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Alpana Kumari
Research Scholar, Department of Seed Science and Technology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Arun Kumar
Assistant Professor Cum Jr Scientist, Department of Seed Science and Technology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Sudhir Kumar
Assistant Professor Cum Jr Scientist, Department of Plant Breeding and Genetics Bihar Agricultural College, Sabour, Bhagalpur, Bihar, India

Birendra Kumar
Assistant Professor Cum Jr Scientist, Department of Agronomy, Bihar Agricultural College, Sabour, Bhagalpur, Bihar, India

PK Singh
University Professor Cum Chief Scientist, Department of Plant Breeding and Genetics, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Corresponding Author:
Arun Kumar
Assistant Professor Cum Jr Scientist, Department of Seed Science and Technology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Evaluation of micronutrient application on field performance of bread wheat

Alpana Kumari, Arun Kumar, Sudhir Kumar, Birendra Kumar and PK Singh

Abstract
Seed treatment is one of the key techniques for improvement of field performance of crop plant. In the present study, this technique was explored for crop performance of treated wheat seed. The seed material of DBW 187 was treated with the different concentration of Iron and zinc sulphate *viz*., $ZnSO^4$ (0.25%), $ZnSO^4$ (0.50%), $ZnSO^4$ (1.0%), $ZnSO^4$ (2.0%), $FeSO^4$ (0.25%), $FeSO^4$ (0.50%), $FeSO^4$ (1.0%), $FeSO^4$ (2.0%) for 10 hours and dry back seed to original and safe moisture content and other method of micronutrient application was also adopted viz., Soil application of $ZnSO^4$ (25 kg/ha) and $FeSO^4$ (50 kg/ha), foliar spray of $ZnSO^4$ (0.5%) and $FeSO^4$ (1.0%) at recommended dose along with hydropriming seed treatment. among the $ZnSO_4$ treatment, seed treatment with $ZnSO_4$ (0.50%) improved the number of tillers/m^2 significantly highest and even though higher than hydropriming. The treatment with $ZnSO_4$ (0.25%) significantly enhanced the seed yield/plant at highest level among all the treatment and improved over and above hydropriming along with $ZnSO_4$ (0.50%). The treatment with $ZnSO_4$ (0.50%) significantly enhanced the seed yield/m^2 at highest level and higher than hydropriming along with ZnSO4 (0.25%) and $FeSO_4$ (0.5%).

Keywords: Seed treatment, field performance, micronutrient

Introduction
Wheat (*Triticum aestivum* L). is a grass that is mainly cultivated for its seed. It is the main staple food cultivated worldwide. Worldwide, wheat is grown on 224.49 mha land with a production of 792.40 mt having productivity 3.529 t/ha in 2020-21(DES, MoA&FW, 2021). The international trade in wheat is greater than that of all other types of crops put together. In India wheat is cultivated on 31.61 mha area (2020-21) with a production of 109.52 mt and having productivity, 3.464 t/ha (DES, MoAFW, 2021). As far Bihar is concerned, it was grown on 2.22 mha area with a production of 6.34mt and productivity 2.855 t/ha during 2020-21 (DES, MoAFW, 2021).

Several micronutrients play a crucial role in growth and development of crop plant. Micronutrients stored in seeds and grain are essential for initial crop growth during germination and early seedling establishment. The seed treatment with micronutrients potentially provides a simple and inexpensive method for improving micronutrient in plant nutrition (Farooq *et al*., 2012) [5]. It also enhances the mobilizing nutrients, biological and biochemical activities in seed and further improve the germination rate of wheat seed. It also helps in membrane stabilization, free radical detoxification and several other activities in plant. Generally, primed seed exhibit a faster and more synchronized germination, young seedlings resistant to abiotic stress (Ajouri *et al*., 2004) [2]. It also improves mineral uptake and dry matter accumulation in the crop as well as enhances water use efficiency in drought stressed plants.

The present study was carried out during rabi season 2021-22 in area specified to Bihar Agricultural College farm under Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India. The seed material was consisted of single seed lot of wheat *var*. DBW 187 and was treated with the different concentration of Iron and zinc sulphate *viz*., $ZnSO^4$ (0.25%), $ZnSO^4$ (0.50%), $ZnSO^4$ (1.0%), $ZnSO^4$ (2.0%), $FeSO^4$ (0.25%), $FeSO^4$ (0.50%), $FeSO^4$ (1.0%), $FeSO^4$ (2.0%) for 10 hours and dry back seed to original and safe moisture content and other method of micronutrient application was also adopted *viz*., soil application of $ZnSO^4$ (25 kg/ha) and $FeSO^4$ (50 kg/ha), foliar spray of $ZnSO^4$ (0.5%) and $FeSO^4$ (1.0%) at recommended dose along with hydropriming (10 hour, distil water) seed treatment. The seed was sown in the field after seed treatment and dry back of treated seed to initial and safe moisture content.

Then data were recorded on field parameters *viz*., plant height (cm), spike length (cm), number of spike/m^2, number of tillers/m^2, seed weight (100) (seed index), number of seed/spikes, seed weight/spike, seed yield/plant, seed yield/m^2 and harvest index (%)/plant. The mean value of these parameters is given in table 1.

Result and Discussion

Table 1: Mean values for different laboratory parameters for treated seed.

Treatment	Plant height (cm)	Spike length (cm)	Number of spike /m^2	Number of tiller/m^2	Seed weight (100)	Number of Seed/Spike	Seed weight/spike (g)	Seed yield/plant (g)	Seed yield per/m^2 (g)	Harvest index (%)/ plant
Control	82.73	9.97	194.67	197.3	3.12	50.6	1.5	8.59	429.7	45.84
Hydropriming	96.75	10.84	198.67	220.7	3.63	57.1	2.07	10.41	520.3	53.06
Soil application of $ZnSO_4$ (25 kg/ha)	96	11.04	227.33	229.3	3.42	53.6	1.84	11.55	577.3	57.84
Foliar spray of $ZnSO_4$ (0.5%)	92	10.17	210.67	213.3	3.68	48.1	1.64	10.32	516	53.02
Seed treated with $ZnSO_4$ (0.25%)	93.97	10.45	228	228.7	3.31	52.8	1.76	13.5	636.7	57.63
Seed treated with $ZnSO_4$ (0.50%)	94.41	12.03	272.67	275.3	3.75	53.3	2	12.73	675	55.89
Seed treated with $ZnSO_4$ (1.0%)	95.56	13.29	202.67	204	3.28	48	1.88	10.54	527	50.84
Seed treated with $ZnSO_4$ (2.0%)	97.08	10.2	224.67	199.3	3.49	48	1.68	11.15	557.3	56.88
Soil application of $FeSO_4$ (50 kg/ha)	96.42	11.07	212	214	3.52	51.4	1.82	11.18	559	51.96
Foliar spray of $FeSO_4$ (1.0%)	95.83	10.75	281.33	269.3	3.38	51.2	1.74	10.03	501.3	47.6
Seed treated with $FeSO_4$ (0.25%)	95.07	11.77	228.67	230	3.4	49	1.66	10.39	519.7	53.44
Seed treated with $FeSO_4$ (0.50%)	93.77	10.73	245.33	246.7	3.45	55	1.9	12.17	608.7	53.56
Seed treated with $FeSO_4$ (1.0%)	95.8	11.01	237.33	238.7	3.19	53.2	1.7	11.54	577	51.43
Seed treated with $FeSO_4$ (2.0%)	93.49	11.24	210	212.7	3.53	50.8	1.79	10.61	530.7	50.07
CD (p=0.01)	6.555	1.38	26.636	22.394	0.32	NS	0.189	1.742	87.111	5.212

All the treatments significantly enhanced plant height (9.27-14.35) over untreated (82.73) recorded at maturity stage. The treatment with ZnSO4 (2.0%) enhanced the plant height highest i.e., 97.08 cm but it is at par with hydropriming even though it was significantly higher than control. The spike length (0.2-3.32cm) was also significantly enhanced due to all these treatments over untreated (9.97cm). The treatment with $ZnSO_4$ (0.5%), $ZnSO_4$ (1.0%) and FeSO4 (0.25%) significantly enhanced the spike length over control. However, none of the treatment except $ZnSO_4$ (1.0%) improved significantly the spike length over and above the hydropriming.

The soil application of $ZnSO_4$ (25 kg/ha) and all the seed treatment with $ZnSO_4$ and $FeSO_4$ significantly enhanced number of spike/m^2 (4-78.0) over untreated (194.67) except $ZnSO_4$ (1.0%) and $FeSO_4$ (2.0%) which is also significantly over and above the improvement due to hydropriming for 10 hours. However, foliar spray of $FeSO_4$ (1.0%) improved the number of spike /m^2 at highest level among all the treatment in comparison to hydropriming.

All the treatments significantly enhanced number of tillers/m^2 (2-78) over untreated (197.3). The seed treatment with $FeSO_4$ at all concentration significantly enhanced the number of tillers/m^2 except $FeSO_4$ (2.0%) and foliar spray of $FeSO_4$ (1.0%) and $FeSO_4$ (0.5%) showed improvement over hydropriming. However, among the $ZnSO_4$ treatment, seed treatment with $ZnSO_4$ (0.50%) improved the number of tillers/m^2 significantly highest and even though higher than hydropriming.

The foliar spray of $ZnSO_4$ (0.5%) and soil application of $FeSO_4$ (50 kg/ha) seed treatments with $ZnSO_4$ (0.50%), $ZnSO_4$ (2.0%), $FeSO_4$ (0.5%) and $FeSO_4$ (2.0%) significantly enhanced 100 seed weight (0.07-0.63 cm) over untreated (3.12). However, none of the the treatment enhanced over and above hydropriming.

These micronutrient treatments including hydropriming improved number of seed/spike, but it was not significant, means all the treatment improved the number of seed/spikes which at par with the control. All the treatments significantly enhanced seed weight/spike (0.2-0.57) over untreated (1.50). However, the treatment with hydropriming significantly enhanced the seed weight/spike at highest level among all the treatment.

These treatments significantly enhanced seed yield/plant (1.44-4.91) over untreated (8.59). The treatment with $ZnSO_4$ (0.25%) significantly enhanced the seed yield/plant at highest level among all the treatment and improved over and above hydropriming along with $ZnSO_4$ (0.50%).

The seed yield/m^2 (71.6-245.3) was also improved over untreated (429.7) upon micronutrient treatments except for foliar spray of $FeSO_4$ (1.0%). The treatment with $ZnSO_4$ (0.50%) significantly enhanced the seed yield/m^2 at highest level and higher than hydropriming along with $ZnSO_4$ (0.25%) and $FeSO_4$ (0.5%).

These treatments also significantly improved Harvest Index (HI) (%) per plant (4.23-12) over untreated (45.84) except $ZnSO_4$ (1.0%) and $FeSO_4$ (2.0%). The treatment with $FeSO_4$ at all concentration significantly enhanced the HI (%) per plant over hydropriming in the range of (0.38-4.78) However, the none of the treatment significantly improved harvest index (%)/plant.

The micronutrient treatment with $ZnSO_4$ (1.0, 2.0%) improve spike length and plant height at highest level. Earlier several researchers have also found the results in concurrence with present finding, like, Firdous *et al.*, (2018) [4] reported that effect of zinc application was significant on the grain yield (q/ha), straw yield (q/ha), and sterility percentage but had no effect on spike length, thousand grain weight and harvest Index. The average grain yield of two years was highest (3.93 t/ha) under the combination of soil and foliar application of Zn and lowest yield (3.36 t/ha) in control is observed. The maximum reduction in sterility percentage was found in soil along with foliar application of Zn and based on the findings of study combined application of basal and foliar Zn on wheat may increase the grain yield was concluded.

The micronutrient treatment with $ZnSO_4$ (0.5%) result in highest 100 seed weight, number of tiller/m^2 and amount of tillers/plant. Aboutalebian *et al.*, (2012) [1] showed that speed and percent emergence, number of tillers per plant, number of spikes/m^2, 1000-grain weight and number of grains/spikes of wheat were improved by seed priming with zinc sulphate and then compound solutions of zinc sulphate and urea had greatest effect on all traits.

The treatment with $ZnSO_4$ (0.50%) highest in seed yield/m^2 and seed yield/plant. Meena et al., (2013) [6] conducted an experiment for two consecutive years to evaluate the influence of hydro-priming on grain yield of wheat and concluded that pregerminated seed produced significantly higher grain yield (5.49 t/ha), which was statistically similar to hydro-priming (5.30 t/ha). The hydro-primed and pre-germinated seeds established earlier than dry seed leading to better crop establishment which leads to higher number of tiller and grain yield.

Therefore, from present investigation it may conclude that all the micronutrient treatment improved the field parameters of wheat production significantly but not over and above the hydropriming treatment except $ZnSO_4$ (0.5%). The seed treatment with $ZnSO_4$ (0.5%) for 10 hours improved the number of tillers/m^2 and seed yield/m^2 significantly which is also over and above the hydropriming treatment for 10 hours and these two parameters are very important yield component which directly reflect the seed yield per hectare.

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