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EFFECT OF OSMOPRIMING OF BORO RICE SEEDS ON FIELD ESTABLISHMENT OF SEEDLINGS

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Abstract

An experiment was conducted at the Seed Laboratory of the Department of Agronomy, Bangladesh Agricultural University, Mymensingh during the period from January to April 2012 to study the effect of osmopriming of *Boro* rice seed (cv. BRRI dhan29). Seeds were soaked in 1%, 3% and 5% solutions of ZnSO₄, KCl and CaCl₂ for 24 hours, respectively, with 30 hours incubation at 35°C temperature. Seed quality tests such as percent germination, mean germination time, vigor index, shoot length, root length, shoot dry weight and root dry weight of rice seedlings were measured for all treatments. Population m⁻² was also calculated to investigate the field establishment of primed seeds. The highest germination, vigor index, population m⁻², shoot length and shoot dry weight at 15 and 30 DAS, root length at 15 DAS, root dry weight at 15 and 30 DAS and the lowest mean germination time was observed from priming of seeds with 3% ZnSO₄. Exceptionally, priming with 3% CaCl₂ showed the highest root length at 30 DAS. On the contrary, 3% and 5% CaCl₂ priming treatment showed the lowest germination, vigor index, population m⁻², shoot length and shoot dry weight at 15 and 30 DAS, root length at 15 DAS, root dry weight at 15 and 30 DAS and the highest mean germination time. It can be concluded that rice seed (cv. BRRI dhan29) can be primed with 3% ZnSO₄ solution for improving germination and field establishment of seedlings.

Key words: Rice, Osmopriming, Germination, Vigor, Seedling establishment.

Introduction

Rice (*Oryza sativa* L.) is life for most people living in Asia. Rice has shaped the cultures, diets and economies of thousands of millions of people. Considering its important position, the United Nations designated year 2004 as the International Year of Rice. It is the grain with the second highest worldwide production after maize (FAOSTAT, 2010). World rice demand is predicted to increase by 25% from 2001 to 2025 (Maclean *et al.*, 2002).

Rice is the most important and extensively cultivated cereal crop in Bangladesh. Rice has been considered as staple food of the Bangladeshi people. About 80% of the total cultivated lands in Bangladesh are used for rice cultivation and its total production is 31.98 million metric tons (BBS, 2011).

Rice production depends on a number of factors. Quality seed is one of the important factors for the production of rice. Optimum crop stand establishment is the prerequisite for successful production. If the crops are given a good start at the beginning of life, they usually grow well, strong and healthy. Seedling that germinates faster and grows rapidly are able to

produce sufficient deep root system before the seed bed dried out and harden and these seedlings have enough competitive ability against weeds and seedling diseases.

At this situation seed priming can be a simple solution towards stand establishment (Harris *et al.*, 2002). Good seedling establishment is an important constraint to crop production in semi arid tropics (Itabari *et al.*, 1993; Harris *et al.*, 1999). Germination and seedling growth are appraised on the basis of important physiological and biochemical attributes mainly related to the rapidity of germination, vigorous seedling and reserve metabolism pattern. Priming treatments have been found to enhance the amylase activity which is positively correlated with the reserve mobilization and germination rate in rice (Lee and Kim, 2000; Basra *et al.*, 2005). Priming increases level of α -amylase activity as reported by Basra *et al.* (2005) in hardened rice seeds.

Osmopriming of seeds are being used in many parts of the world to reduce the germination time, to get synchronized germination, improve germination rate

and better seedling establishment in many field crops like rice (Lee and Kim, 1999, 2000; Basra *et al.*, 2004; Farooq *et al.*, 2004), wheat, maize (Dell and Tritto, 1990; Basra *et al.*, 2003). Osmopriming practically ensures rapid and uniform germination and it has potential in improving field emergence and ensures early flowering and harvesting under stress condition, especially in dry areas.

Hence, the present study was undertaken to investigate the effect of osmopriming on seed germination and seedling establishment of rice with the objectives to select the best priming chemical and concentration improving seedling establishment of *Boro* rice and to see the effects of osmopriming on the field establishment potential of seedlings.

Materials and Methods

This experiment was conducted at the Seed Laboratory of the Department of Agronomy, Bangladesh Agricultural University (BAU), Mymensingh during the period from January to April 2012. Seeds of rice variety BRRI dhan29 were used as the test material in the experiment. This rice variety is one of the modern varieties of *Boro* rice developed by the Bangladesh Rice Research Institute (BRRI) in 1994. Seeds of BRRI dhan29 were collected from the Agronomy Field Laboratory, Department of Agronomy, BAU, Mymensingh. Rice seeds were soaked in 1%, 3% and 5% solutions of ZnSO₄, KCl and CaCl₂ for 24 hours and incubated for 30 hours at 35°C in incubator. Therefore, there were 9 treatment combinations. The experiment was laid out in a two factor Completely Randomized Design with three replications. Sterilized sand was used as germination media and plastic pot was used as container. The moisture content of the media was maintained at 80% of the field capacity. The sand was collected from Brahmaputra River. Seed quality parameters viz. germination percentage, mean germination time (days), vigor index, seedlings shoot length and root length (cm) at 15 and 30 days after sowing (DAS), seedlings shoot dry weight and root dry weight (g) at 15 and 30 DAS, and population m⁻² were recorded. The germination test was conducted at 25°C temperature in germination room of Seed Laboratory. Daily count of germination of seed was taken on the basis of emergence from the media to calculate data on mean germination time and it was calculated using the formula- Mean germination time (MGT) = $\frac{\sum tn}{\sum n}$ where, t = days to germination, n = number of seedlings germination on day (Goodchild and Walker, 1971). Daily count of germination of seed was taken to calculate data on vigor index. It was calculated by the following formula (Maguire, 1962) vigor index (VI) =

$\frac{X_1}{N_1} + \frac{X_2}{N_2} + \dots + \frac{X_n}{N_n}$ where, X₁ = number of seedlings at first count, N₁ = number of days at first count, X₂ = number of seedlings at second count, N₂ = number of days at second count, X_n = number of seedlings at final count, N_n = number of days at final count. To record data on shoot and root length randomly 10 normal seedlings were selected from each pot were taken. These seedlings were then dried in an electric oven at 72°C temperature for 48 hours and their dry weights of shoots and roots were recorded. For the measurement of plant population m⁻² primed seeds were sown in pots filled with soil in the dry bed direct seeded (DBDS) system. In one square meter area there were 26 hills whereas three seeds were sown in each hill. Population m⁻² was calculated accordingly with the capability of germination percentage of rice seeds.

Results and Discussion

There was significant effect on germination, mean germination time, vigor index, shoot length and root length of rice seedlings due to osmopriming treatments. The highest germination was obtained in seed primed with 3% ZnSO₄ solution followed by 1% ZnSO₄, 1% KCl whereas the lowest germination was found in seed primed with 3% CaCl₂ solution for 24 hours. This result is in agreement with that of Prom-U-Thai *et al.* (2012) and Takhti and Shekafandeh (2012). The lowest mean germination time was obtained in seed primed with 3% ZnSO₄ solution followed by 1% ZnSO₄, 1% KCl, whereas the highest mean germination time was found in seed primed with 5% CaCl₂ solution. Similar results were reported by Harris *et al.* (2002) and Lee *et al.* (1998). At all the conditions the highest vigor index was found in seed primed with 3% ZnSO₄ solution followed by 1% KCl and 5% ZnSO₄. On the other hand, the lowest vigor index was found in seed primed with 5% CaCl₂ solution. This result is similar to that of Harris *et al.* (2000); Lee and Kim (2000); Basra *et al.* (2003); Prom-U-Thai *et al.* (2012) and Takhti and Shekafandeh (2012). The shoot length of rice seedlings at 15 DAS for different treatments ranged between 16.94 cm and 21.12 cm. At all conditions, the highest shoot length at 15 DAS was found in seed primed with 3% ZnSO₄ solution. On the other hand, the lowest shoot length at 15 DAS was found in seed primed with 3% CaCl₂ solution. The highest shoot length (30.51cm) at 30 DAS was found in seed primed with 3% ZnSO₄ solution whereas the lowest shoot length (27.45 cm) at 30 DAS was found in seed primed with 1% CaCl₂ solution. At all conditions, the highest root length (7.83 cm) at 15 DAS was found in seed primed with 3% ZnSO₄

solution whereas the lowest root length (5.59 cm) at 15 DAS was found in seed primed with 3% CaCl₂ solution. This result is in agreement with that of Tongma *et al.* (2001), Farooq *et al.* (2006c), Prom-U-Thai *et al.* (2012) and Takhti and Shekafandeh (2012). The highest root length (14.10 cm) at 30 DAS was found in seed primed with 3% CaCl₂ solution whereas the lowest root length (10.03cm) at 30 DAS was found in seed primed with 1% ZnSO₄ solution. These result are in agreement with that of Islam *et al.* (2012), Farooq *et al.* (2008), Farooq *et al.* (2006a) and Ruan *et al.* (2002). The dry weights of shoot and root were not significantly affected by osmopriming. Apparently the highest shoot dry weight at 15 DAS of rice seedlings (0.063 g) was obtained in seed primed with 3% ZnSO₄ solution followed by 1% ZnSO₄, 1% KCl whereas the lowest shoot dry weight of rice seedlings (0.034 g) was found in seed primed with 3% CaCl₂ solution. Numerically the highest shoot dry weight at 30 DAS of rice seedlings (0.139 g) was obtained in seed primed with 3% ZnSO₄ solution followed by 5% ZnSO₄, 1% ZnSO₄, 5% KCl whereas the lowest shoot dry weight of rice seedlings (0.076 g) was found in seed primed with 3% CaCl₂ solution.

This result of the present study is in agreement with that of Farooq *et al.* (2006b, 2007 and 2008), Tongma

et al. (2001), Prom-U-Thai *et al.* (2012) and Takhti and Shekafandeh (2012). The highest root dry weight of rice seedlings (0.025 g) at 15 DAS was obtained in seed primed with 3% ZnSO₄ solution followed by 5% ZnSO₄, 1% ZnSO₄, 5% KCl whereas the lowest root dry weight of rice seedlings (0.008 g) was found in seed primed with 1% CaCl₂ solution. The highest root dry weight of rice seedlings (0.057 g) at 30 DAS was obtained in seed primed with 3% ZnSO₄ solution followed by 5% ZnSO₄, 1% ZnSO₄, 3% KCl whereas the lowest shoot dry weight of rice seedlings (0.035 g) was found in seed primed with 3% CaCl₂ solution. Similar results were also found by Prom-U-Thai *et al.* (2012) and Takhti and Shekafandeh (2012). Osmopriming treatments had significant effect on population m⁻² of rice seedling. The population m⁻² of rice seedling for different treatments ranged between 76.44 and 69.94. The highest population m⁻² of rice seedlings (76.44) was obtained in seed primed with 3% ZnSO₄ solution followed by 1% KCl, 1% ZnSO₄, 3% KCl whereas the lowest population m⁻² of rice seedlings (69.94) was found in seed primed with 3% CaCl₂ solution. This result of the present study is in agreement with that of Esmeili and Heidarzade (2012) and Takhti and Shekafandeh (2012).

Table 1: Effect of chemicals and concentration on germination percentage, shoot length, root length, shoot dry weight, root dry weight, population, mean germination time and vigor index of BRR1 dhan29

Chemical	Concentration (%)	Germination percentage	Shoot length at 15 DAS (cm)	Shoot length at 30 DAS (cm)	Root length at 15 DAS (cm)	Root length at 30 DAS (cm)	Shoot dry weight at 15 DAS (g)	Shoot dry weight at 30 DAS (g)	Root dry weight at 15 DAS (g)	Root dry weight at 30 DAS (g)	Population m ⁻² (No.)	Mean germination time (days)	Vigor index
ZnSO ₄	1	94.44bc	20.87a	27.85d	6.830c	10.03f	0.056	0.117	0.017	0.042	73.59bc	6.94 de	10.38b
	3	98.00a	21.12a	30.51a	7.830a	11.80d	0.063	0.139	0.025	0.057	76.44a	6.027e	12.99a
	5	93.0cd	18.55c	26.21e	7.210b	11.33e	0.048	0.132	0.019	0.049	72.54cd	7.543 bcd	9.173bc
KCl	1	95.00b	19.81b	27.59d	7.280b	13.24b	0.050	0.095	0.014	0.040	74.27b	7.19 cd	10.46b
	3	93.67bcd	18.16c	27.89d	5.970de	14.09a	0.037	0.096	0.010	0.044	73.31bc	8.670 ab	7.393de
	5	93.67bcd	18.40c	28.03cd	6.163d	12.40c	0.041	0.104	0.011	0.042	73.06cd	8.260 abc	8.167cd
CaCl ₂	1	92.33d	18.42c	27.45d	5.760ef	12.46c	0.035	0.078	0.008	0.038	72.02d	7.257 cd	8.860cd
	3	89.67e	16.94d	28.96b	5.590f	14.10a	0.034	0.076	0.009	0.035	69.94e	8.607 ab	7.510de
	5	92.33d	18.21c	28.63bc	5.600f	13.76a	0.036	0.084	0.011	0.038	72.02d	9.317 a	6.873e
Level of significance	**	**	**	**	**	**	NS	NS	NS	NS	**	**	**

The figures in a column having the same letter or without letter do not differ significantly, whereas figures with dissimilar letter differ significantly as per DMRT.

NS= Not significantly different at p ≤ 0.05

** = Significant at 1% level of probability

In conclusion, it can be stated that *Boro* rice (cv. BRRI dhan29) seed can be primed with 3% ZnSO₄ solution for improving germination and field establishment of seedlings.

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