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Studies on Effect of Micronutrients on Seed Quality Parameters in Paddy (*Oryza sativa*. L)

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Seed priming is one of the key techniques for improvement of crop performance and nutrient enrichment in seed. In the present study, this technique was explored for improving germination and crop performance of treated paddy seed. The seed material comprised of Shabhagi dhanhaving12 months old seed lot which was treated with $ZnSO_4$and $FeSO_4$each at four level of treatment 0.25, 0.5, 1.0,2.0 per cent. Seed quality parameters of treated seed was enhanced. The treatment with $ZnSO_4$ (0.5%) showed highest seedling dry weight. $ZnSO_4$ (2%) recorded highest dehydrogenase activity, and also highest zinc content in seed.$FeSO_4$ (2.0 %) recorded lowest EC , highest SVI-I and highest iron content in seed; while $ZnSO_4$ (1.0 %) recorded highest SVI-II.

Introduction

Paddy is a staple food of more than 60 per cent of the world population. It is staple food of most of the south-east Asian people; 90 percent of paddy is grown and consumed in Asian region. Paddy is a nutritive staple food and one of the most important cereal crops, especially for people in Asia. India rank 2nd in the world in terms of production as well as area for paddy after China; Bihar ranks 6th in production. The total area under paddy covers in India is 43.8 (GOI, 2019) million hectares with annual production of 112.91 million tonnes and productivity of 2578 tonnes per hectare. Most of the paddy in India is grown in Kharif season. It is also an important crop of Bihar, which covers a total area of 3.17 million hectares having annual production of 9.04 million tonnes and productivity of 2847 tonne per hectare (Directorate of Economics & Statistics, Ministry of Agriculture & Farmer Welfare, India, 2018-2019).

Several micronutrients play a crucial role in growth and development of crop plant. Seed enrichment was expected to alleviate soil deficiencies and to provide resistance against seedling root diseases.Micronutrients stored in seeds and grain are essential for initial crop growth during germination and early seedling establishment.

Zinc is important for maintaining the integrity of biological membranes, protein synthesis, photosynthesis, pollen formation and disease resistance (Alloway, 2008).Zinc is an important essential element present in plant enzymatic systems. Genc *et al.* (2006) reported that zinc has vast numbers of functions in plant metabolism and consequently zinc deficiency has amultitude of effects on plant growth.Likewise, Iron also play an important role in metabolic processes such as DNA synthesis, respiration photosynthesis, chlorophyll synthesis, plays significant role in various physiological and biochemical pathway.

Seed enhancements include physical, physiological and biological treatments to overcome germination constraints by uniform stands, earlier crop development and better yields. Improved germination rates and seedling vigour are due to reduced emergence time by earlier start of metabolic activities of hydrolytic enzymes and resource mobilization.Seed nutripriming provides an effective technology for enhancement in quality of seed as well as enrichment of seed with micronutrient at basic level. There is a scanty of study available to assess the effect of seed treatment with micronutrient in paddy for improvement in seed quality as well as nutrient enrichment.Keeping in view the above facts, present studywas planned on paddy *var*.Shabhagi dhan,

Materials and Methods

The material comprised of paddy *var*. Sahbhagi dhan having 12-month seed lot. The seed material was undergone different seed enhancement treatments with micronutrient ($FeSO_4$ and $ZnSO_4$)solution with four level of concentration *viz.*, 0.25, 0.5, 1.0, 2.0 per cent for 24 hours in ratio of 1:2 (kg of seeds/volume of solution) to assess their effect on vigour and micronutrient content of seed lot. Then the treated seeds were dried in room temperature to maintain the initial seed moisture content. The experiment was conducted at research farm and laboratory of Department of Seed Science and Technology, BAU, Sabour during 2019.

Results and Discussion

The mean sum of squares (MSS) for different laboratory parameters of directly treated seed due to sources like seed enhancement treatments ($FeSO_4$ and $ZnSO_4$) with four concentration level (0.25,0.5,1.0 and 2.0 %) is given in table 1.

Highly significant mean sum of squares for various level of micronutrients treatment indicated the presence of substantial amount of variation for all the parameters except seedling dry weight and electrical conductivity. The observed variation in the different parameters was due to the effect of these enhancement treatments.

The mean values for different laboratory parameters of treated seed *viz*., standard germination (%), root length (cm), shoot length (cm), seedling dry weight (mg), dehydrogenase activity, electrical conductivity, vigor indices, zinc and iron content in seed after treatment with micronutrient solution are given in table2.

Standard Germination (SG; %)

The mean values of standard germination ranged between 73.50 and 92.00 in the seed-lot of paddy variety after seed enhancement treatment with micronutrient solution for 24 hours. All the treatments improved the germination percentage (8.16-18.50 %) over untreated (73.50) in seed. Treatment with these solutions enhanced the germination over hydropriming, which is also significant, in the range of 1.00-10.34 percent. The improvement inSGwas recorded highest when seed treated with $FeSO_4$(2.0 %) among all treatment than untreated and also that of hydropriming.

This finding is concurrent with Afzal *et al.* (2013) which concluded that priming of maize seed with $ZnSO_4$ (1.5 per cent) solution was result in highest germination percentage among all treatments and crop growth rate (CGR) was also highest in comparison to non-primed seed.

Root length (RL, cm)

The mean values of root length ranged between 11.18 and 15.17 in the seed-lot after seed treatment with micronutrient solution of $ZnSO_4$ and $FeSO_4$ at various concentration for 24 hours. All the treatments enhanced the root length (0.93-3.99) over untreated (11.18). The treatment with $FeSO_4$ at all concentration significantly enhanced the root length over hydropriming in the range of 0.37-0.79. However, none of the $ZnSO_4$ treatment improved the root length in comparison to hydropriming. The improvement was recorded highest when seed treated with $FeSO_4$(1.0 %), among all other treatment than untreated and that of hydropriming.

Shoot length (SL, cm)

The mean values of shoot length ranged between 9.50 and 12.84 in the seed-lot after seed treatment. All the treatments significantly enhanced shoot length (0.10-3.34) over untreated (9.50). The treatment with $FeSO_4$ at all concentration significantly enhanced the shoot length over hydropriming in the range of 0.49-0.60. However, none of the concentration of $ZnSO_4$improved the shoot length in comparison to hydropriming except 1.0 per cent of $ZnSO_4$.The improvement in shoot length was recorded highest when seed treated with $FeSO_4$(2.0 %) among all treatment than untreated and also that of hydropriming.

Seedling dry weight (SDW; mg)

The mean values of seedling dry weight were ranged between 79.0 and 91.0 of seed-lot after treatment with micronutrient solution of $ZnSO_4$ and $FeSO_4$. All the treatments improved the seedling dry weight, though it was not significant.

The SDW was increased from 1.67 to 12.0 over untreated(79.0). Treatment with both $ZnSO_4$ and $FeSO_4$ at all concentration non-significantly resulted in higher SDW over hydropriming except for $FeSO_4$ (0.25 and 2.0 %). The improvement in seedling dry weight was recorded highest when seed treatment was done with $ZnSO_4$ (0.50 %) among all other treatment.

Dehydrogenase activity (DHA; OD)

The mean values of dehydrogenase activity were ranged between 0.244 and 0.265 of seed-lot after treatment with micronutrient solution of $ZnSO_4$ and $FeSO_4$. All the treatments improved DHA, though it was non-significant.

The DHA was increased from 0.007 to 0.021 over untreated (0.244). Treatment with both $ZnSO_4$ and $FeSO_4$ at all concentration non-significantly resulted in higher DHA over hydropriming. The improvement in DHA was recorded highest when seed treatment is done with $ZnSO_4$ (2.0 %) among all treatment.

Table.1 Mean squares for different laboratory parameters for treated seed

Source of variation	DF	SG (%)	Rl (cm)	Sl (cm)	Sdw (g)	DHA	EC µS/cm/50 seeds)	SVI-I	SVI-II	Zn content (ppm)	Fe content (ppm)
Treatment	9	75.37** (48.17)	5.08**	4.53**	41.86	0.000001	14.90	244,477.85**	1003406**	1.56**	2.51**
Error	20	9.875 (7.634)	0.791	0.783	35.63	0.000064	13.90	23,047.92	237322.04	0.154**	16.53
Total	29										

Table.2 Mean values for different laboratory parameters for treated seed

Treatment	SG (%)	Rl (cm)	Sl (cm)	Sdw (g)	DHA	EC µS/cm/50 seeds)	SVI-I	SVI-II	Zn content (ppm)	Fe content (ppm)
Untreated	73.50 (59.013)	11.18	9.50	79.00	0.244	67.89	1521.20	5805.83	0.29	5.14
Hydropriming	81.66 (64.62)	14.38	11.48	83.00	0.251	67.10	2113.03	6779.67	0.32	5.51
$ZnSO_4$ (0.25%)	82.66 (65.38)	12.11	10.96	88.00	0.253	65.99	1907.76	7277.33	0.38	7.05
$ZnSO_4$ (0.50%)	83.67 (66.15)	14.25	9.60	91.00	0.258	65.71	1994.70	7616.00	0.39	8.26
$ZnSO_4$ (1.0%)	89.00 (70.65)	13.80	12.84	88.33	0.263	64.31	2345.63	7860.33	0.42	8.34
$ZnSO_4$ (2.0 %)	85.67 (67.86)	13.60	9.95	83.67	0.265	64.14	2019.76	7148.67	0.43	8.45
$FeSO_4$ (0.25%)	84.6 (67.07)	14.95	11.97	80.67	0.252	63.50	2278.03	6819.33	0.30	6.30
$FeSO_4$ (0.50%)	86.33 (68.37)	14.75	12.05	85.00	0.254	62.49	2313.93	7329.67	0.323	11.54
$FeSO_4$ (1.0%)	88.00 (69.86)	15.17	11.98	84.00	0.257	62.61	2390.83	7378.33	0.32	12.10
$FeSO_4$ (2.0 %)	92.00 (73.97)	14.78	12.57	81.67	0.263	60.92	2465.63	7517.00	0.30	13.91
CD (0.01)	5.39 (4.74)	1.53	1.51	N/A	N/A	N/A	260.39	835.56	0.047	0.49
CV (%)	3.709 (4.106)	6.39	7.83	7.070	7.93	5.78	7.11	6.67	7.991	3.155

Electrical conductivity (EC; μS/cm/50 seeds)

The mean values of electrical conductance of seed leachates were ranged between 67.89 and 60.92 of seed-lot after seed treatment with micronutrient solution of $ZnSO_4$ and $FeSO_4$. All the treatments improved the membrane permeability though non-significant as seed leachates was collected in the solution was lower in quantity0.79 to 6.97 over untreated (56.08). Treatment with both $ZnSO_4$ and $FeSO_4$ at all concentration non significantly improved the membrane permeability as the EC of the seed lot decreased over hydropriming. The lowest EC was recorded when seed treatment done with $FeSO_4$ (2.0 %) among all treatment than untreated and also that of hydropriming.

Seedling vigour index-I (SVI-I)

The mean values of seedling vigour index-I of seed-lot ranged between 1521.20 and 2465.63. All the treatments enhanced the vigour of the seed lot as SVI-I was increased (386.50-944.43) over untreated (1521.20). Treatment with $FeSO_4$ at all concentration significantly enhanced the vigour of the seed lot over hydropriming in the range of 165-352.60. However, treatment with $ZnSO_4$ significantly improved the vigour in comparison to hydropriming at only 1.0 per cent by 232.60.The improvement in vigour index-I was recorded highest when seed treated with $FeSO_4$ (2.0 %) among all treatment than untreated and also that of hydropriming.

Seedling vigour index-II (SVI-II)

The mean values of seedling vigour index-II of seed-lot ranged between 5805.83 and 7860.33 after seed treatment with micronutrient. All the treatments enhanced the vigour of the seed lot as SVI-II was increased (973.77-2054.50) over untreated (5805.83).Treatment with both micronutrient at all concentration significantly enhanced the vigour of the seed lot over hydropriming in the range of 39.66-1080.66. Among all other treatment the vigour index-I was recorded highest when seed treated with $ZnSO_4$(1.0 %) than untreated also that of hydropriming.

Zinc content in seed (Zn;ppm)

The mean values of Zinc content in seed ranged between 0.29 and 0.430 ppm of seed-lot after treatment with micronutrient ($ZnSO_4$, $FeSO_4$) at different concentrations. All the treatments improved the Zn content in seed**.** This content was increased from 0.01 to 0.14 over untreated (0.290). Treatment with both $ZnSO_4$ and at all concentration significantly improved the Zn content in seed over hydropriming in the range of 0.06 to 0.11. However, all the treatment with $FeSO_4$was at par with the hydropriming. This improvement was recorded highest when seed treatment was done with $ZnSO_4$ (2.0 %) than untreated and also that of hydropriming.

Iron content in seed (Fe; ppm)

The mean values of Iron content in seed ranged between 5.14 and 13.91 ppm of seed-lot. All the treatments improved the Fe content in seed**.** This content was increased from 0.37 to 8.77 over untreated (5.14). Treatment with both micronutrient at all concentration significantly enhanced Fe content of seed lot over hydropriming in the range of 0.79-8.41.This iron content was recorded highest when seed treatment was done with $FeSO_4$ (2.0 %) among all treatment than untreated and that of hydropriming.

Overall, seed treatment with micronutrient (Fe and Zinc) improves the seed quality as well as growth and yield attributes in Paddy. Seed treatment with $FeSO_4$ (2.0 %) improves all seed quality parameters of directly treated seed. This finding is concurrent with Afzal *et al.* (2013) which concluded that priming of maize seed with $ZnSO_4$ (1.5 per cent) solution was result in highest germination percentage among all treatments and crop growth rate (CGR) was also highest in comparison to non-primed seed. The seed germination, coleoptile elongation, seedling emergence and establishment of iron-coated rice seeds improved considerably, which resulted in an increase of plant height and dry weight (Mori *et al.*, 2012). The wheat seed primed with Zn increased the rate of germination (reduced mean germination time) and improves overall performance of seed but higher concentration of same (> 0.5M) might be toxic to seed (Rehman *et al.*, 2015). Several other researchers had also reported the result in the same direction as found in the present study.

Hasan *et al*., 2016 also concluded that paddy seed primed with $ZnSO_4$ (3.0 %) for 30 hours, resulted in highest germination percentage and the lowest mean germination time.Marthandan *et al*., 2017 reported that undried rice seeds at high moisture stores under cold storage is found to be best as compared to ambient storage condition. The enzymes which help the storability of seed was maximum in undried and dried seeds stored under cold storage condition *viz*., Dehydrogenase (0.174 and 0.773 OD value) amylase (1.38 and 1.43 mg). Imran *et al*. (2014) reported that the nutrient seed priming improves seedling development of maize under low root zone temperature during early growth also significant increase in seed contents of the respective nutrients *i.e*., Fe (25 %), Zn (500 %) and Mn (800 %).

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