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Influence of Different Age of Seedlings and Micro Nutrient Management Practices on Growth and Yield Attributes of Rice (*Oryza sativa* L.) under System of Rice Intensification

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ABSTRACT

Background: The age of the seedlings at transplanting is a crucial component in achieving uniform rice stands since it influences prospective agronomic features. A micronutrient is the relative amount of a nutrient necessary for plant development. It participates in metabolic activities, enzymatic mechanisms. As a result, all of these, directly and indirectly, contribute to plant growth and development. The growth of rice depends on both the age of seedlings and micronutrients. So, based on the above considerations, we conducted our experiment entitled "Influence of different age of seedlings and micronutrient management practices on growth attributes and yield attributes of rice (*Oryza sativa* L.) under system of rice intensification."

Methods: An experiment was conducted at experimental research farm Rampur, Selaqui, Doon PG College of Agriculture and Allied Sciences, Dehradun during *kharif* season of 2016. The experiment was laid out in factorial randomized block design with twelve treatments and was replicated thrice *viz.,* in which factor A consists of different age of seedlings *viz.,* 14 days, 21 days and 28 days and factor B consists application of micronutrients at different days *viz.,* 0.5% $ZnSO_4$, $FeSO_4$ at 20 and 30 DAT.

Result: The results of the study revealed that the 14 days age of seedling with the foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT resulted in maximum plant height, no. of tillers/m^2 and highest grain and straw yield.

Key words: Age of seedlings, Foliar application, $FeSO_4$, $ZnSO_4$.

INTRODUCTION

Rice is one of the most important food grains produced and consumed all over the globe, as per the 4th advance estimates total rice output in the nation is projected at 122.27 Mt (Anonymous 2020-21). Global rice consumption is anticipated to grow from 439 Mt in 2010 to 496 Mt in 2020 and subsequently climb to 553 Mt in 2035 (FAO, 2013). To satisfy the food needs of the rising population, rice production has to be boosted with excellent management methods and the diminishing quantity of land and water resources. Rice is a monocot, generally cultivated as an annual plant that nutritionally comprises 80% carbohydrates, 7-8% proteins, 3% fat and 3% fibre (Juliano, 1985). The conventional way for farming rice is through flooding, which takes a significant quantity of water. To lower the water use in the rice crop system of rice intensification, is an alternate technique to raise the rice yield with fewer external and cost-effective inputs. By using SRI, it is feasible to conserve water (Uphoff, 2007). Seedling age at transplanting is a significant component for SRI cultivation, *i.e.*, principally agronomical trades like tillering, plant height, *etc.*, (Ginigaddara and Ranamukhaarachchi 2011). To boost the productivity of rice, supplementation of micronutrients together with fertilizers is also a vital component in enhancing the quality of grain to overcome malnutrition issues in human population. In India, among the micronutrients, zinc deficiency is the biggest concern in practically all the places, notably in lowland rice (Singh *et al.,* 2010). Therefore, it was important to research influence of zinc and iron together with varying age of seedlings, on the growth attributes of rice.

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MATERIALS AND METHODS

An experiment was conducted during the *kharif* season of 2016 in Doon (PG) College of Agriculture and Allied Sciences, Rampur, Selaqui, Dehradun (Uttarakhand), situated at 30° N latitude, 77.8° E longitude, at an altitude of 682.58 m above the mean sea level in the Terai belt of the Shivalik range of the Himalayan foothills. This experiment

was done with twelve treatments and was duplicated thrice and laid out in Factorial Randomized block Design (FRBD) *viz*., in which factor A consists of the varied age of seedlings, A_1 - 14 days, A_2 - 21 days, A_3 - 28 days and Factor B consists of micro nutrient management approaches. B_1 Control, B_2 foliar application of 0.5% $ZnSO_4$ at 20 and 30 DAT, B_3 foliar application of 0.5% $FeSO_4$ at 20 and 30 DAT and B_4 foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT. The rice variety of PS 5 was sown on June 26th. The seedlings were transplanted at different days. 0.5% $ZnSO_4$ and $FeSO_4$ solution was prepared by using 0.5 g in 100 ml of water. All the biometric observations *viz.,* plant height, no of tillers m^{-2}, leaf area index was recorded at 30 days interval of sowing, yield observations on no of filled grains $panicle^{-1}$, grain and straw yield was recorded. As the experimental plot is deficit of micronutrients like Iron and zinc our experiment was focused mainly on micronutrients with different age of seedlings.

RESULTS AND DISCUSSION

Growth attributes

Effect of age of seedlings

Plant height was monitored at a 30 days interval. Height was affected significantly by different treatments at 30 DAT and at harvest. The plant height of rice changed greatly owing to the age of seedlings. The maximum plant height was achieved in the treatment of 14-day old seedlings (100.24 cm) (Table 1) at harvest. It may be due to the earlier transplanting and also young seedlings establish quicker than older seedlings owing to this plant absorbs nutrients quickly than the older seedlings. Younger seedling recovered fast enough to transplanting shock for faster growth to achieve higher yield (Sarath and Thilak 2004). The minimum plant height was attained in the treatment at 28 days age of seedling (79.58 cm).

No. of tillers m^{-2} was significantly affected due to age of seedlings. Tiller count was high during the initial stage of the crop but later it is reduced after the panicle initiation stage, higher no. of tillers m^{-2} was found in the treatment of 14 days younger seedling compared to the 28 days old seedlings. This may be attributable due to the shock of root damage suffered during seedling uprooting and transplanting was considerably less in young seedlings (14 days old) than in older seedlings. Effect of seedling age on tillering revealed that the young seedlings will have higher ability to enhance production Ali *et al.,* 2013.

LAI was significantly influenced by different age of seedlings. Leaf area index was counted in duration of 30 days interval. The highest leaf area index was found in the treatment of 14 days young seedling (1.82) (A_1). Minimum leaf area index was found in the treatment of 28 days seedling (A_3). It might be due the effect of transplanting time 14 days seedling as established earlier than the other. The other age of seedlings (21 and 28 days) due to transplanting shock they established very late. High root activity and photosynthetic activity of young seedlings that cause increase in leaf area and more dry matter than older seedlings (Rewainy *et al.,* 2007).

Effect of micronutrient management practices

All the micronutrient management practices followed were significantly affected the plant height at 30 DAT and at harvest. The findings in Table 1 clearly showed that plant height varied significantly due to micronutrient management strategies. The highest plant was obtained in the treatment which is applied with Foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT (94.11 cm). Minimum plant height was found in control treatment (85.68 cm). Similar findings were reported by Ananda and Patil (2010). Most of the photosynthetic pathways depends on enzymes and coenzymes which are synthesized by micronutrients. Zn and Fe are essential for several enzymes that regulate metabolic

Table 1: Effect of different age of seedlings and micronutrient management practices on plant height, no of tillers m^{-2}, leaf area index of rice (*Oryza sativa* L.).

Treatments	Plant height (cm)		No of tillers m^{-2}		LAI at
	30 DAT	Harvest	30 DAT	Harvest	Harvest
Age of seedlings					
14 days	31.78	100.24	63.79	225.40	1.82
21 days	29.64	89.95	54.96	200.41	1.67
28 days	27.29	79.58	46.266	179.57	1.53
S.Em	0.13	0.55	0.34	0.97	0.008
C.D (*P=0.05*)	0.56	2.24	1.36	3.93	0.03
Micro nutrient management practices					
Control	28.79	85.68	52.05	193.61	1.61
Foliar application of 0.5% $ZnSO_4$ at 20 and 30 DAT	32.29	91.37	55.99	204.55	1.69
Foliar application of 0.5% $FeSO_4$ at 20 and 30 DAT	30.64	88.54	54.06	199.10	1.65
Foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT	33.45	94.11	57.91	209.90	1.74
S.Em	0.18	0.74	0.44	1.30	0.008
C.D (*P=0.05*)	0.65	2.58	1.57	4.54	0.03

activities in plants. They involve in auxin production, transformation of carbohydrate and regulation of sugar in plants. Increase in growth attributes was mainly due to Zn and Fe application which are involved in the synthesis of growth promoting hormones and the reproduction process of many plants which are vital for grain formation (Ramana *et al.,* 2006).

The micronutrient management practices followed was positively influenced the no. of tillers. Tiller production was increased significantly in all the treatments. The higher no. of tillers was found in the treatment which is treated with foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT (209.90) (B_4). This might be attributed to enhanced photosynthetic processes, chlorophyll production, protein synthesis and nitrogen fixation due to Zn and F treatment. Availability of optimum quantity of micronutrients which facilitated more number of tillers at all the growth stages of the crop (Mustafa *et al.,* 2013).

Leaf area index was positively impacted due to micronutrients applied. Leaf area index was affected significantly within the treatments. The maximum leaf area index was obtained in the treatment which is applied with Foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT (1.74) (B_4). The increase of leaf area index is due to foliar application of the micronutrients and helps in cell elongation and chlorophyll formation (Zayed *et al.,* 2011). Lowest leaf area index was found in the treatment Control (1.61) (B_1). The application of Zn resulted in a considerable increase in the synthesis of IAA, an essential growth hormone responsible for plant development, resulting in enhanced plant growth. It was also seen in a larger quantity of chlorophyll content in a zinc and iron treatment.

Yield and yield attributes

Effect of age of seedlings

The age of the seedlings had a substantial influence on the number of filled grains panicle^{-1} (Table 2). The seedling with the most significant number of filled grains panicle^{-1} was 14 days old (86.99). This might be because seedlings less than 28 days old had more tillering capacity and vigour, which aided in the extraction of nutrients from the soil. Similar findings were reported by Thiyagarajan *et al.,* 2002.

The age of seedlings has a substantial impact on grain output. The seedling's 14 days resulted in greater grain output (6434 kg ha^{-1}). The percentage of increase of grain yield of 14 days age of seedlings was over 4.58% and 9.12% respectively more than the old age seedlings. It is most likely due to an increase in effective tillers, number of grains panicle^{-1} resulting in a nutrient transfer to the reproductive portion.

The straw yield was positively impacted by seedling age. Transplanting seedlings 14 days old resulted in enhanced straw output (5847 kg ha^{-1}). This might be due to an increase in tillers, which resulted in higher dry matter production due to increased photosynthetic activity, which aids in transporting nutrients to different regions of the plant and enlarges plant tissues, resulting in higher straw output.

Effect of micronutrient management practices

The results in Table 2 clearly showed that foliar treatments of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT substantially influenced the number of filled grains panicle^{-1} (91.23). Zinc and iron foliar applications resulted in rapid absorption and zinc is responsible for pollen and grain production. Foliar treatment of zinc and iron increased pollen grain viability and high seed formation. Jat *et al.,* 2011 and Karim *et al.,* 2012 discovered similar results.

The micronutrient management strategies used had a beneficial impact on grain output. The highest grain yield was obtained in the treatment augmented with 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT and it was comparable to foliar application of 0.5% $ZnSO_4$ (5564 kg ha^{-1}). The percentage of increase in the grain yield was about 21.53% than the control. This may be accomplished because zinc and iron play an essential role in the production of IAA,

Table 2: Effect of different age of seedlings and micronutrient management practices on No of filled grains panicle^{-1}, grain and straw yield (*Oryza sativa* L.).

Treatments	No of filled grains panicle^{-1}	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Age of seedlings			
14 days	86.99	5371	6434
21 days	83.41	5064	6139
28 days	80.4	4828	5847
S.Em	1.01	62.88	74.66
C.D (*P=0.05*)	2.97	184.41	218.98
Micro nutrient management practices			
Control	72.38	4300	5097
Foliar application of 0.5% $ZnSO_4$ at 20 and 30 DAT	90.07	5481	6735
Foliar application of 0.5% $FeSO_4$ at 20 and 30 DAT	80.37	5004	5885
Foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at 20 and 30 DAT	91.23	5564	6841
S.Em	1.17	72.60	86.21
C.D (*P=0.05*)	3.43	212.94	252.85

particularly in the primordial reproductive part and the portioning of photosynthesis towards them, which boosts yield. Rahman *et al.,* 2012 and Beutler *et al.,* 2014 found an increase in grain yield.

The application of micronutrients increased straw yield. The application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ as a foliar spray at 20 and 30 DAT (6841 kg ha^{-1}) resulted in increased straw yield. Zinc and iron have a favorable influence on root proliferation, which increases the absorption of plant nutrients from the soil, providing into the aerial portions of the plant and eventually improving vegetative development. Iron and zinc combined application aids in distribution through xylem and retranslocation in the phloem, which increases vegetative tissue formation, resulting in improved photosynthetic activity and an increase in dry matter (Nadim *et al.,* 2012).

CONCLUSION

In the view of above consideration, the present study revealed that the 14 days age of seedling with foliar application of 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ showed highest plant height, more no. of tillers and higher grain, straw yield than the 21- and 28-days age of seedling. It is due to 14 days age of seedlings is established quicker than the aged seedlings and Zinc, Ferrous are immobile in soil but it is mobile in plants due to foliar application the plants absorb quickly the nutrients and increases the plant metabolism.

Conflict of interest: None.

REFERENCES

Anonymous, (2020-21). 4th Advance Estimates, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare.

Ali, M.S., Hasain, M.A., Sikder, S., Islam, M.R. and Hafiz, M.H. (2013). Effect of seedling age and water management on the performance of boro rice (*Oryza sativa* L.) variety BRRI dhan28. The Agriculturists. 11(2): 28-37.

Ananda, N. and Patil, B.N. (2010). Effect of micronutrients (Zn and Fe) and time of nitrogen application on growth and yield of durum wheat. Journal of Agriculture Sciences. 18(3): 599-603.

Beutler, A.N., Silva, V.N., Deak, E.A., Burg, G.M., Schmidd, M.R. and Toebe, M. (2014). Zinc doses, sources and application times: Seed physiological potential and flooded rice yield. Australian Journal of Crop Science. 8(11): 1517.

Ginigaddara Sanjeewuanie, G.A. and Ranamukhaarachchi, S.L. (2011). Study of age of seedling at transplanting on growth dynamics and yield of rice under alternating flooding and suspension of irrigational water management. Recent Research in Science and Technology. 3: 76-88.

Jat, S.L., Shivay, Y.S. and Parihar, C.M. (2011). Dual purpose summer legumes and zinc fertilization for improving productivity and zinc utilization in aromatic hybrid rice (*Oryza sativa* L.). Indian Journal of Agronomy. 56(4): 328-333.

Juliano, B.O. (1985). Rice Chemistry and Technology. American Association of Cereal Chemists, USA; 757.

Karim, M.R., Zhang, Y.Q., Zhao, R.R., Chen, X.P., Zhang, F.S. and Zou, C.Q. (2012). Alleviation of drought stress in winter wheat by late foliar application of zinc, boron and manganese. Journal of Plant Nutrition and Soil Science. 175(1): 142-151.

Mustafa, G., Ehsanullah, Akbar, N., Qaisrani, S.Q., Iqbal, A., Khan, H.Z., Jabran, K., Chattha, A.A., Trethowan, R., Chattha, T. and Atta, M.B. (2013). Effect of zinc application on growth and yield of rice (*Oryza sativa* L.). IJAVMS. 5(6): 530-535.

Nadim, M.A., Awan, I.U., Baloch, M.S., Khan, E.A., Naveed, K. and Khan, M.A. (2012). Response of wheat to different micronutrients and their application methods. Journal of Animal Plant Sciences. 22(1): 113-119.

Ramana, A.V., Reddy, S.D. and Reddy, K.R. (2006). Influence of mulching and micronutrient management practices on upland rice. Karnataka Journal of Agriculture Sciences. 19(4): 785-788.

Rewainy, E.I.M., Hamoud, S.A., Metwaly, T.F. and Sedeek, S.E. (2007). Response of two rice cultivars to different seedling ages and nitrogen levels. African Crop Science Conference Proceedings. 8: 1937-1941.

Rahman, H.U., Aziz, T., Farooq, M., Wakeel, A. and Rangel, Z. (2012). Zinc nutrition in rice production systems: A review. Plant and Soil. 361(1-2): 203-226.

Sarath, P.N. and Thilak, B. (2004). Comparison of Productivity of System of Rice Intensification and Conventional Rice Farming System in the Dry-zone Region of Sri Lanka. 4th International Crop Science Congress.

Singh, V. and Ram, N. (2010). Effect of 25 years continuous fertilizer use on response to applied nutrients and uptake of micronutrients by rice-wheat-cowpea system. Cereal Research Communication. 33(2/3): 589-594.

Thiyagarajan, T.M., Velu, V., Ramaswamy, S., Durgadevi, D., Govindarajan, K., Priyadarshini, R., Sudhalakshmi, C., Senthil Kumar, K., Nisha, P.T., Gayathry, G., Hengsdijk, H. and Bindraban, P.S. (2002). Effects of SRI Practices on Hybrid Rice Performance in Tamil Nadu, India, In: Water wise Rice Production, IRRI Publication, pp. 119-127.

Uphoff, N. (2007). System of Rice Intensification; Using Alternative Cultural Practices to Increase Rice Production and Profitability from Existing Yield Potentials. International Rice Commission Newsletter, Number 55, UN. Food and Agriculture Organization, Rome.

Zayed, B.A., Salem, A.K.M. and Sharkawy, H.M.E. (2011). Effect of different micronutrient treatments on rice (*Oryza sativa* L.) growth and yield under saline soil conditions. World Journal of Agricultural Sciences. 7(2): 179-184.