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Effect of the uptake of N, P, K, Fe, Zn and B by rice (*Oryza sativa* L.)

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Abstract
The present investigation entitled "Effect of the uptake of N, P, K, Fe, Zn and B by rice (*Oryza sativa* L.)" was carried out during *Kharif* season of year 2019 at Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology (Narendra Nagar) Kumarganj, Ayodhya (U.P.). The field experiment included 9 treatments in Randomized Block Design with nine treatments. Total uptake of nitrogen, phosphorus, potassium and boron by the rice achieved with the application of 100% RDF(150-60-40 kg ha^{-1} NPK) – Inorganic fertilizer + foliar spray of boron (0.1%) before panicle initiation while more uptake of zinc and ferrous was observed with the 100% RDF + foliar spray of zinc (0.5%) and 100% RDF + foliar spray of ferrous (1.0%), respectively.

Keywords: Uptake, inorganic, spray, application

Introduction
Rice (*Oryza sativa* L.) is one of the most important food grain crops of more than 60 percent of the world's population. About 90 percent of all rice grown in the world is produced and consumed in the Asian region. It is the world's leading food crop in terms of area and production. Among the rice growing countries, India has the largest area followed by China and Indonesia. India ranks second in production after China. Andhra Pradesh, Bihar, Uttar Pradesh, Madhya Pradesh and West Bengal are leading states in the area of rice. In India, it is grown over an area of 43.79 million hectares having production of 112.91 million tonnes with average productivity of 2578 kg ha^{-1}. In Uttar Pradesh, it is grown on 5.95 million hectares area with production of 13.27 million tonnes and productivity of 2230 kg ha^{-1} (Anonymous 2018).

Rice contributes 43% of total food grain production and 46% of the total cereal production of the country. In India, West Bengal is top producing state followed by Uttar Pradesh, Punjab and Orissa. Other rice growing leading states are Chhattisgarh (rice bowl of India), Tamil Nadu, Telangana, Assam, Bihar, Madhya Pradesh, Gujarat and Karnataka. Uttar Pradesh is an important rice growing state of the country in which rice is grown on 5.95 million hectares and 13.27 million tonnes, production with productivity of 2230 kg ha^{-1} (Agricultural Statistics at a Glance, 2018) [1].

Materials and Methods
An experiment was conducted during *Kharif* season 2019 at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar, Kumarganj, Ayodhya, Uttar Pradesh, India. The field was well leveled having good soil condition. Geographically, Ayodhya (Kumarganj) falls in subtropical climate and is situated at 26.47^0 N latitude, 82.12^0 E longitude with an altitude of 113 meters above mean sea level. The experimental site is situated in main campus of university on left side of Ayodhya- Raibarelli road at the distance of 42 km from Ayodhya district headquarter.

Summary and Conclusion
The scrutiny of data of yield attributes clearly reveals that there was a significant impact of different nutrient management practices on yield attributing character's like as number of effective tiller m^{-2}, panicle weight (g), number of grains $panicle^{-1}$ however the length of

panicle and 1000-grains weight (g) was not affected significantly. The crop sown with 100% RDF – Inorganic fertilizer + B @ 0.1% foliar spray recorded the significantly highest number of effective tiller m^{-2}, panicle weight (g), number of grains $panicle^{-1}$ and it was at par with treatment T_4 (100% RDF - Inorganic fertilizer + $ZnSO_4$ @ 25 kg ha^{-1} as basal dose), T_5 (RDF 100% - Inorganic fertilizer + Zn @ 0.5% foliar spray) and T_6 (100% RDF – Inorganic fertilizer + BO_3 @ 1.5 kg ha^{-1} as basal dose) which might due to chemical fertilizers provide readily plant nutrients to crop. Similar responses were also recorded by Rehman *et al.* (2014) [2].

100% RDF – Inorganic fertilizer + B @ 0.1% foliar spray recorded the significantly highest grain (48.87 q ha^{-1}), straw (66.25 q ha^{-1}), biological yield (115.12 q ha^{-1}). The grain yield is higher due to higher yield attributing yield character's (*viz.*- number of effective tillers, length of panicle, panicle weight, number of grains $panicles^{-1}$ and 1000 grains weight) as well as higher nutrient uptake by the crop. Boron also helps in seed setting and prevent the shattering of seeds. It might also due to that the chemical fertilizers not only increase the rate of photosynthesis but also increase the translocation of source to sink which resulted in higher grain yield. However the rate of releasing of nutrients from organic manures is slow in beginning. The increases in growth parameters *viz.*- plant height, number of tillers, leaf area and dry matter accumulation have been resulted in higher straw yield.

The biological yield is sum of grain and straw yield which is cumulative effect of growth and yield attributing character's (*viz.*- plant height, number of tillers, leaf area and dry matter accumulation, number of panicles, length of panicle, panicle weight, number of grains $panicles^{-1}$ and 1000- grains weight) as well as higher nutrient uptake by the crop. The effect of nutrient management on harvest index was non-significant.

The grain, straw, biological yield and harvest index was closely followed by treatment T_6-100% RDF – Inorganic fertilizer + BO_3 @ 1.5 kg ha^{-1} as basal dose. This result was closely justified with report of Patil *et al.* (2017).

Table 1: Effect of nutrient management on effective tillers (m^{-2}), panicle length (cm), panicle weight (g), grains $panicle^{-1}$ and test weight (g) of rice

Symbol	Treatments	No. of effective tillers (m^{-2})	Panicle length (cm)	Panicle weight (g)	No. of grains $panicle^{-1}$	Test weight (g)
T_1	100% RDF – Inorganic fertilizer (150-60-40 kg ha^{-1})	241.33	21.02	3.33	124.67	22.46
T_2	100% RDF – Inorganic fertilizer + $FeSO_4$ @ 50 kg ha^{-1} as basal dose	265.67	21.87	3.51	129.67	22.56
T_3	100% RDF – Inorganic fertilizer + Fe @ 1.0% foliar spray	278.33	22.12	3.65	133.33	22.89
T_4	100% RDF – Inorganic fertilizer + $ZnSO_4$ @ 25 kg ha^{-1} as basal dose	298.33	22.6	3.82	139.67	23.08
T_5	100% RDF – Inorganic fertilizer + Zn @ 0.5% foliar spray	309.67	22.87	3.88	141.33	23.18
T_6	100% RDF – Inorganic fertilizer + BO_3 @ 1.5 kg ha^{-1} as basal dose	319.67	23.04	4.03	147.67	23.23
T_7	100% RDF – Inorganic fertilizer + B@ 0.1% foliar spray	330.33	23.32	4.21	154.33	23.36
T_8	75% RDF + 25% RDN through FYM	254.67	21.61	3.47	127.33	22.54
T_9	50% RDF + 50% RDN through FYM	234.33	20.97	3.06	119.67	22.45
	SEm ±	14.40	1.13	0.19	6.93	1.17
	CD at 5%	43.17	NS	0.56	20.78	NS

Table 2: Effect of nutrient management on grain yield (q ha^{-1}), straw yield (q ha^{-1}), biological yield (q ha^{-1}) and harvest index (%) of rice

Symbol	Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
T_1	100% RDF – Inorganic fertilizer (150-60-40 kg ha^{-1})	34.37	51.23	85.60	40.15
T_2	100% RDF – Inorganic fertilizer + $FeSO_4$ @ 50 kg ha^{-1} as basal dose	37.47	53.30	90.77	41.28
T_3	100% RDF – Inorganic fertilizer + Fe @ 1.0% foliar spray	38.54	53.75	92.29	41.76
T_4	100% RDF – Inorganic fertilizer + $ZnSO_4$ @ 25 kg ha^{-1} as basal dose	43.87	60.46	104.33	42.05
T_5	100% RDF – Inorganic fertilizer + Zn @ 0.5% foliar spray	45.24	62.12	107.36	42.14
T_6	100% RDF – Inorganic fertilizer + BO_3 @ 1.5 kg ha^{-1} as basal dose	46.37	63.43	109.80	42.23
T_7	100% RDF – Inorganic fertilizer + B@ 0.1% foliar spray	48.87	66.25	115.12	42.45
T_8	75% RDF + 25% RDN through FYM	35.87	51.85	87.72	40.89
T_9	50% RDF + 50% RDN through FYM	32.46	48.91	81.37	39.89
	S.Em ±	2.06	2.91	4.97	2.12
	CD at 5%	6.18	8.72	14.90	NS

Conclusion

Total uptake of nitrogen, phosphorus, potassium and boron by the rice achieved with the application of 100% RDF(150-60-40 kg ha^{-1} NPK) – Inorganic fertilizer + foliar spray of boron (0.1%) before panicle initiation while more uptake of zinc and ferrous was observed with the 100% RDF + foliar spray of zinc (0.5%) and 100% RDF + foliar spray of ferrous (1.0%), respectively.

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