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RESEARCH ARTICLE

Influence of seed invigouration and foliar spray on seed yield of semi dry rice

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SUMMARY

A study was conducted in Soil and Water Management Research Institute, Thanjavur with different combination of seed treatments and foliar spray on growth parameters of rice and its seed yield. Paddy variety Anna (R) 4 seeds were invigourated with different seed treating chemical/biocontroll agents *viz*., 1% Potassium Chloride, 750 PPM Gelatin (commercial grade), 2% Pigmented Facultative Methylotroph (PPFM) for 12 hours soaking and dried back to original moisture content of 13%. The seeds were dibbled with a spacing of 20 x 10 cm and other recommended package of practice was followed to all the plots. Foliar nutrition on 60 and 90 days after sowing was done with 2% DAP, 4 % cowpea sprout extract and 4 % horsegram sprout extract were applied. Seeds hardened with 2% Pink Pigmented Facultative Methylotroph (PPFM) for 12 hrs and foliar spray with 4 % cowpea sprout extract on 60 and 90 days after sowing recorded significant enhancement in productive tillers, seeds /panicle, 1000 seed weight and 11 per cent higher seed yield than the control.

Key Words : Rice invigouration, KCl, Foliar spray, DAP, PPFM, Field establishment, Seed yield

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Rice (*Oryza sativa* L.) is a staple food for more than half of the world population which provides about 55 to 80 % of total calories for people in South Asia, Southeast Asia, and Latin America. In the rest of the world, it represents a high-value commodity crop. The food security of World is confronted by escalating food demand and endangered by dwindling water availability. In these situations, both farmers and researchers are devising strategies for water-wise crop production without compromising on yield (Gleick, 1993). The dedicated efforts of the researchers have lead to a new way of cultivating rice that requires lesser water than the conventional production system. In this new method, rice is grown in aerobic soils using

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supplementary irrigation like other cereals and aims for high yields (Huaqi *et al*., 2002). Although aerobic rice is an attractive alternative to the traditional rice production system (Balasubramanian and Hill, 2002; Farooq *et al.,* 2006), poor stand establishment and high weed infestation are major constraints in its mass scale adoption (Farooq *et al*., 2006). One major advantage of a traditional transplanting system is weed control, which would need special emphasis in aerobic rice culture (Farooq *et al*., 2006). The age of nursery seedlings is one of the important determinants of seedling establishment in transplanted rice. In convention method, seeds are used for growing nurseries in most parts of the world, which result in poor and erratic seedling growth. In a system of rice intensification, younger nursery seedlings are transplanted than the conventional transplanting system (Farooq *et al*., 2006). The growth of rice nursery seedlings and, subsequently, their performance in transplanted culture can also be improved through seed invigouration. Seed invigouration is reported to rapid root growth that enhances nutrient and water uptake (Farooq et al. 2006). It improves the tolerance to low temperature (Naidu and Williams, 2004; Sasaki *et al.,* 2005), salinity (Ruan *et al*., 2003; Kim *et al.,* 2006) and drought (Harris and Jones, 1997; Du and Tuong, 2002) by enhancing the activities of antioxidants, including superoxide dismutase, catalase (Fashui, 2002; Deshpande *et al*., 2003), peroxidases, and glutathione reductase (Fashui, 2002). Besides, priming reduced the levels of active oxygen species and plasma membrane permeability (Fashui, 2002). Although earlier reviews (Khan, 1992; Basu, 1994; Bray, 1995; Taylor *et al*., 1998; Welbaum *et al*., 1998; McDonald, 2000; Harris, 2006) dealt elegantly with seed invigoration in various crop species, no single review is available on rice. Suitable seed invigoration technique coupled with foliar spray can improve seed performance, produce elite seedling and thereby improves the productivity. Hence, an attempt was made to study suitable seed invigouration techniques along with foliar spray for improving productivity of rice under semi dry conditions.

MATERIAL AND METHODS

A lab and field study was conducted in Soil and Water Management Research Institute, Thanjavur with different seed invigouration treatments. In lab study, seed invigourating bioactive agents were selected in order to produce the elite seedlings in such a way that seeds were invigiurated with following bioactive agents, *viz*., 1% Potassium Chloride (KCl), 750 PPM Gelatin (commercial grade) and 2% Pigmented Facultative Methylotroph (PPFM) for 12 hours of soaking and then seeds were tried back to original moisture content of 13 %. The invigourated seeds were placed for germination test as per ISTA (1999) in sand media and vigour index was computed as per Abdul- Baki and Anderson, (1967). Further, their effectiveness was evaluated by raising rice crop (Variety Anna 4)) during *Rabi,* 2013 by following completely randomized design with four replications under semi dry situations and the yield parameters like productive tillers / m^2, seeds / panicle, seed yield (kg/ m^2) and computed seed yield (kg/ ha) at field were collected.

Outcome of the seed invigouration treatments, the best two treatments *viz*., 2% PPFM and 750 PPM Gelatin were chosen for studying the additive performance of foliar spray at 60 and 90 days after sowing (DAS) with organic and inorganic nutrients *viz*., 2% DAP, 4% Cowpea sprout extract and 3% Horse gram extract. The field trial was laid out Factorial Completely Randomized Design with three replications during *Rabi*, 2014. The yield parameters like productive tillers / m^2, seeds / panicle, seed yield (kg/m^2) and computed seed yield (kg/ ha) were observed.

The data gathered were analyzed as per Panse and Sukhtme (1957) for analyzing the significance between the treatments.

RESULTS AND DISCUSSION

Among the seed invigouration treatments, the seeds treated with Gelatin @ 750 ppm for a period of 12 hours soaking significantly performed better as compared to all other treatments and recorded 5, 15, 41 and 69 per cent increase on germination, seedling emergence, seedling length and vigour index respectively over control (Table 1). Similarly, the seed invigouration with PPFM @ 2 per cent for a period of 12 hours soaking was found to be recorded the next best treatment with increase on 14, 11, 29 and 53 per cent of germination, seedling emergence, seedling length and vigour index respectively over control.

At field level, seed invigouration with Pink Pigmented Facultative *Methylotroph* (PPFM) @ 2% recorded significantly recorded highest number of productive tillers/ m^2 (278), seeds/panicle (57.56), seed yield (0.358 kg/m^2) and computed grain yield (3580 kg/

ha) than other treatments (Table 2). The best two treatments *viz*., seed hardening with Gelatin @750 ppm and PPFM @ 2% were taken for further study with foliar nutrition.

Among the different combinations of seed invigouration treatments and foliar treatments, seed invigouration with Pink Pigmented Facultative *Methylotroph* (PPFM) @ 2% and foliar spray with cowpea sprout extract @ 4 % on 60 and 90 DAS significantly recorded the highest number productive tillers/ m^2 (409), grains /panicle (68.82), grain yield (0.467 kg/m^2), computed grain yield (4670 kg/ha) and than other treatments (Table 3).

The main reason for increase vigour in invigourated seeds is due to different physiological activities within the seed occur at different moisture levels and the last physiological activity in the germination process is the emergence of radicle (Vertuci and Leopold, 1984; Taylor, 1998). The initiation of radical emergence requires high seed water content (upto 30%).By limiting seed water content, all the metabolic steps necessary for germination can ocour without the irreversible act of radical emergence. Prior to radical emergence, the seed is considered desiccation tolerant, thus the invigourated moisture content can be reduced by drying. Hence, this might be the main reason for better performance of seed invigouration.

The foliar spray greatly influenced on emergence of tillers and other yield yield attributing parameters. Better assimilation of photosynthates due to better utilization of solar radiation might have increased the size of sink and effective translocation of assimilates, which might have lead to improved grain yield. Higher translocation and conversion rates of stored matter from

Table 1: Influence of seed invigouration on seed germination and seedling vigour of paddy

Treatments	Seedling emergence on 7th day (%)	Seed germination (%)	Seedling length (cm)	Vigour index
Unsoaked seeds (Control)	65	75	32.5	2438
Water soaking	69	78	38.8	3026
Potassium chloride @ 1.0 %	70	86	38.0	3268
Gelatin @ 750 ppm	81	90	45.8	4122
PPFM @ 2 %	76	89	42.0	3738
CD (0.05%)	0.112	0.236	2.021	15.874

Table 2 : Effect of different seed invigouration techniques on growth and yield parameters under water deficit condition

Treatment	Plant height (cm) at 90 DAS	Productive tillers/ m^2	Grains/ panicle	1000 seed weight (g)	Grain yield (kg/m^2)	Computed grain yield (kg/ha)
Untreated seed	98.0	264	55.71	21.56	0.321	3210
Potassium chloride @ 1.0 %	98.5	271	57.18	22.11	0.339	3390
Gelatin @ 750 ppm	98.0	268	56.12	21.89	0.329	3290
PPFM @ 2 %	99.0	278	57.56	22.89	0.358	3580
CD (0.05%)	NS	10.66	1.655	0.658	0.018	104.56

Table 3 : Effect of different seed crop invigouration techniques on on growth and yield parameters under water deficit condition

Foliar spray (F)	Productive tillers/ m^2			Seeds / panicle			Grain yield (kg/ m^2)			Computed grain yield (kg/ha)		
	Seed treatments (I)			Seed treatments			Seed treatments			Seed treatments		
	PPFM	Gelatin	Mean	PPFM	Gelatin	Mean	PPFM	Gelatin	Mean	PPFM	Gelatin	Mean
Unsprayed	318	298	308	61.22	59.12	60.17	0.426	0.401	0.414	4260	4010	4135
DAP @2%	381	354	368	64.60	60.38	62.49	0.446	0.413	0.430	4460	4130	4295
Cowpea sprout extract @ 4 %	409	396	403	68.82	67.46	68.14	0.467	0.441	0.454	4670	4410	4540
Horse gram sprout extract @ 3 %	398	382	390	65.32	63.60	64.46	0.462	0.433	0.448	4620	4330	4475
Mean	377	358		64.99	62.64		0.450	0.422		4503	4220	
	F	I	FI	F	I	FI	F	I	FI	F	I	FI
CD(0.05)	4.25	3.15	7.50	0.530	1.001	1.529	0.023	0.014	0.021	27	58	92

vegetative organs was significant importance for enhanced seed filling and spike weight in SRI rice (Wang *et al.,* 2002). The pulses sprout extract are contains secondary amino acids and hormones which helps improve the physiological activities that favour source sink assimilation. These results are in conformity with Kohila *et al*. (2014) in paddy.

Conclusion:

Seed hardening with 2% Pink Pigmented Facultative *Methylotroph* (PPFM) and foliar spray of 4 % cowpea sprout extract on 60 and 90 DAT is important to achieve higher production and productivity in paddy production under semi dry condition.

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