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To find out the effect of seed priming on growth and yield parameter of rice

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Abstract
The present investigation entitled "To find out the effect of seed priming on growth and yield parameter of rice" was carried out at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur during *Kharif* season 2015-16. The soil of experimental field was clayey in texture (*Vertisols*), neutral in pH and has 0.64 % organic carbon, low nitrogen, high phosphorus and potassium content. Experiment was laid out in Randomized Block Design (RBD) with three replications. The rice variety Rajeshawari tested under two different recommended doses of fertilizers *i.e.* 100% (100:60:40 $N:P_2O_5:K_2O$ kg ha^{-1}) and 80% (80:48:32 $N:P_2O_5:K_2O$ kg ha^{-1}) and seed priming along with distilled water and nutrients *i.e.* potassium dihydrogen phosphate (KH_2PO_4) and EDTA Zn of concentration 0.5% P and 0.1% Zn, respectively. Seeds were primed in distilled water and nutrient solution for 12 hrs and then air-dried for 2 hrs. Dry seeds was also used as control. They were sown in mini plots in field. Plants were harvested after maturity. The result of experiments indicated that 100% GRD with seed priming (N0: P (0.5%): K0: Zn (0.1%)) registered maximum growth and yield characters of rice like number of effective tillers, number of filled grain per panicle and test weight followed by 100% GRD with water soaked seed.

Keywords: Rice, nutrient priming sources: potassium dihydrogen phosphate, EDTA Zn, water soaking, different doses of fertilizer: 100% GRD and 80% GRD, nutrient uptake

Introduction

Rice (*Oryza sativa* L.) is one of the leading food crops in the world. It is reported to feed approximately one half of the world's population. Rice is the most important and extensively cultivated food crop that has been referred as "Global Grain" because of its use as prime staple food in about 100 countries of the world. India is the second largest producer of rice after china has an area of over 43 million hectares and production was 105.24 million tonnes with an average productivity of 2462 kg per hectares (Anonymous, 2014). Chhattisgarh state is popularly known as "Rice bowl of India" because maximum area is covered under rice during kharif and contribute major share in national rice production. The total estimated area of rice in chhattisgarh is 3.68 million hectares, production is 7.44 million hectares and productivity is 2020 kg per hectares, in 2013-2014 (Krishi darshika, 2015) [11].

Phosphorus is an important plant macronutrient, making up about 0.2% of a plant's dry weight. Phosphorus is the second most important nutrient that limit crop yield particularly in developing countries where high cost, lack of infrastructure and poorly operating markets limit their use. The previous researches clearly indicated that Zn-deficient plants showed reduced rate of protein synthesis and protein content. Zinc is essential for the synthesis of plant growth regulators like auxins, also act as a metal activator of several enzymes, involved in the synthesis of protein and nucleic acids in plants. Several worker reported that Zn indicate an antagonistic effect with K, Mn, Fe and Ca. Other hand, Zn undergo to submerged condition in rice soil change the behavior double valency charge to single valency charge and free for attached with other ions so that it can not be available to plant. Several research has shown that in saturated soils, rice can not take up Zn as effectively under flooded conditions. N and P also affect zinc uptake by the plants (Khalil and Jan, 2002) [10].

Seed priming comprises the soaking of seed in water and drying back to the storage moisture until use. The soaking induces a range of biochemical changes in the seed that are required to start the germination process (breaking of dormancy, hydrolysis or metabolism of inhibitors, imbibitions and enzyme activation). Some or all of these process that precede the germination are triggered by priming and persist following the redesiccation of seeds.

Thus, upon seedling, primed seed can rapidly imbibe and revive the seed metabolism, resulting in a higher germination rate and a reduction in the inherent physiological heterogenity in germination.

Soaking in water was reported very effective for germination of most seeds but further beneficial effects are reported when soaked in dilute solutions or the chemicals such as sodium phosphate, sodium chloride (NaCl), potassium chloride (KCl) and potassium dihydrogen phosphate (KH_2PO_4).

Materials and Methods

The experiment was conducted at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur during *Kharif* season 2015-16. The soil of the experimental field was clayey in texture (*Vertisols)* having normal pH, medium in organic carbon, low in available nitrogen and medium in available phosphorus and potassium status. The available iron, zinc, manganese and copper content of the experimental field was sufficient.

Experimental Details

The experiment was laid out in randomized block design with three replications and eight treatments *i.e.* water soaked seed, seed priming with nutrients (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$), dry seed 100% GRD, water soaked seed 100% GRD, seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) 100% GRD, dry seed 80% GRD, water soaked seed 80% GRD and 80% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$). The Rajeshawari rice cultivar was the test crop.

Method of seed priming

Seed priming by water soaking (for 1 ha): 80 kg seeds were soaked in 52 litre of aerated distilled water for 12 hours and then air-dried for 2 hours.

Seed priming with (N_0: $P_{(0.5\%)}$: K_0: $Zn_{(0.1\%)}$): Rice seeds were soaked in 0.5% P (KH_2PO_4) and 0.1% Zn (EDTA Zn) solution for 12 hours and then air-dried for 2 hours.

Solution preparation (For 1 ha): To prepare solutions containing 0.5% P (1.14 kg KH_2PO_4) and 0.1 % Zn (400 gm EDTA Zn) were dissolved in 52 litre of distilled water and then 80 kg seeds were soaked for 12 hours and then air-dried for 2 hours.

Results and Discussion

Effect of seed priming on growth parameter of rice

Plant Population

Table 1 revealed that the number of plants was not significantly varied under different treatments and it ranged from 53.5 to 56 with an average of 54.15 plants m^{-2}.

Effective tiller

Results on effective tillers are presented in Table 1 and depicted in Fig.1 revealed that the numbers of effective tillers were significantly influenced by the treatments. The treatments primed with water and nutrients *i.e.* Water soaked seed 100% GRD (T_4), seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) 100% GRD (T_5) and seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) 80% GRD (T_8) were at par when compared with dry seed 100% GRD (T_3). 80% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_8) did not vary significantly with water soaked seed 80% GRD (T_7) but significantly superior with dry seed 80% GRD (T_6). 80% GRD with water soaked seed (T_7) was at par with dry seed 80% GRD (T_6). The lowest number of effective tiller was observed in water soaked seed (T_1) and seed priming with nutrients (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_2).

Priming rice seed resulted in enhancement of initial seedling vigour, which resulted in early and uniform emergence of healthy and vigorous seedlings which gave a vigorous start. Healthy seedlings resulted in higher number of tillers m^{-2} and number of effective tillers m^{-2}. Similar results were also found by Reddy (2004) [15] and Farooq *et al*. (2007) [3]. Zheng *et al*. (2002) who were also found increasing of tillers number in rice and wheat via applying seed priming treatment.

Filled grains per panicle

Filled grain per panicle is an important yield component of rice (Hafeez *et al*. 2010). it was significantly influenced by the treatments. 100% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_5) did not vary significantly with water soaked seed 100% GRD (T_4) but significantly superior with dry seed 100% GRD (T_3).Water soaked seed 100 % GRD (T_4) was also at par with dry seed 100% GRD (T_3). 80% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_8) did not vary significantly with water soaked seed 80% GRD (T_7) and dry seed 80% GRD (T_6). Water soaked seed without fertilizer (T_1) varied significantly with all other treatments except seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_2).

Priming treatments were clearly exhibited in plant height, leaf area and plant leaf number. Higher nutrient absorption early effect on attained leaf area and more leaf $hill^{-1}$ might encourage in the production of more photo assimilate that might enhance plant biomass which leaded to reduce tiller mortality and produce more number of spikelets and greater assimilates availability to increase grain filling with reduction of half filled and sterile grains simultaneously. Similar results were found by Srivastava *et al*. (2012) [17].

Test weight

Results on test weight was influenced by the treatments. 100% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_5) and 80% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_8) treatment were at par with water soaked seed 100% GRD (T_4). The maximum test weight (29.60 g) was recorded in 100% GRD seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_5) and minimum test weight (26.82 g) was recorded in water soaked seed (T_1).

Similar results were reported by Soleimanzadeh *et al.* (2013) who reported that seed priming with water which was not singnificantly different from seed priming of KH_2PO_4 treatment in corn. Similar results were also reported by Mussa *et al.* (1999) [13] and Arif *et al*. (2007) [1] who reported that seed priming increased thousand grain weight in chickpea.

Table 1: Effect of seed priming on growth parameters of rice.

Treatment	Plant Polulation (m^2)	Effective tiller (m^2)	Filled grain panicle^{-1}	Test weight (g)
T_1 : Water soaked (N_0:P_0:K_0)	53.50^{a}	3.67^{d}	105.53^{e}	26.82^{f}
T_2 : Seed priming with (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$)	53.67^{a}	4.33^{d}	107.20^{de}	28.08^{cd}
T_3 : 100% GRD + Dry seed	54.00^{a}	7.00^{ab}	111.07^{bc}	27.80^{de}
T_4 : 100% GRD + Water soaked seed	56.00^{a}	7.33^{ab}	112.60^{ab}	29.22^{ab}
T_5 : 100% GRD + Seed priming with (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$)	56.00^{a}	7.67^{a}	113.67^{a}	29.60^{a}
T_6 : 80% GRD + Dry seed	53.00^{a}	5.67^{c}	108.20^{d}	27.12^{ef}
T_7 : 80% GRD + Water soaked seed	53.00^{a}	6.33^{bc}	108.20^{d}	28.68^{bcd}
T_8 : 80% GRD + Seed priming with (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$)	54.00^{a}	7.00^{ab}	109.00^{cd}	28.96^{abc}

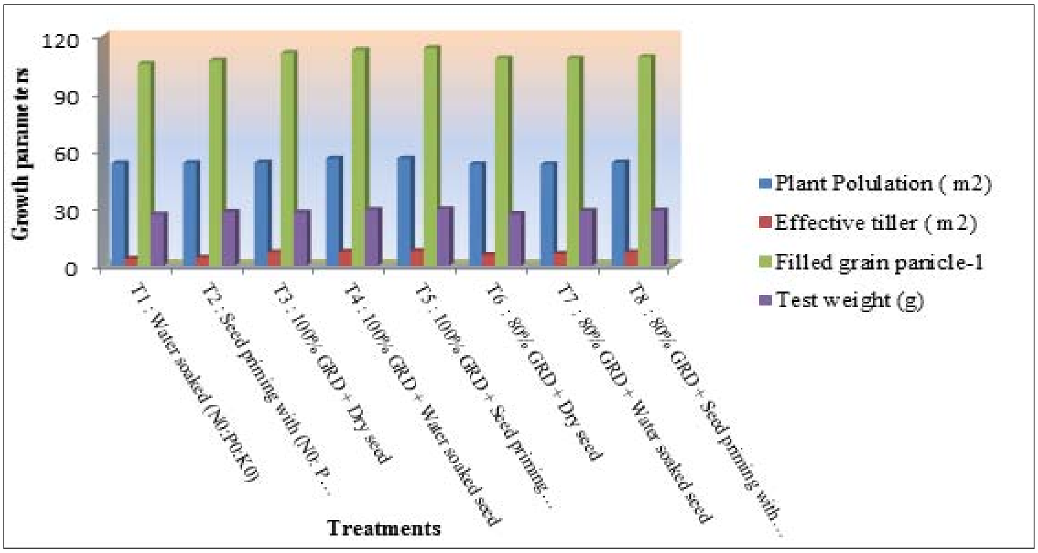

Fig 1: Effect of seed priming on growth parameters of rice.

2. Effect of seed priming on yield parameter of rice

2.1 Grain and straw yield

Results on grain and straw yield are presented in Table 2 and depicted in Fig.2 revealed that the grain and straw yield was significantly influenced by the treatments. 100% GRD with dry seed (T_3), 100% GRD with water soaked seed (T_4) and 100% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_5) did not vary significantly with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) 80% GRD (T_8). 80% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_8) and 80% GRD with water soaked seed (T_7) were also at par with dry seed 80% GRD (T_6).

The least grain yield was observed in water soaked seed (T_1) and seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_2). The least straw yield was found in water soaked seed (T_1) followed by seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_2).

Nutrient priming has been shown to improve crop stand establishment, drought tolerance, reduced pest damange and increased crop yield (Harris *et al*., 1999; Mussa *et al*. 1999 ; Harris *et al*. 2000) [5, 13,7]. Similar results were also found by Chhipa *et al*.(1993), Rashid *et al*.(2000) who reported higher grain yield for seed priming as compared with control. Similar results were also found by Arif *et al*. (2007) and Miraj *et al.* (2013) [12].

Grain yield of 100% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_5) was recorded 64.23 q ha^{-1} which was 194.63% more than only water soaked seed (T_1). Similar results were found by Miraj *et al*. (2013) [12] and Harris *et al.* (2001, 2004 and 2007). The increase grain yield may be due to the fact that priming advances the metabolism which has a direct affect in increasing seed performance and hence yield (Varier *et al.* 2010) [18].

Straw yield of 100% GRD with seed priming (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$) (T_5) was recorded 84.4 q which was 136.7% more over water soaked seed (T_1) treatment. Similar results were found by Miraj, *et al.* (2013) [12] and Iqbal *et al.* (2003) [9].

Table 2: Effect of seed priming on grain and straw yield

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1: Water soaked (N_0:P_0:K_0)	21.80^{d}	35.66^{e}
T_2: Seed priming with (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$)	24.98^{d}	40.86^{e}
T_3: 100% GRD + Dry seed	59.78^{abc}	77.65^{abc}
T_4: 100% GRD + Water soaked seed	62.11^{ab}	81.96^{ab}
T_5: 100% GRD + Seed priming with (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$)	64.23^{a}	84.41^{a}
T_6: 80% GRD + Dry seed	52.96^{c}	68.42^{d}
T_7: 80% GRD + Water soaked seed	54.92^{bc}	70.88^{cd}
T_8: 80% GRD + Seed priming with (N_0: P $_{(0.5\%)}$: K_0: Zn $_{(0.1\%)}$)	57.28^{abc}	73.69^{bcd}

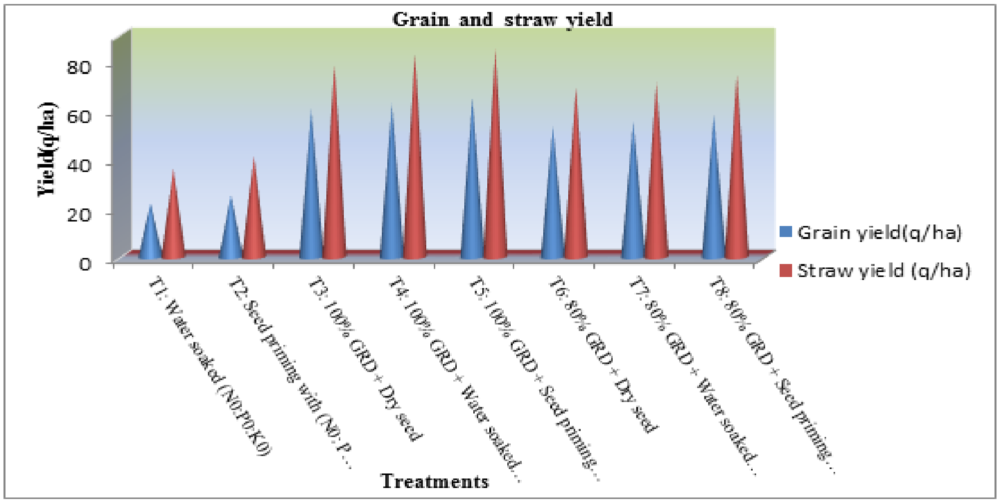

Fig 2: Effect of seed priming on grain and straw yield

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