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EFFECT OF SEED PRIMING ON GERMINATION AND SEEDLING GROWTH OF DRY DIRECT SOWN RICE (*Oryza sativa* L.)

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ABSTRACT

Poor seedling establishment is one of the major constraints in adopting dry direct sown rice. The objective of this study was to determine the effectiveness of seed priming treatments for improving crop stand establishment, seedling vigour index and speed of germination. Two laboratory experiments were conducted at dept. of Crop Physiology, S. V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India, during 2021-22 with eight seed priming treatments broadly consisting of untreated control; hydropriming; priming with GA_3 @ 100 ppm; priming with KNO_3 @ 0.5%; priming with DAP @ 2% and their possible combinations. Seed priming improved germination percentage, crop stand establishment and seedling vigour index along with speed of germination. Faster and uniform emergence of seedlings might be due to improved α-amylase activity by GA_3 which in turn increased the levels of soluble sugars in priming treatments. Priming combination of GA_3 @ 100 ppm + KNO_3 @ 0.5% + DAP @ 2% gave superior results among all the treatments in both laboratory experiments.

KEYWORDS: Dry direct seeded rice, Seed priming, Crop stand establishment, Seed vigour index, Speed of germination.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most predominant crop grown in more than 100 countries of the world. Ninety percent of world's rice is both produced and consumed in Asia which accounts for sixty per cent of world's population. Traditionally, rice is transplanted after puddling the soil which requires huge amount of water at a time. Late onset of monsoon and shortage of labour often delay rice transplantation and decrease the productivity of crop. Furthermore, in the view of decreasing water resources the system of rice cultivation has to undergo changes from transplanted conditions towards dry direct sown rice where utilization of water will be minimal during initial stages and provides assured yields. Dry direct sown rice may have certain benefits like elimination of puddling and labour for nursery maintenance and transplanting and also provides an option to resolve the soil related conflict. Dry direct sown rice has two major constraints like weed management and seedling emergence which requires serious attention and necessitates finding strategies to ensure faster and uniform establishment of the crop (Balasubramanian and Hill, 2002).

Improved seed priming techniques are used to reduce germination time and accomplish uniform seedling emergence in field crop (Farooq *et al*., 2006). The priming techniques include hydropriming, osmopriming, nutripriming and harmonal priming (Basra *et al.,* 2005). Seed priming is beneficial in many aspects of crop growth in rice. For instance, seed priming with GA_3 induces biosynthesis of α-amylase, a key metabolic event in producing vigour seedlings.

MATERIAL AND METHODS

Two laboratory experiments were conducted during 2021-22 using seeds of rice cultivar Nellore Mahsuri (NLR 34449) in completely randomized block design (CRD) with four replications and eight treatments. Seed priming treatments includes, untreated control; hydropriming; priming with GA_3 @ 100 ppm; DAP @ 2%; KNO_3 @ 0.5%; GA_3 @ 100 ppm + KNO_3 @ 0.5%; GA_3 @ 100 ppm + DAP @ 2% and GA_3 @ 100 ppm + KNO_3 @ 0.5% + DAP @ 2%. Seeds were soaked in priming solutions for 12 hours and then shade dried for 12 hours. In laboratory experiment I, 10 seeds were placed in each Petri plate whereas, in laboratory experiment II twenty-five seeds were placed by hand drilling in soil trays and irrigated when soil moisture was

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low. The parameters like germination percentage (ISTA, 2011), mean germination time ((Ellis and Robert, 1981), co-efficient of velocity of germination (Kotowski, 1926) and seedling vigour index (SVI-I and II) (Abdul and Anderson, 1973) were calculated.

Statistical Analysis

The obtained data from the laboratory experiments were analysed statistically with SPSS software and ANOVA. The critical difference was carried out at 5 per cent (0.05) probability or corrections among parameters were at 95% of significant level.

RESULTS AND DISCUSSION

Effect of seed priming on seedling vigour of dry direct sown rice (laboratory study I)

Germination percentage

Germination percentage was recorded in laboratory experiment I at 5, 10 and 15 DAS whereas in laboratory experiment II it was recorded at 7, 14 and 21 DAS. There was no significance difference in germination percentage at 5,10 and 15 days after priming the seeds in laboratory experiment I. Priming treatment with GA_3 @ 100 ppm + KNO_3 @ 0.5% + DAP @ 2% recorded the highest germination percentage (95.00) followed by priming with GA_3 @ 100 ppm + KNO_3 @ 0.5% (85.00) which is at par with all other treatments at 5 DAS. There was slight variation in germination percentage at 10 days after treating the seeds and no significant difference was noticed in seed germination at 15 DAS 9 (Table 1).

Seedling vigour index

Seed priming treatments significantly changed seedling vigour index in dry direct sown rice. Priming with GA_3 @ 100 ppm + KNO_3 @ 0.5% + DAP @ 2% recorded the highest seedling vigour index (5 DAS- 884.40, 10 DAS- 1212.75 and 15 DAS- 1279.78) among all the treatments. Whereas, least was recorded in untreated control at all the stages (5 DAS- 313.35, 10 DAS- 442.10 and 15 DAS- 635.43) (Table 1).

Speed of germination

Speed of germination was analyzed with the help of mean germination time, coefficient of velocity of germination and germination index.

Mean germination time (MGT)

The mean germination time of seed for different treatments ranged from 4.50 to 4.88 days. Among the treatments, the highest mean germination time was recorded in T1 (Control) (4.88) which was followed by T_5 (Priming with DAP @ 2%) (4.58) and it was par with all other priming treatments (Table 1). The results revealed that, priming enhanced the rapid germination of seeds compared with non-primed seeds. The significant enhancement in germination might because due to increased α-amylase activity which was positively correlated with reserve mobilization and mean germination time in rice. Similar results were also obtained by earlier workers (Lee and Kim, 2000; Harris *et al*., 2001).

Coefficient of Velocity of Germination (CVG) (%)

Among all the treatments, T_2 (hydropriming) performed well (99.72) which was at par with other priming treatments except T_1 (Control) which recorded the lowest CVG (50.00) (Table 1). The results were in corroboration with reports of Raun *et al*. (2002) that, enhanced velocity of germination was obtained with priming in rice.

Germination index (GI)

A significant difference was observed among the treatments for germination index. The highest germination index was noticed in treatment T_8 (Priming with GA_3 @ 100 ppm + DAP @ 2% + KNO_3 @ 0.5%) (76.75) which was at par with all other priming treatments and the lowest value was found in T_1 (Control) (59.50) (Table 1). These findings were in line with Raun *et al*. (2002).

Effect of seed priming on seedling vigour of dry direct sown rice (laboratory study II)

Germination percentage (%)

A significant difference was observed in the germination percentage at all three intervals. Among all the treatments, T_8 (Priming with GA_3 @ 100 ppm + DAP @ 2% + KNO_3 @ 0.5%) had recorded the highest germination percentage at 7DAS (97.00) and 14DAS (98.00). There was no increase in the germination percentage of the seeds as the seeds which are viable were all emerged by 14 days. Hence, there was no further enhancement in germination percentage at 21 DAS (Table 2).There was a positive influence of seed priming in rice on germination percentage which might be due to increased α-amylase content in the seed during germination, which might be due to the synergistic effect of gibberellic acids (GA_3), Di- ammonium phosphate (DAP) and potassium nitrate (KNO_3) on seed germination. These results were found to be similar to those of Harris *et* al., (2002) and Farooq *et al*., (2007).

Seedling Vigour Index

Seedling vigour index differed significantly at 7, 14 and 21 DAS. The data revealed that, the highest

Table 1. Effect of seed priming treatments on germination percentage, seedling vigour index and speed of germination of dry direct sown rice (Laboratory study I)

Treatments	Germination percentage			Seedling vigour index			Speed of germination		
	5 DAS	10 DAS	15 DAS	5 DAS	10 DAS	15 DAS	MGT	CVG	GI
T_1: Control	85.00	85.00	85.00	313.35	442.10	635.43	4.88	50.00	59.50
T_2: Hydro priming with water	85.00	85.00	85.00	481.20	669.35	783.83	4.50	97.73	69.75
T_3: Priming with GA_3 @ 100 ppm	85.00	85.00	85.00	629.90	926.83	977.45	4.50	97.50	69.75
T_4: Priming with KNO_3 @ 0.5%	85.00	90.00	90.00	484.25	632.25	857.48	4.56	82.14	69.50
T_5: Priming with DAP @ 2%	85.00	90.00	90.00	483.50	753.73	851.95	4.58	83.81	73.75
T_6: Priming with GA_3 @ 100 ppm + DAP @ 2%	85.00	90.00	90.00	675.50	1056.15	1171.58	4.56	80.78	71.00
T_7: Priming with GA_3 @ 100 ppm + KNO_3 @ 0.5%	85.00	90.00	90.00	697.73	1065.38	1124.33	4.56	81.70	71.25
T_8: Priming with GA_3 @ 100 ppm + DAP @ 2% + KNO_3 @ 0.5%	95.00	95.00	95.00	884.40	1212.75	1279.78	4.53	91.67	76.75
C.D	8.43	7.30	7.30	76.71	83.64	88.24	0.15	22.50	7.31
C.V	NS	NS	NS	9.04	6.78	6.30	2.28	18.53	7.14

Table 2. Effect of seed priming treatments on germination percentage and seedling vigour index of dry direct sown rice (Laboratory study II)

Treatments	Germination Percentage			Seedling vigour index		
	7 DAS	14 DAS	21 DAS	7 DAS	14 DAS	21 DAS
T_1: Control	88.00	92.00	92.00	742.50	1060.30	1447.84
T_2: Hydro priming with water	90.00	93.00	93.00	961.55	1186.85	1559.45
T_3: Priming with GA_3 @ 100 ppm	90.00	96.00	96.00	1130.11	1512.72	1840.08
T_4: Priming with KNO_3 @ 0.5%	92.00	96.00	96.00	1044.66	1329.20	1600.56
T_5: Priming with DAP @ 2%	92.00	97.00	97.00	1043.74	1328.01	1728.69
T_6: Priming with GA_3 @ 100 ppm + DAP @ 2%	92.00	96.00	96.00	1234.88	1495.20	1813.92
T_7: Priming with GA_3 @ 100 ppm + KNO_3 @ 0.5%	93.00	94.00	94.00	1336.73	1557.30	1890.86
T_8: Priming with GA_3 @ 100 ppm + DAP @ 2% + KNO_3 @ 0.5%	97.00	98.00	98.00	1537.82	1808.09	2108.73
C.D	3.67	3.67	3.67	58.39	74.56	73.11
C.V	2.74	2.64	2.64	3.54	3.62	2.86

seedling vigour index was recorded in T_8 (Priming with GA_3 @ 100 ppm + DAP @ 2% + KNO_3 @ 0.5%) with values of 1537.82, 1808.09 and 2108.73, followed by T_7 (Priming with GA_3 @ 100 ppm + KNO_3 @ 0.5%) (1336.73, 1557.30 and 1890.86) and the lowest SVI was observed in T_1 (Control) (742.50, 1060.30 and 1447.84) at 7, 14 and 21 DAS respectively. The positive influence of GA_3, DAP and KNO_3 on seedling vigour index was also suggested by earlier researchers (Rood *et al*., 1990, Hussain *et al*., 2006)

The results of the laboratory studies showed that, seed priming with GA_3 @ 100 ppm + DAP @ 2% + KNO_3 @ 0.5%) had increased physiological parameters like, germination percentage, seedling vigour index, speed of germination in dry direct sown rice.

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