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Effect of zinc and Boron on potato yield and quality, nutrient uptake and soil health

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Abstract

The present investigation untitled “Effect of zinc and boron on growth and yield of potato” was carried out during *rabi*, Season of 2019-20 at Main Experiment Station, Vegetable Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (UP). The experiment was laid out in Randomized Block Design with the replications. There were seven treatment *viz* T₁-control (RDF) NPK @ 150:100:120 kg/Ha T₂- T₁ +25 kg Zn soil /ha T₃- T₁ +5 kg Borax/ha, T₄- T₁ + 25 kg Zn SO₄+5 kg Borax/ha. T₅-T₁+spray zinc (0.5%), T₆-T₁+ spray borax (0.5%), T₇-T₁+spray zinc sulphate + borax @ 0.5%. The soil of the experimental field was silt loam in texture, having low organic carbon (0.35%) available N (145.5 kg/ha), P (15.7 kg/ha), K (255.0 kg/ha) and Zn (0.43 ppm), B (0.10 ppm). The potato variety *_Kufri neelkanth_* was sown on 11 November more in row spacing 60x20 cm away tuber seed rate @ 25 Kg/ha. Nitrogen, phosphorous, potassium, zinc sulphate and borax were applied as per treatment. All the growth character yield and nutrient uptake (Zn and B) were found significantly superior in T₄ treatment (where zinc sulphate and borax @ 25 and 5 kg/ha) over control (without zinc sulphate and borax). Maximum potato tuber yield (36.5 t/ha) and haulm yield (62.09 t/ha), zinc uptake (565.7gm/ha), Boron uptake (620 gm/ha) and BC: ratio (3.44) was observed under T₄ treatment. On the basis of result it may be concluded that application of N, P, K, zinc sulphate and Borax @ 150:100:120:25:5 kg/ha was found most suitable dose and combination for increasing yield, yield attribute character nutrients availability and uptake (Zn and Boron), soil health and net return.

Keywords: Fertilizers, potato, nutrient yield and quality and soil health

Introduction

Adequate supply of Boron and Zinc can improve the structural indignity and permeability of cell membrane work as a defense mechanism against fungi infection. It is reported that among micronutrients Zn and B have occupied a unique position in enhancing the yield of potato (Trehan and Grewal, 1989). Zn helps to increase the rate of photosynthesis and the translocation of photosynthates leading to increased size and number of tubers. Zinc is the most deficient micronutrient in Indian soils (52%), followed by boron (33%) (ISSS, 2009). Most of the Indian soils are widely deficient in micronutrients, especially Zn, Mn, B and Fe (Parmer *et al.*, 2016) [25]. The micronutrients play a vital role in crop production. Past few years it have been observed that micronutrients increase the productivity of crop in direct manner. However, so far their effects on the quality of crops have been largely ignored (Randhawa and Takkar, 1975) [27]. It is therefore, essential that fertilizer use in relation to the quality of the produce should receive urgent attention. The fast-growing characteristic of the potato allowed poor families to cultivate it on small plots and break the circle of poverty. Hundred millions of people around the world depend on potatoes to survive. Potato is farm in more than 100 countries under temperate subtropical as well as tropical conditions and ranks as the world's third most important food crop, after rice and wheat. China is now the largest potato producer followed by India and the Russian Federation.

Material and Method

The experiment was conducted during the winter season of 2019 to 2020 at Experiment form of Narendra Deva University of Agriculture & Technology, Narendra Nager (Kumarganj), Ayodhya (up) INDIA, which is located 42km away from Ayodhya on Ayodhya-Raebareli road. The soil of the experiment field was silt loam in texture with medium fertility. The field experiment was laid out in Randomized block design with three replication having seven treatment i.e T₁-control (RDF) NPK @ 150:100:120 kg/Ha T₂- T₁ +25 kg Zn soil /ha T₃- T₁ +5 kg Borax/ha, T₄- T₁ + 25 kg Zn SO₄+5 kg Borax/ha.

T₅-T₁+spray zinc (0.5%), T₆-T₁+ spray borax (0.5%), T₇-T₁+spray zinc sulphate + borax @ 0.5%. As per nutrient (N,P,K, Zn and B) are applied. The potato variety (Kufri Neelkanth) raised follow the good agricultural practices of the region. soil health parameter are analyzed by adopting Standarded Labouratry methods.

Result and Discussion

It is clear from the table1 that potato tuber emergence, plant height and tuber yield increased with the addition of N, P₂O₅, K₂O, Zn, B. Tuber emergence of potato at 30 DAS presented in Table 1. clearly revealed that different treatments did not show any significant effect on tuber emergence. Maximum emergence (96.5%) was observed with T₄ treatment (where 25 kg ZnSO₄+5kg Borax along with recommended dose N, P, K @ 150:100:120 kg/ha applied). However, minimum (93.5%) was recorded with control plot (T₁).

Table 1: Effect of various treatments on emergence and plant height (cm) at various growth stages in potato

| Treatments | Emergence 30 (DAS) % | Plant height 60 (DAS) |
|--|----------------------|-----------------------|
| T ₁ .Control 150:100:120-N:P ₂ O:K | 93.5 | 34.7 |
| T ₂ .T ₁ +25 Kg ZnSO ₄ ha ⁻¹ | 94.5 | 36.0 |
| T ₃ .T ₁ +5 kg Borax ha ⁻¹ | 95.3 | 35.2 |
| T ₄ .T ₁ +25Kg ZnSO ₄ ha ⁻¹ +5 kg Borex ha ⁻¹ | 96.5 | 38.2 |
| T ₅ .T ₁ + Spray of Zinc | 94.0 | 36.0 |
| T ₆ .T ₁ +Spray of Boron | 95.0 | 35.0 |
| T ₇ .T ₁ +Spray of Zn +Boron | 93.6 | 37.5 |
| S.Em | 0.47 | 0.46 |
| CD=0.05 | NS | 1.43 |

The perusal of data presented in Table 2 and illustrated in Fig 2 clearly indicate that all the treatment resulted increase the potato tuber yield as compared to control. Zinc sulphate alone a in combination with borax increases as compared with no zinc sulphate and borax alone or in combination. Maximum potato tuber yield (36.5 t/ha) was recorded under T₄ treatment where NPK, Zinc sulphate and borax applied @ 150:100:120: 25 and 5 kg/ha respectively, which was significantly superior with control. However, minimum (33.0 t/ha) was observed in control plot.

Table 2: Effect of various treatments on tuber yield in potato

| Treatments | Tuber yield (ton/ha) | Haulm yield (ton/ha) |
|---|----------------------|----------------------|
| T ₁ .Control 150:100:120-N:P ₂ O:K | 33.0 | 57.70 |
| T ₂ .T ₁ +25 Kg ZnSO ₄ ha ⁻¹ | 35.4 | 60.25 |
| T ₃ .T ₁ +5 kg Borax ha ⁻¹ | 33.5 | 59.00 |
| T ₄ .T ₁ +25Kg ZnSO ₄ ha ⁻¹ +5kg Borex ^{-ha-1} | 36.5 | 62.09 |
| T ₅ .T ₁ + Spray of Zinc | 34.7 | 59.80 |
| T ₆ .T ₁ +Spray of Boron | 33.5 | 58.25 |
| T ₇ .T ₁ +Spray of Zn +Boron | 36.0 | 61.90 |
| S.Em | 0.18 | 0.28 |
| CD=0.05 | 0.56 | 0.88 |

Different treatment increased the nutrients (N, P, K, Zn and B) uptake over control (without zinc and boron application). Joint application of zinc and boron was found more effective as combined to alone either zinc sulphate or borax application. The recovery of zinc and borax was higher when zinc sulphate and borax was applied jointly as compared to alone or without zinc and borax treatment plant (control.) Different treatment increased the N, P, K, Zn and B uptake over control. It might be due to better utilization and supply of

nutrients to potato crop. Under T₄ treatment observed might uptake as compared to rest of the treatment might be due to Increase of nutrients availability (under T₄ treatment) means more translocation of nutrients (N, P, K, Zn and B) from soil to plant. The results are agreement with the Khalil *et al.* (2002) and Hogue *et al.* (2009)

Table 3: Effect of various treatment on nutrient uptake in Zn and B

| Treatment | Nutrient uptake in Zn gm/ha | Nutrient uptake in B gm/ha |
|--|-----------------------------|----------------------------|
| T ₁ .Control 150:100:120-N:P ₂ O:K | 429.0 | 495.0 |
| T ₂ .T ₁ +25 Kg ZnSO ₄ ha ⁻¹ | 527.6 | 560.0 |
| T ₃ .T ₁ +5 kg Borax ha ⁻¹ | 458.9 | 536.0 |
| T ₄ .T ₁ +25Kg ZnSO ₄ ha ⁻¹ +5kg Borex ^{ha-1} | 565.7 | 620.5 |
| T ₅ .T ₁ + Spray of Zinc | 520.5 | 578.0 |
| T ₆ .T ₁ +Spray of Boron | 442.4 | 501.6 |
| T ₇ .T ₁ +Spray of Zn +Boron | 547.2 | 565.2 |
| S.Em | 1.1 | 0.82 |
| CD=0.05 | 3.68 | 2.54 |

Different treatment increased the nutrients (N, P, K, Zn and B) uptake over control (without zinc and boron application). Joint application of zinc and boron was found more effective as combined to alone either zinc sulphate or borax application. The recovery of zinc and borax was higher when zinc sulphate and borax was applied jointly as compared to alone or without zinc and borax treatment plant (control.) Different treatment increased the N, P, K, Zn and B uptake over control. It might be due to better utilization and supply of nutrients to potato crop. Under T₄ treatment observed might uptake as compared to rest of the treatment might be due to increase of nutrients availability (under T₄ treatment) means more translocation of nutrients (N, P, K, Zn and B) from soil to plant. The results are agreement with the Khalil *et al.* (2002) and Hogue *et al.* (2009).

Table 4: Effect of various treatment on soil health parameter:

| Treatments | PH | EC | OC | N | P | K | Zn | B |
|----------------|-----|------|------|-------|------|-------|------|-------|
| T ₁ | 8.1 | 0.23 | 0.35 | 145.5 | 15.7 | 255.0 | 11.5 | 17.3 |
| T ₂ | 8.1 | 0.23 | 0.36 | 135.8 | 14 | 245.0 | 13.0 | 19.00 |
| T ₃ | 8.1 | 0.23 | 0.35 | 137.5 | 15.2 | 249.0 | 11.0 | 19.5 |
| T ₄ | 8.1 | 0.23 | 0.35 | 135.7 | 14.0 | 247.0 | 13.7 | 19.7 |
| T ₅ | 8.1 | 0.23 | 0.35 | 137.0 | 14.5 | 248.5 | 13.0 | 20.0 |
| T ₆ | 8.1 | 0.22 | 0.35 | 140.0 | 15.0 | 252.0 | 11.5 | 18.0 |
| T ₇ | 8.1 | 0.23 | 0.35 | 136.0 | 14.0 | 245.0 | 13.5 | 18.2 |
| CD | | | | 0.21 | 0.16 | 0.26 | 0.04 | 0.35 |
| S. em | NS | NS | NS | 0.66 | 0.49 | 0.82 | 0.13 | 1.09 |

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