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Evaluation of zinc and iron treatment on growth and seed yield in paddy (*Oryza sativa* L.)

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Abstract

Iron and zinc defeciency is quite common to rice wheat cropping system of India. Seed priming is one of the key techniques for improvement of crop performances and nutrient enrichment in seed. The study was coducted both for nursery as well as transplanted field in paddy *var*. Shabhagi Dhan to analyse the influence of paddy seed treated with micronutrients (iron and zinc) on growth and yield. The single seed lot was treated with four graded level of concentration (0.25, 0.5, 1.0 and 2.0%) of $ZnSO_4$ and $FeSO_4$ solution at room temperature for 24 hours. The $ZnSO_4$ (1.0%) recorded highest seedling height, $FeSO_4$ (2.0%) for seedling biomass while $FeSO_4$ (0.5%) for zinc concentration and $ZnSO_4$ (0.5%) recorded highest iron concentration in seedlings during nursery. In transplanted field study seed treatment with $FeSO_4$ (0.5%) recorded significantly higher number of tillers/m^2, number of panicle/m^2 seed yield/m^2 over control and hydropriming. Treatment with $FeSO_4$ (2.0%) recorded significant enhancement in number of productive tillers/hills, plant height, panicle length, seed yield/hill, harvest index/hill; however, $ZnSO_4$ (1.0%) resulted in higher content of iron and zinc content in plant over control and hydropriming.

Keywords: seed priming, nutrient enrichment, crop performance, nursery, transplanted field

1. Introduction

Rice is a major staple food for most of the population in world. The total area covers under paddy in India is 44 mhawith annual production of 121.46 million tonnes (MOA, 2021). In financial year 2019 rice production across the northern state of Bihar account to 6.16 million metric tones (MOA, 2020).

Seed is basic and vital input for sustained growth in agricultural production since time immemorial as performance of all other farm input directly depends on quality of seed used in the cultivation. The cultivation of more than more than 90 per cent of the food crops are being started from seed. It is a wealth of the farming community as yesterday's harvest and tomorrows hope. Quality seed production is the foremost requirement for successful agriculture, which demands each and every seed is readily germinable and produce a vigorous seedling ensuring high yield.

Micronutrients are involved in key physiological processes of photosynthesis and respiration (Marschner, 1995; Menegel, 2001) [15] and their deficiency can inhibit these vital physiological processes thus limiting yield gain. Application of micronutrient at early stage of reproductive phase in plant makes substantial improvement in pollen fertility, pollen stigma interaction, seed setting and seed quality (Pandey, 2010) [21].

Further, it is reported that, around 50 per cent of world soils where cereals are cultivating is deficient in zinc and 30 per cent in iron. Among several micronutrient, Zinc is important for maintaining the integrity of biological membranes, protein synthesis, photosynthesis, pollen formation and disease resistance (Alloway, 2008). Zinc is involved in the majority of functions in plant metabolism and consequently deficiency of it has multitude of effects on plant growth (Genc *et al.*, 2006) [17]. It is an important essential element present in plant enzymatic systems. Likewise, Iron also plays an important role in metabolic processes such as DNA synthesis, respiration, photosynthesis, chlorophyll synthesis, and many other physiological and biochemical pathway. Nutripriming with several micronutrients potentially provides a simple and inexpensive method for improving micronutrient in plant nutrition (Farooq *et al*., 2012) [18].

Seed enhancement is one of the techniques which improves quality of below standard seed. Again, seed enhancement treatment with micronutrient also improves several quality parameters in different crops.

This also improves the stand establishment and increases yield and micronutrient seed contents. Seed enhancement technologies are gaining increasing attention for their potential to improve seed vigour and modify seed emergence capabilities. The present study was formulated to assess the role of seed priming with micronutrient in growth and yield of paddy.

Material and Methods

The research material consists of single seed lot of rice variety Shabhagi Dhan. Seed treatment is done with micronutrient ($FeSO_4$ and $ZnSO_4$) solution with various level of concentration along with recommended dose of soil and foliar application. The trail was conducted at research farm, Bihar Agricultural College, BAU, Sabour during kharif season (2019-20).

Graded concentration of Zn (21%) and Fe (19%) applied to 6 month old seed lot of Shabhagi dhan as 0,0.25,0.5,1 and 2% of solution prepared by mixing of 0.25,0.5,1 and 2 gm in 100 ml of distilled water. All the treatment is done on Sahbhagi seed lot at 25 ºC. The seed of each lot was soaked in sufficient amount of solution of $ZnSO_4$ and $FeSO_4$ for 24 hour and then seed was dried under shade at 25 ºC to the initial seed weight to maintain original or near to safe moisture content.

After one week of transplanting recommended dose of $ZnSO_4$ (25kg ha^{-1}) and $FeSO_4$ (50 kg ha^{-1}) as 30g $ZnSO_4$was properly mixed with 500 g soil and 60 gm $FeSO_4$ mixed with 500 g soil applied in the selected plot. Foliar spray of $ZnSO_4$ (0.5%) and $FeSO_4$ (1.0%) applied on selected plot before anthesis period.

Result and Discussion

Nursery study

The mean values for different parameters for nursery study *viz.*, seedling height (cm), seedling biomass (gm), zinc and iron content in seedling after treatment with micronutrient solution are given in table1**.**

The range of mean values of seedling height (27.15-34.53 cm), Seedling biomass (2.42-3.78 gm), Zinc (0.33-0.41 ppm) and iron (3.12-11.14 ppm) content in seedling is given (table 1). Each seed enhancement treatments with $ZnSO_4$ and $FeSO_4$ at different concentration recorded significant differences in all parameters of 21 days old paddy seedling in nursery.

Each seed enhancement treatments with $ZnSO_4$ and $FeSO_4$ at different concentration recorded significant differences in seedling height (2.17-7.38 cm), seedling biomass (0.03-1.33g), zinc (0.04-0.08 ppm), iron (4.37-8.02) over and above the untreated *viz.*,27.15 cm, 2.45g, 0.33 and 3.12 ppm, respectively. The seed treatment with both $ZnSO_4$ and $FeSO_4$ at all concentration significantly enhanced seedling height (1.26-5.21), seedling biomass (0.47-0.89 g), zinc (0.03-0.04 ppm) and iron (4.37-8.02 ppm) content over and above hydropriming (fig.1).

Table 1: Mean values for different parameters under nursery study

Treatment	Seedling height (cm)	Seedling biomass (g)	Zn content in seedling (ppm)	Fe content in seedling(ppm)
Untreated	27.15	2.45	0.33	3.12
Hydropriming	29.32	2.89	0.37	9.50
$ZnSO_4$ (0.25%)	29.08	3.12	0.35	10.38
$ZnSO_4$ (0.50%)	30.73	2.68	0.34	11.14
$ZnSO_4$ (1.0%)	34.53	2.92	0.40	8.04
$ZnSO_4$ (2.0%)	30.90	3.40	0.39	7.88
$FeSO_4$ (0.25%)	30.32	2.41	0.37	8.44
$FeSO_4$ (0.50%)	28.06	2.88	0.41	10.25
$FeSO_4$ (1.0%)	29.78	3.34	0.37	10.22
$FeSO_4$ (2.0%)	31.24	3.78	0.36	7.49
CD (0.01)	3.03	0.47	0.035	1.36
CV (%)	5.82	9.13	5.536	9.108

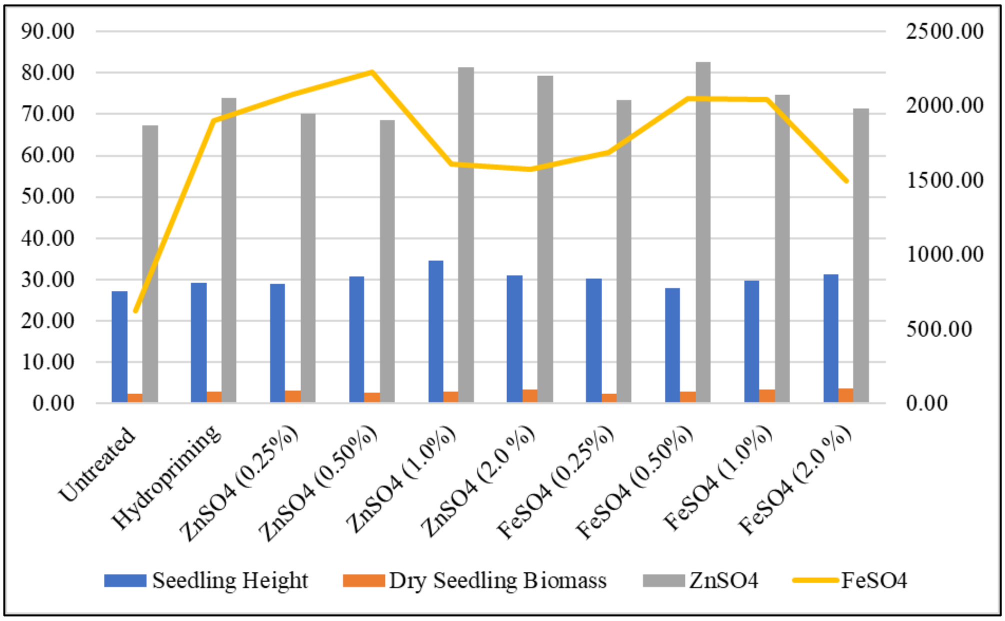

Fig 1: Mean values for different nursery parameters through line and bar diagram.

Among all treatments $ZnSO_4$ (1.0%) and $FeSO_4$ (2.0%) exhibited highest seedling height (34.533) cm and seedling biomass (3.78 gm) of 21 days old nursery, respectively. Further, seed treatment with $FeSO_4$ (0.5%) recorded highest concentration of zinc (0.41 ppm) in seedling among all treatments.

Treatment with both $ZnSO_4$ and $FeSO_4$ at all concentration significantly improve the Iron content in seed but this was much higher with $ZnSO_4$(0.50%).

Transplanted field study

The range of mean values of number of tillers in one-meter square area (155.00-214.67), number of productive tillers/hill (8.53-11.00)**,** plant height (99.03-104.77cm), no. of panicle/m^2 (68.33-84.00), panicle length (22.28-25.23 cm), no. of seeds/panicle (113.87- 132.97), 100 seed weight-seed index (2.39-2.74), seed yield/hill (81.67-110.67 g), seed yield/m^2 (279.67-359.33 g), harvest index/hill (41.00-49.00), Zn (0.353-0.443 ppm) and iron (1.48-2.78 ppm) content in harvested plant.

The range of mean values of number of tillers in one-meter square area (155.00-214.67), number of productive tillers/hill (8.53-11.00)**,** plant height(99.03-104.77cm), no. of panicle/m^2(68.33-84.00), panicle length (22.28-25.23 cm), no. of seeds/panicle (113.87- 132.97), 100 seed weight-seed index (2.39-2.74), seed yield/hill (81.67-110.67 g), seed yield/m^2(279.67-359.33 g), harvest index/hill (41.00-49.00), Zn (0.353-0.443 ppm) and iron (1.48-2.78 ppm) content in harvested plant.Each seed enhancement treatments with $ZnSO_4$ and $FeSO_4$ at different concentration recorded significant differences in number of tillers in one-meter square area (8.33-51.34), number of productive tilers/hill (0.77-1.70), plant height (1.24-5.74 cm), no. of panicle/m^2 (2.37-8.02), panicle length ((1.41-1.54cm), no. of seeds/panicle(0.23-18.87), 100 seed weight-seed index (0.06-0.29), seed yield/hill (3.00- 21.00), seed yield/m^2(6.33-1.67)harvest index/hill(49.00), Zn (0.353-0.443 ppm) and iron (1.48-2.78 ppm) content in harvested plantover and above the untreated.

Table 2: Mean values for different parameters for transplanted study.

Treatment	No. of Tillers/ m^2	No. of prod. tillers/ hill	Plant height (cm)	No. of panicles /m^2	Panicle length (cm)	No. of seeds/ panicle	Seed index	Seed yield/ hill	Seed yield/m^2	H.I (%)/ hill	Zn plant (ppm)	Fe plan (ppm)
Untreated	163.33	9.30	99.03	70.67	24.37	114.10	2.45	84.67	279.67	47.33	0.376	2.76
Hydropriming	192.67	9.90	100.43	70.33	23.69	117.03	2.60	92.67	326.83	41.00	0.406	1.97
$ZnSO_4$ (Soil 25Kg/ha)	177.33	9.50	102.17	72.00	23.68	128.60	2.55	97.33	320.67	47.00	0.443	1.88
$ZnSO_4$ (Foliar spray 0.5%)	189.33	10.17	100.97	69.33	25.23	128.23	2.55	93.33	311.50	41.67	0.415	1.48
$ZnSO_4$ (0.25%)	191.00	10.63	101.67	68.33	22.28	122.97	2.52	86.17	305.50	41.33	0.353	1.52
$ZnSO_4$(0.50%)	189.33	10.40	101.57	83.33	23.37	132.97	2.65	96.83	342.50	42.33	0.373	1.82
$ZnSO_4$ (1.0%)	155.00	8.53	102.57	80.33	23.56	121.60	2.45	90.67	330.33	43.33	0.416	2.78
$ZnSO_4$ (2.0%)	198.67	10.33	100.80	74.33	23.58	115.87	2.39	88.67	299.33	44.33	0.413	1.81
$FeSO_4$ (Soil 50Kg/ha)	176.33	10.63	103.43	76.33	23.67	116.13	2.41	96.33	347.83	46.33	0.371	2.72
$FeSO_4$ (Foliar Spray 1.0%)	181.33	10.33	100.40	78.67	24.14	113.87	2.74	90.17	331.50	44.33	0.383	1.93
$FeSO_4$ (0.25%)	184.00	10.00	100.27	76.67	23.35	124.16	2.60	98.33	315.50	45.33	0.428	2.34
$FeSO_4$ (0.50%)	214.67	10.57	101.00	84.00	23.36	124.70	2.62	81.67	359.33	43.33	0.316	2.63
$FeSO_4$ (1.0%)	193.33	9.60	102.10	80.67	23.29	115.23	2.57	89.50	338.33	44.67	0.403	2.56
$FeSO_4$ (2.0%)	212.67	11.00	104.77	83.00	24.44	120.93	2.43	110.67	331.67	49.00	0.410	1.74
CD (0.01)	17.82	0.88	N/A	7.60	1.01	7.667	0.15	14.38	37.54	N/A	0.0541	0.560
CV (%)	5.65	5.19	3.32	5.90	2.52	3.749	3.59	9.198	6.86	10.5	8.15	15.76

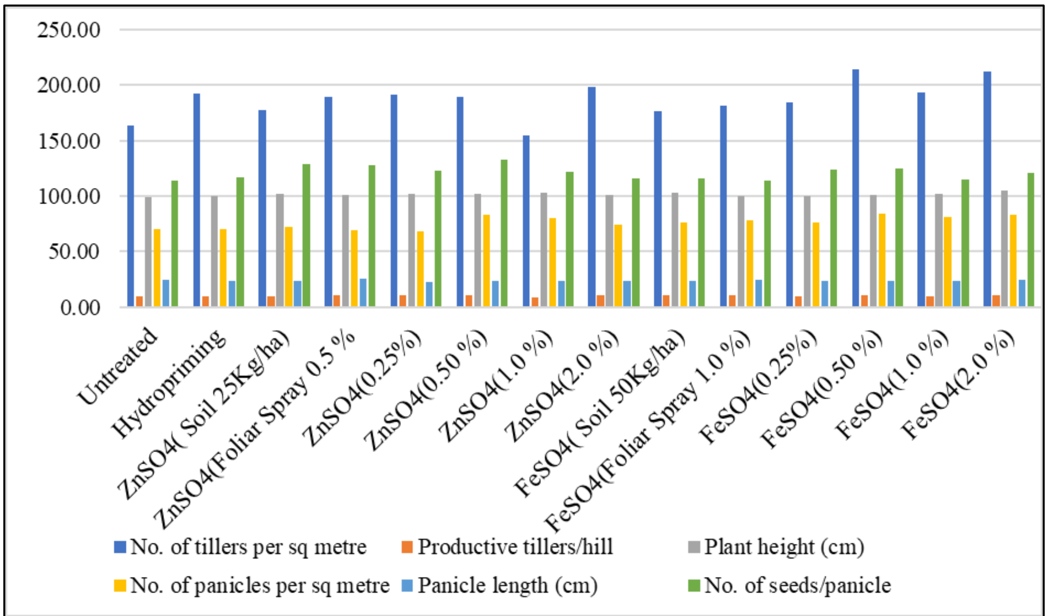

Fig 2.1: Mean values for different vegetative and reproductive parameters in transplanted field

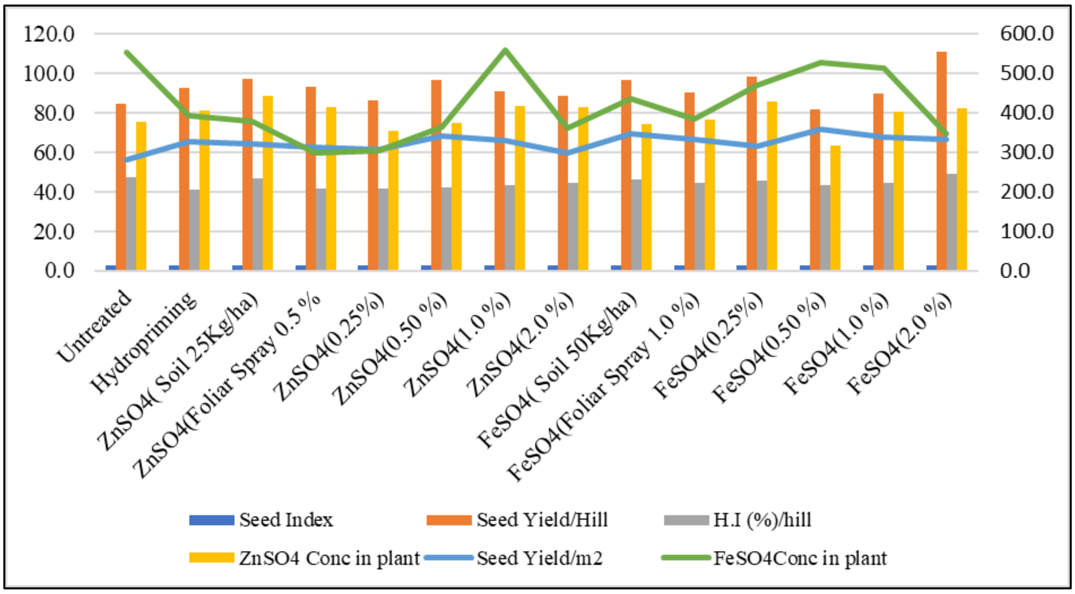

Fig 2.2: Mean values for different seed yield and nutrient content parameters in transplanted field

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 per cent), Zn (500 per cent) and Mn (800 per cent (Imran *et al*. 2013). Foliar application of 0.5 per cent $ZnSO_4$ recorded highest 100 seed weight (13.4 g), germination (88%) and vigour index (874) as compared to control in soyabean (Hugar and Kurdikeri, 2000) [4]
$FeSO_4$ (2.0%) showed highest number of productive tillers/hill (11.00) and highest plant height (104.77), highest seed yield/hill, HI (%)/hill, $ZnSO_4$ content in seed (0.396). The same result is according to (Mirshekari, 2010 and Badiri *et al*., 2014) [7, 3]. Result is supported by Wei *et al*., 2013) [20] who have reported that iron coated seed has higher growth and yield attributes as compared to untreated seed.
$ZnSO_4$ (foliar spray) showed highest panicle length (25.23 cm), $ZnSO_4$ (0.5%) gave highest number of seeds/panicles. The same result is supported by Kapoor (2017) [6] who observed that foliar application of $FeSO_4$ (0.5%) significantly enhanced the growth, seed yield and quality of coriander seed. Pathak *et al*., 2012 [10]; Yuan *et al*., 2013 [19] and Tapas *et al*., 2017 also reported the same finding.
$FeSO_4$ (soil, 50 kg/ha) showed highest iron concentration in seed (0.91) and this result is also supported by Meena *et al*., 2017 [8]. $ZnSO_4$ (soil, 25 kg/ha), gave highest zinc in seedlings i.e., (0.443 ppm) this result is supported by Phattarkul *et al*., 2012, as zinc concentration was increased by 25 per cent through foliar Zn application and 32 per cent by foliar and soil Zn application and Salton *et al*., 2001 [13]. $ZnSO_4$ (1.0%) recorded highest concentration of Fe in plant and the same was supported by study of Anuradha *et al*., 2012 [2].

Conclusion
Seed treatment with micronutrient (Fe and Zinc) improves the growth and yield attributes in Paddy. Though a variable response was obtained during study but, seed treatment with $FeSO_4$ (2.0%) improves all growth and yield attributes in both nursery and transplanted field. However, seed treatment with $ZnSO_4$ (1.0%) improved both iron and zinc contentin plantover control and hydropriming.

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References
1. Anonymous. Area of cultivation for rice in India FY 2014-2020. Ministry of Agriculture and Farmer's welfare, GOI. 2021
2. Anuradha K, Agarwal S, Batchu A, Babu PA, Swamy M PB, Longvah T *et al*. Evaluating rice germplasm for iron and zinc concentration in brown rice and seed. Dimensions Journal of Phytology 2012;4(1):19-25.
3. Badiri A, Mirshekari B, Hadavi E, Hamidi A. Effect of seeds priming with micronutrients on growth, seed yield and mucilage of plantain. International Journal of Plant, Animal and Environmental Sciences 2014;4(3):335-342.
4. Hugar AB, Kurdikeri MB. Effects of application methods and levels of zinc and molybdenum on field performance and seed yield in soyabean. Karnataka Journal of agricultural Sciences 2000;13(2):439-441.
5. Imran S, Afzal, Amjad M, Akram A, Khawar KM, Pretorius S. Seed priming with aqueous plant extracts improved seed germination and seedling growth under chilling stress in lentil (*Lens culineris* Medik) Acta Advances in Agricultural Sciences 2014;2:58-59.
6. Kapoor AC, Mukesh B, Sen RR. Effectiveness of micronutrients in the improvement of seed yield and quality of coriander cv.CO4. Advances in Seed Science and Technology 2017;1(6):037-041.
7. Mirshekari B. Seed germination, growth, and yield of dill affected by nutrient priming under conditions of Zn and Mn deficiency. J Hort Environ Biotech 2010;51(6):487-493.
8. Meena N, Fathima PS. Effect of biofortification of hybrid rice with zinc and iron on yield and yield attributes of hybrid rice (*Oryza sativa* L.). Chemical science review and letters 2017;6(24):2533-2536.
9. Mehri S. Effect of Seed Priming on Yield and Yield Components of Soybean. American-Eurasian Journal of Agricultural and Environmental Science 2015;15(3):399-403.
10. Pathak GC, Gupta B, Pandey N. Improving reproductive efficiency of chickpea by foliar application of zinc, Braz. J Plant Physiol 2012;24(3):173-180.

11. Phattarakul N, Rerkasem B, Li LJ, Wu HL, Zou QC, Ram H *et al*. Biofortication of rice grain with zinc through zinc fertilization in different countries, Plant Soil 2012;361(10):131-141.
12. Schwinn FJ. Seed treatment-A panacea for plant protection? In: Seed Treatment: Progress and Prospects Mono. Thornton Health, UK 1994, 3-14.
13. Slaton NA, Wilson CE, Ntamatungiro S, Norman RJ, Boothe DL. Evaluation of Zinc seed treatments for rice. *Agron. J* 2001;93:152-157.
14. Pandit KT, Mookherjee. Performance of direct seeded upland rice (*Oryza sativa* L.) as influenced by seed priming and micronutrients in old alluvial zone of West Bengal, India Int. J Curr. Microbial. App. Sci 2017;6(10):2163-2169.
15. Marschner H. Mineral Nutrition of Higher Plants. 2nd edition Academic press ISBN: 978-0-12-473542-2. 1995.
16. Whelch. Effects of nutrient deficiency in seed production and quality ADV. Plant nutrient 1986;2:205-247.
17. Genc Y, GK Mc, Donald KG, Graham DR. Contribution of different mechanism to zinc efficiency in breed wheat during early vegetative stage. Plant and Soil 2006;281:353-367.
18. Farooq M, Wahid A, Kadambot, Siddique HM. Micronutrient application through seed treatments - a review. Journal of Soil Science and Plant Nutrition, 2012;12(1):125-142.
19. Yuan L, Lianghuan W, Chunlei Y, Qian LV. Effects of iron and zinc foliar applications on rice plants and their grain accumulation and grain nutritional quality. J Sci. Food Agric 2013;93:254-261.
20. Wei Y, Shohag MJI, Ying F, Yang X, Wu C, Wang Y. Effect of ferrous sulphate fortification in germinated brown rice on seed iron concentration and bioavailability. Food Chemistry 2013;138:1952-1958.
21. Pandey N. Role of micronutrients in reproductive physiology of plants. Plant Stress, Global science books 2010;4(2):1-13.