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# Study the effect of soil and foliar application of Fe, Zn and B on growth factors of rice

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**Abstract**
The present investigation entitled "Study the effect of soil and foliar application of Fe, Zn and B on growth factors of 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 *viz.;* $T_1$-100% RDF- Inorganic fertilizer (150-60-40 kg $ha^{-1}$), $T_2$- 100% RDF - Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose, $T_3$- 100% RDF - Inorganic fertilizer + Fe @ 1.0% foliar spray, $T_4$-100% RDF - Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose, $T_5$-100% RDF - Inorganic fertilizer + Zn @ 0.5% foliar spray, $T_6$-100% RDF - Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose, $T_7$-100% RDF - Inorganic fertilizer + B @ 0.1% foliar spray, $T_8$- 75% RDF + 25% RDN through FYM and $T_9$- 50% RDF + 50% RDN through FYM replicated thrice. The applied micronutrients to the soil, foliar application of ferrous, zinc and boron gave better response on growth attributes of the rice crop.

**Keywords:** Foliar, micronutrients, fertilizer, experiment

## 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) [3].

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

Almost all the growth parameter followed sigmoid curve. Initially the rate growth (plant height, number of tiller, leaf area index, dry matter accumulation and days taken to panicle initiation) was rather slow followed by rapid growth till 30 DAT stage and thereafter the growth rate increased marginally and finally it declined.

Plant height is controlled by genetic make-up of genotype, but it is also affected by nutrition and environmental conditions. In the present study, it was observed that the treatment $T_5$- RDF 100% - Inorganic fertilizer + Zn @ 0.5% foliar spray achieved highest plant height which was taller than almost all the treatment and followed by treatment $T_4$ (100% RDF - Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose), $T_2$ (100% RDF - Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose), $T_3$ (100% RDF - Inorganic fertilizer + Fe @ 1.0% foliar spray) and $T_7$ (100% RDF - Inorganic fertilizer + B @ 0.1% foliar spray).

This was attributed due to maximum fertilizer and micro-nutriens was given to this treatment as compare to other treatment available in the experiment that resulting in taller plant. Increase in plant height might be due to adequate nitrogen supply through inorganic sources to growing plants. Increase in plant height is a function of cell expansion and depend upon nitrogen availability. The findings of this investigation fall in line with those observed by Khan *et al.* (2002), Rahman *et al.*(2008), Shivay *et al.*(2008).

The scrutiny of result for number of tillers $m^{-2}$ indicates that the crop sown with RDF 100% - Inorganic fertilizer + Zn @ 0.5% foliar spray recorded highest number of tillers till the end of life process. The interesting behavior exhibited by different treatment may be explained by the fact that the 100% (150-60-40 kg $ha^{-1}$) + Zn @ 0.5% foliar spray and followed by treatment $T_4$ (100% RDF - Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose). Higher numbers of tillers might be due to planted crop was exposed to favorable nutrient during the whole life cycle and thus the different phases of plant life could be completed at appropriate timings. Higher number of tiller might be due to more availability of nitrogen which plays a vital role in growth favoring constituents in plant system owing to better supply of nitrogen resulted in more numbers of tillers $m^{-2}$. Similar result was found by Arif *et al.* (2012) [4].

There was significant increase in LAI with 100% RDF and combination of organic and inorganic fertilizer. Treatment $T_5$- RDF 100% - Inorganic farming + Zn @ 0.5% foliar spray recorded significantly higher LAI over all the treatments but remain at par with $T_2$ (100% RDF - Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose), $T_4$ (100% RDF - Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose) and treatment $T_2$ (100% RDF - Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose), $T_3$ (100% RDF - Inorganic fertilizer + Fe @ 1.0% foliar spray), $T_4$ (100% RDF - Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose), $T_6$ (100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose) and $T_7$ (100% RDF - Inorganic fertilizer + B @ 0.1% foliar spray) respectively at 60 and 90 DAT. Maximum LAI (4.58) was found with treatment $T_5$- RDF 100% - Inorganic farming + Zn @ 0.5% foliar spray and minimum under treatment $T_9$- 50% RDF + 50% RDN - FYM (3.08). The available nutrient might have helped in enhancing leaf area index, which there by resulted in higher photo-assimilates and more dry matter accumulation.

Nutrient management had significant effect on dry matter accumulation under various treatments at different growth stages of rice except 30 DAT stage. Crop sown with 100% RDF–Inorganic fertilizer + B @ 0.1% foliar spray recorded the highest dry matter accumulation and it was at par with $T_4$ (100% RDF - Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose), $T_5$ (RDF 100% - Inorganic farming + Zn @ 0.5% foliar spray) and $T_6$ (100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose) which might be mainly because of production of more number of tillers and number of panicle $m^{-2}$ due to higher amount of chemical fertilizer.

Nutrient management practices had non-significant effect on days taken to panicle initiation. Treatment $T_6$- 100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose has earliest emerged panicle at 75 days and other treatment were taken more time.

**Table 1:** Effect of nutrient management on plant height (cm) at various growth stages of rice

| Symbol | Treatments | Plant height (cm) | | | |
|---|---|---|---|---|---|
| | | 30 DAT | 60 DAT | 90 DAT | At harvest |
| $T_1$ | 100% RDF – Inorganic fertilizer (150-60-40 kg $ha^{-1}$) | 27.00 | 66.96 | 83.56 | 86.28 |
| $T_2$ | 100% RDF – Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose | 29.59 | 75.25 | 102.36 | 104.38 |
| $T_3$ | 100% RDF – Inorganic fertilizer + Fe @ 1.0% foliar spray | 29.28 | 74.38 | 99.99 | 102.48 |
| $T_4$ | 100% RDF – Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose | 30.23 | 78.19 | 104.65 | 108.38 |
| $T_5$ | 100% RDF – Inorganic fertilizer + Zn @ 0.5% foliar spray | 30.27 | 80.07 | 106.57 | 110.37 |
| $T_6$ | 100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose | 28.45 | 70.15 | 94.73 | 95.84 |
| $T_7$ | 100% RDF – Inorganic fertilizer + B@ 0.1% foliar spray | 28.80 | 71.29 | 96.56 | 97.48 |
| $T_8$ | 75% RDF + 25% RDN through FYM | 27.59 | 67.95 | 85.25 | 87.49 |
| $T_9$ | 50% RDF + 50% RDN through FYM | 25.93 | 64.23 | 80.29 | 83.28 |
| | S.Em ± | 1.22 | 3.28 | 4.08 | 4.19 |
| | CD at 5% | NS | 9.85 | 12.25 | 12.56 |

**Table 2:** Effect of nutrient management on number of tillers ($m^{-2}$) at various growth stages of rice

| Symbol | Treatments | No. of tillers ($m^{-2}$) | | | |
|---|---|---|---|---|---|
| | | 30 DAT | 60 DAT | 90 DAT | At harvest |
| $T_1$ | 100% RDF – Inorganic fertilizer (150-60-40 kg $ha^{-1}$) | 176.36 | 358.27 | 388.67 | 384.33 |
| $T_2$ | 100% RDF – Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose | 193.27 | 422.67 | 454.67 | 448.33 |
| $T_3$ | 100% RDF – Inorganic fertilizer + Fe @ 1.0% foliar spray | 191.35 | 418.33 | 448.33 | 442.67 |
| $T_4$ | 100% RDF – Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose | 195.35 | 419.67 | 453.67 | 450.33 |
| $T_5$ | 100% RDF – Inorganic fertilizer + Zn @ 0.5% foliar spray | 198.65 | 433.33 | 463.33 | 459.67 |
| $T_6$ | 100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose | 185.38 | 404.67 | 439.67 | 435.33 |
| $T_7$ | 100% RDF – Inorganic fertilizer + B@ 0.1% foliar spray | 187.27 | 412.33 | 448.33 | 443.65 |

| | | | | | |
|---|---|---|---|---|---|
| $T_8$ | 75% RDF + 25% RDN through FYM | 178.37 | 377.67 | 411.67 | 408.33 |
| $T_9$ | 50% RDF + 50% RDN through FYM | 174.33 | 325.33 | 360.33 | 356.66 |
| | S.Em ± | 7.92 | 20.10 | 21.80 | 21.56 |
| | CD at 5% | NS | 60.27 | 65.36 | 64.66 |

**Table 3:** Effect of nutrient management on leaf area index (LAI) at various growth stages of rice

| Symbol | Treatments | Leaf area index (LAI) | | |
|---|---|---|---|---|
| | | 30 DAT | 60 DAT | 90 DAT |
| $T_1$ | 100% RDF – Inorganic fertilizer (150-60-40 kg $ha^{-1}$) | 1.43 | 2.83 | 3.32 |
| $T_2$ | 100% RDF – Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose | 1.50 | 3.16 | 4.39 |
| $T_3$ | 100% RDF – Inorganic fertilizer + Fe @ 1.0% foliar spray | 1.49 | 2.99 | 4.32 |
| $T_4$ | 100% RDF – Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose | 1.56 | 3.42 | 4.49 |
| $T_5$ | 100% RDF – Inorganic fertilizer + Zn @ 0.5% foliar spray | 1.61 | 3.56 | 4.58 |
| $T_6$ | 100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose | 1.44 | 2.91 | 4.09 |
| $T_7$ | 100% RDF – Inorganic fertilizer + B@ 0.1% foliar spray | 1.46 | 2.95 | 4.21 |
| $T_8$ | 75% RDF + 25% RDN through FYM | 1.43 | 2.87 | 3.65 |
| $T_9$ | 50% RDF + 50% RDN through FYM | 1.43 | 2.78 | 3.08 |
| | S.Em ± | 0.06 | 0.15 | 0.20 |
| | CD at 5% | NS | 0.46 | 0.60 |

**Table 4:** Effect of nutrient management on dry matter accumulation (g $m^{-2}$) at various growth stages of rice

| Symbol | Treatments | Dry matter accumulation (g $m^{-2}$) | | | |
|---|---|---|---|---|---|
| | | 30 DAT | 60 DAT | 90 DAT | At harvest |
| $T_1$ | 100% RDF – Inorganic fertilizer (150-60-40 kg $ha^{-1}$) | 210.37 | 337.97 | 452.48 | 856.03 |
| $T_2$ | 100% RDF – Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose | 224.36 | 387.47 | 508.37 | 907.70 |
| $T_3$ | 100% RDF – Inorganic fertilizer + Fe @ 1.0% foliar spray | 222.47 | 384.59 | 520.47 | 922.89 |
| $T_4$ | 100% RDF – Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose | 230.18 | 401.86 | 639.34 | 1043.28 |
| $T_5$ | 100% RDF – Inorganic fertilizer + Zn @ 0.5% foliar spray | 233.32 | 413.94 | 677.48 | 1073.56 |
| $T_6$ | 100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose | 217.98 | 387.38 | 701.48 | 1098.03 |
| $T_7$ | 100% RDF – Inorganic fertilizer + B@ 0.1% foliar spray | 220.47 | 392.8 | 751.48 | 1151.23 |
| $T_8$ | 75% RDF + 25% RDN through FYM | 213.47 | 348.75 | 479.49 | 877.23 |
| $T_9$ | 50% RDF + 50% RDN through FYM | 208.47 | 318.86 | 420.48 | 813.73 |
| | S.Em ± | 11.18 | 18.99 | 29.45 | 49.70 |
| | CD at 5% | NS | 56.95 | 88.29 | 149.01 |

**Table 5:** Effect of nutrient management on days taken to panicle initiation of rice

| Symbol | Treatments | Days taken to panicle initiation |
|---|---|---|
| $T_1$ | 100% RDF – Inorganic fertilizer (150-60-40 kg $ha^{-1}$) | 79 |
| $T_2$ | 100% RDF – Inorganic fertilizer + $FeSO_4$ @ 50 kg $ha^{-1}$ as basal dose | 78 |
| $T_3$ | 100% RDF – Inorganic fertilizer + Fe @ 1.0% foliar spray | 77 |
| $T_4$ | 100% RDF – Inorganic fertilizer + $ZnSO_4$ @ 25 kg $ha^{-1}$ as basal dose | 78 |
| $T_5$ | 100% RDF – Inorganic fertilizer + Zn @ 0.5% foliar spray | 78 |
| $T_6$ | 100% RDF – Inorganic fertilizer + $BO_3$ @ 1.5 kg $ha^{-1}$ as basal dose | 73 |
| $T_7$ | 100% RDF – Inorganic fertilizer + B@ 0.1% foliar spray | 75 |
| $T_8$ | 75% RDF + 25% RDN through FYM | 78 |
| $T_9$ | 50% RDF + 50% RDN through FYM | 79 |
| | S.Em ± | 3.96 |
| | CD at 5% | NS |

## Conclusion

The applied micronutrients to the soil, foliar application of ferrous, zinc and boron gave better response on growth attributes of the rice crop.

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