5-month-old (medium vigour) seed.

Both pre- and post-aging germination tests were conducted using a modified version of the inclined glass plate blotter method described by Punjabi and Basu (1982). After 7 days of germination at 20 1°C, measurements of root and shoot length were taken.

All germination experiments in the current investigation used this newly standardised glass plate approach. To the closest millimetre, the root and shoot length of healthy seedlings were measured. Normal seedlings alone were used to calculate the mean root and shoot lengths. This thesis makes relatively loose use of the word vigour, which is based on the average root and branch length of the seedlings it produces, regardless of whether the seeds were treated or not.

Irrigation and used cultural practices

During the cropping season, traditional methods required constant maintenance of a standing water depth of 2-3 centimetres. In contrast, simply a consistently wet and saturated soil environment was stated for the SRI technique. Normal procedures for fertilising, weeding, and controlling pests were also carried out. After 12 days of seeding, data on plant population was collected, and before harvest, data on plant height, tillers per unit area, and effective tillers were recorded. Grain yield per area, panicle length, seeds per panicle, and 1000-seed weight were recorded in a replicated fashion for each treatment after harvest.

Efficacy of Rice Intensification technology of mid-storage seed invigoration treatments of rice employing conventional method and system for improved storability and field performance

The rice seeds, which had been kept in the glass bottles with rubber stoppers at room temperature for five months, were treated halfway through their storage period. The previous experiment's treatment specifics, selected technique, and field trials were all adhered to.

Physiological and biochemical changes Studies in relation to seed deterioration

Leaching of electrolytes and sugar from seeds may provide a measure of membrane function.

Statistical analysis

Analysis of variance (Fisher, 1948) was used to statistically analyse the data collected from the laboratory germination test, field trials, and biochemical testing to determine the treatment effects on the preservation of vigour and viability. Root and branch length data were also changed to arc-sin values before analysis, as were germination percentages for treated and untreated seeds.

Results:

Determination of rice seed under ambient conditions of decline pattern in vigour and viability

In the month of December, the germination rate for seeds kept in a cotton bag dropped to 50%, whereas the rate for seeds kept in a metal tin and a glass bottle (both moisture barrier containers) was about 80%. Seeds kept in glass bottles germinated at a greater rate and produced healthier seedlings than those kept in any of the other containers. Seeds were particularly susceptible to degradation under ambient circumstances throughout the months of July, August, and September.

Studies of rice employing conventional method and system of rice intensification technology on pre-storage seed invigoration treatment for extending storability and improved field performance

Immediately after pre-storage treatment, Satabdi rice seeds showed no improvement in germinability compared to untreated control (Table 1). The treated seed only slightly outperformed the untreated seed in terms of root and shoot length. The cultivar Swama masuri produced results with a similar pattern.

Table 1: Rice (*cv. Satabdi* and *Swarna masuri*) seed germinability immediately after pre-storage dry and wet physiological treatment

[A] cv. Satabdi

Treatment		**Control**	**Neem Leaf powder**	**Aspirin**	**Soaking-drying**	**L.S.D value at 0.05 P**	**L.S.D value at 0.01 P**
Germination	%	81	87	92	87	--	--
	Arc-sin value	64.5	69.3	74.1	69.3	NS	NS
Mean root	**length (mm)**	58.15	62.39	65.57	65.33	**NS**	.NS
Mean shoot	**length (mm)**	69.96	69.14	73.38	76.59	**NS**	NS
Vigour Index		10377	11509	12853	12418	-	--

[B] cv. Swarna masuri

	Treatment	**Control**	**Neem Leaf powder**	**Aspirin**	**Soaking-drying**	**L.S.D value at 0.05 P**	**L.S.D value at 0.01 P**
Germination	o/o	80	83	79	85	--	

	Arc-sin value	63.8	66	63	67.6	NS	NS
Mean root	length (mm)	63.58	61.87	59.57	65.37	NS	NS
Mean shoot	**length (mm)**	59.43	74.82	68.4	76.75	0.55	NS
Vigour Index		9661	11414	10174	12151	--	

Efficacy of rice employing conventional method and System of Rice Intensification Technology of mid-storage seed invigoration treatments for improved storability and field performance

There was no difference between treated and untreated seeds in terms of germination rate before ageing (just after treatment) (Table 2). Accelerated, however, resulted in a statistically significant increase in the germination percentage and the root and shoot length of the treated seeds compared to the untreated control (Table 3). The proportion of germinated seeds, as well as the length of the resulting seedlings, was both greater in the treated seeds than in the control. Seed invigoration treatments were shown to be effective in increasing storability in both the *cv. Satabdi* and *cv. Swama masuri* cultivars compared to their respective controls.

Table 2: Mid-storage seed invigoration treatments Effect of rice seed (*cv. Satabdi* and *Swarna masuri*) on the germinability immediately after treatment (before ageing)

[A] cv. Satabdi

	Treatment	Control	Neem leaf powder	Aspirin	Soaking-drying	L.S.D. value at 0.05 P	L.S.D. value at 0.01 P
Germination	%	80	86	84	84	--	--
	Arc-sin value	63.44	68.03	66.42	66.42	NS	NS
Mean root	**(mm)**	98	107	111	108	NS	NS

length							
Mean shoot length	**(mm)**	64	71	75	76	1.5	2.6
Vigour Index		12960	15308	15624	· 15456	--	--

[B] cv. Swarna masuri

	·. Treatment	**Control**	**Neem leaf powder**	**Aspirin**	**Soaking-drying**	**L.S.D. value at 0.05 P**	**L.S.D. value at 0.01 P**
Germination	%	78	84	80	82	--	
	Arc-sin value	62.03	66.42	63.44	64.9	NS	NS
Mean root length (mm)		86	90	94	91	NS	NS
Mean shoot length (mm)		42	44	48	49	1.3	2.3
Vigour Index		9984	11256	11360	11480	-	

Table 3 : Mid-storage seed invigoration treatment Effect of rice seed (*cv. Satabdi* and *Swarna masuri*) on the germinability after subjecting to accelerated ageing at 100% RH and 40 ± 1°C temperature for 14 days

[A] cv. Satabdi

Treatment			**Control**	**Neem leaf powder**	**Aspirin**	**Soaking-drying**	**L.S.D. value at 0.05 P**	**L.S.D. value at 0.0! P**
Germination	%		69	76	79	74 -	-	-
	Arc-	**value**	56.17	60.67	62.72	59.34	NS	NS

	sin						
Mean root length (mm)		71	·74	77	76	1.6	NS
Mean shoot length (mm)		44	44	47	46	1.5	NS
Vigour Index		7935	8968	9796	9028	-	-

[B] cv. Swama masuri

Treatment		**Control**	**Neem leaf powder**	**Aspirin**	**Soaking-drying**	**L.S.D. value at 0.05 P**	**L.S.D. value at 0.01 P**
Germination	%	62	66	63	65	--	--
	Arc-sin value	51.94	54.33	52.33	53.73	1.14	NS
Mean root length (mm)		62	69	74	70	1.3	2.3
Mean shoot length. (mm)		30	37	38	36	1.4	2.3
Vigour Index		5704	*6996*	7056	6890	--	--

Physiological and biochemical changes studies in relation to seed deterioration

Physiological and biochemical tests conducted on seeds of both cultivars immediately following treatment showed no significant differences in germination rate, membrane permeability (as measured by electrolyte leakage and sugar leaching), or dehydrogenase enzyme activity (Table 4). The membrane permeability and enzyme activity of both cultivars were found to be comparable right after treatment, before the ageing test. Accelerated ageing (RH 100% and 40°C for 12 days) improved germination percentage and decreased electrolyte and sugar leakage in both cv. Satabdi and cv. Swarna masuri treated seeds compared to their respective control Table 5. Both cultivars' treated seed exhibited considerably increased dehydrogenase enzyme activity compared to their respective controls.

Table 4: Effect of pre-storage dry and wet physiological treatment of stored rice seed immediately after treatment (before ageing) of sugar and dehydrogenase enzyme activity on germination percentage, electrical conductance of seed leachate, leakage

[A] cv. Satabdi

Treatment		**Control**	**Neem leaf powder**	**Aspirin**	**Soaking-drying**	**L.S.D. value at 0.05 P**	**L.S.D. \ralue at 0.01 P**
Germination	%	80	86	89	85	--	
	Arc-sin value	63.4	68	70.6	67.2	NS	NS
Electrical conductance (dsni"1)		1.1	1.3	1.5	1.2	NS	NS
Leakage of	sugar. (µg/ml)	0.04	0.07	0.04	0.04	NS	NS
Dehydrogenase activity (O.D.)		0.2	0.22	0.24	0.21	0.01	NS

[B] cv. Swama masuri

	Treatment	**Control**	**Neem leaf powder**	**Aspirin**	**Soaking-drying**	**L.S.D. value at 0.05 P**	**L.S.D. value at 0.01 P**
Germination	%	82	86	81	84	--	
	Arc-sin value	64	68	64.1	66.4.	NS	NS
Electrical conductance (dsm^{-1})		1.5	1.2	1.4	1.8	NS	NS
Leakage of sugar	(µg/ml)	0.08	0.08	0.07	0.07	NS	NS
Dehydrogenase activity (O.D.)		0.19	0.16	0.2	0.22	0.01	NS

Table 5: Effect of pre-storage seed invigoration treatments on dry and wet physiological treatment on germination percentage, electrical conductance of seed leachate, leakage of sugar and dehydrogenase enzyme activity of stored rice seeds after subjecting to accelerated ageing at 100% RH and 40 ± 1°C temperature for 12 days

[A] *cv. Satabdi*

Treatment	**%**	**Control**	**Neem leaf powder**	**Aspirin I 70**	**Soaking-drying I**	**L.S.D. value at 0.05 P**	**L.S.D. value at 0.01 P**
Germination						--	
	Arc-sin value.	49.6	59.3	56.8	57.4	5.03	NS
Electrical conductance (dsm"^{1})		3.9	3	3.5	3.9	0.22	0.4
Leakage of sugar	(µg/ml)	0.17	·0.15	0.14	0.12	0.02	NS
Dehydrogenase activity (O.D.)		0.07	0.09	0.1	0.09	0.02	NS

[B] *cv. Swarna masuri*

Treatment	**Germination**		**Electrical conductance (dsm"^{1})**	**Leakage of sugar (µg/ml)**	**Dehydrogenase activity (0.D.)**
	%	**Arc-sin value**			
Control	62	51.9	3.9	0.14	0.05
Neem leaf powder	72	58.1	3.8	0.12	*0.0*
Aspirin	70	56.8	3.1	0.11	0.06
Soaking-drying	73	58.7	3.6	0.16	0.10
L.S.D. value at 0.05 P		3.4	0.20	0.017	0.02

L.S.D. value at 0.01 P	--	NS	0.40	0.031	0.04

Conclusion:

When it comes to improving yield and other yield features, the System of Rice Intensification technique of cultivation clearly outperforms the traditional way. For this reason, the System of Rice Intensification (SRI) may recommend dry treatments with neem leaf powder (2 g/kg of seed) or aspirin (100 mg/kg of seed) in high vigour rice seeds before harvest to enhance the seeds' capacity to withstand storage and field conditions. Mid-storage soaking-drying treatment may be used to enhance rice's storability and field performance if the seeds are of medium vigour grade.

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