

Response of potato (*Solanum tuberosum* L.) to foliar application of macro and micronutrients in the Red and Lateritic Zone of West Bengal

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ABSTRACT

A field experiment was carried out in the red & lateritic soil of Regional Research Station, Jhargram, Bidhan Chandra Krishi Viswavidyalaya, West Bengal during the rabi season of 2015 to evaluate the response of potato crop to foliar application of macro and micronutrients. The treatments comprised of T₁-Foliar application of zinc (Zn)(Zn-EDTA) @ 1 g.l⁻¹, T₂-Foliar application of boron(B) (20%) @ 1.5 g.l⁻¹, T₃-Foliar application of iron (Fe)(FeSo₄) @ 10 g.l⁻¹, T₄-Foliar application of manganese (Mn)(MnSo₄) @ 5 g.l⁻¹, T₅-Foliar application of NPK(19-19-19) @ 10 g.l⁻¹, T₆-Foliar application of mixture of Zn, B, Fe, Mn, T₇-Foliar application of mixture of Zn, B, Fe, Mn and NPK, T₈-Control(water spray). Among the treatments, foliar application of micronutrients mixture i.e. mixture of Zn, B, Fe, Mn along with NPK(19-19-19) produced the highest tuber yield of 22.45 t ha⁻¹ which was 32.01 per cent higher than control plot yield.

Keywords : Foliar spray, macronutrient, micronutrient, NPK, potato,yield

Potato (*Solanum tuberosum* L.) is one of the leading staple food of human diet in the world. Potato is a good source of daily calorie need of human being. It provides many essential nutrients and vitamins including potassium, phosphorus, manganese, magnesium etc. to human being. Potato is a heavy nutrient requiring crop as it provides a huge bulk dry matter. The crop has a shallow and sparse root system, most of the soil fail to meet its nutrient demand. Consequently potato crop responses much to external use of fertilizer. Potato is cultivated in the Indo-gangetic plane and pleatu which contain low amount of nitrogen, phosphorus, organic matter as well as micronutrient, therefore judicious use of nutrient is required for better crop development.

Apart from macronutrient requirement, micronutrients play important role for growth and development of potato crop. As micronutrients, mainly zinc (Zn), boron(B), iron(Fe), manganese (Mn), are concerned with nutrient management of potato. Each of these micronutrients have specific role for the development of quality tuber. But these elements are required in trace amount for different physiological processes of potato crop. Among these, boron and zinc play pivotal role in pollination and fruit development. Zinc is involved in hormone biosynthesis, cytoplasm synthesis, activation and function of different enzymes, protein synthesis etc. Boron plays active role in protein synthesis during seed and cell wall formation. Boron also helps in water and nutrient transportation from root to shoot (Ziaeyan *et.al.*, 2009). Manganese is associated with activation of enzyme like decarboxylase, dehydrogenase in photosynthesis. Iron is essential for chlorophyll development in cell without which photosynthesis is not possible.

Although micronutrients are needed in trace amount, but many soils are incapable to supply them in adequate quantity for optimum yield. The use of high analysis NPK fertilizer, improved potato varieties, unavailability of organic manure and its application to potato field in low dose have altogether augmented the need to supply micronutrients in potato cultivation. Foliar spray of nutrients is considered as the most important agricultural practices that affects the growing period of plant foliage and tuber formation as well as quality of produced yield (Gabr *et al.*, 2001; Bekhit *et al.*, 2005). Foliar application of micronutrient and macronutrient to plants is considered the most effective methods in correcting nutrient deficiency in plant as compare to soil application. Under this situation a field experiment was conducted to evaluate the response of potato crop to foliar application of micro and macronutrient.

MATERIALS AND METHODS

A field experiment was conducted in the field of Regional Research Station, Jhargram, Bidhan Chandra Krishi Viswavidyalaya during the Rabi season 2015. The field is situated in red and lateritic climatic zone of West Bengal. The soil is acidic in nature with poor water holding capacity. The experiment was laid out in Randomized Block Design with three replications. The treatments comprised of T₁-Foliar application of Zn(Zn-EDTA) @ 1 g.l⁻¹, T₂-Foliar application of B (20%) @ 1.5 g.l⁻¹, T₃-Foliar application of Fe (FeSo₄) @ 10 g.l⁻¹, T₄-Foliar application of Mn(MnSo₄) @ 5 g.l⁻¹, T₅-Foliar application of NPK (19-19-19) @ 10g.l⁻¹, T₆-Foliar application of mixture of Zn, B, Fe, Mn, T₇-Foliar application of mixture of Zn, B, Fe, Mn and NPK, T₈-Control(water spray). The

Table 1: Effect of foliar nutrition of micro and macronutrient on growth factors of potato

| Treatments | Plant height (cm) | | No. of leaf plant ⁻¹ | No. of branch plant ⁻¹ | No. of root plant ⁻¹ | Root length (cm) | |
|---|-------------------|-------------|---------------------------------|-----------------------------------|---------------------------------|------------------|-------------|
| | 60 DAS | 90 DAS | | | | 60 DAS | 90 DAS |
| Foliar spray of Zn@ 1g.l ⁻¹ | 35.66 | 39.00 | 68.50 | 11.80 | 19.00 | 14.05 | 18.00 |
| Foliar spray of B @ 1.5g.l ⁻¹ | 38.33 | 42.33 | 68.50 | 12.83 | 20.60 | 16.46 | 22.55 |
| Foliar spray of Fe@10g.l ⁻¹ | 34.66 | 39.33 | 68.83 | 11.71 | 14.23 | 14.06 | 17.88 |
| Foliar spray of Mn @ 5g.l ⁻¹ | 37.50 | 38.16 | 63.70 | 10.65 | 20.23 | 13.76 | 16.66 |
| Foliar spray of NPK@10g.l ⁻¹ | 36.00 | 37.33 | 77.63 | 12.15 | 18.73 | 15.80 | 17.00 |
| Foliar spray of mixture of Zn, B, Fe, Mn | 35.16 | 41.16 | 72.80 | 12.50 | 18.00 | 17.03 | 21.00 |
| Foliar spray of mixture of NPK & Zn,B,Fe,Mn | 43.16 | 45.00 | 82.00 | 13.65 | 19.50 | 15.38 | 21.85 |
| Control | 33.33 | 35.33 | 57.33 | 10.00 | 18.50 | 18.71 | 19.91 |
| LSD(0.05) | 3.10 | 3.88 | 3.74 | 0.827 | NS | NS | 3.79 |

Table 2: Effect of foliar nutrition of micro and macronutrient on yield components and yield of potato

| Treatments | No. of tuber plant ⁻¹ | No. of tuber plant ⁻¹ | Tuber diameter (cm) | Tuber wt.(g) | Tuber yield (t.ha ⁻¹) |
|---|----------------------------------|----------------------------------|---------------------|--------------|-----------------------------------|
| | 60 DAS | 90 DAS | | | |
| Foliar spray of Zn@ 1g.l ⁻¹ | 2.90 | 4.22 | 11.89 | 48.77 | 19.79 |
| Foliar spray of B@1.5g.l ⁻¹ | 3.00 | 4.88 | 13.12 | 50.66 | 20.41 |
| Foliar spray of Fe@10g.l ⁻¹ | 2.00 | 4.44 | 11.92 | 42.67 | 18.76 |
| Foliar spray of Mn@5g.l ⁻¹ | 2.23 | 4.66 | 11.99 | 43.34 | 19.37 |
| Foliar spray of NPK@10g/l | 2.50 | 4.89 | 13.69 | 43.67 | 17.57 |
| Foliar spray of micro nutrient mixture (Zn,B,Fe,Mn) | 3.50 | 5.16 | 12.81 | 60.67 | 21.53 |
| Foliar spray of NPK & Zn, B, Fe, Mn mixture | 3.67 | 5.67 | 13.93 | 65.67 | 22.45 |
| Control | 2.00 | 4.11 | 11.48 | 42.67 | 16.95 |
| LSD(0.05) | 0.99 | 0.70 | 1.66 | 3.40 | 16.13 |

spraying was done two times once at 15 days before flowering and next at 15 days after flowering. Variety of potato was Kufri Jyoti. Seed (small size potato tuber) was sown on 15th November 2015 @ 18 q ha⁻¹. The plot size was 4 x 5 m. The fertilizer dose of potato was 75-150-50 (N P K) kg/ha⁻¹, topdressing with 75-50 (N K)/ha⁻¹ was done two times during earthing up. Irrigation, weeding and other intercultural operations were done as and when required. The crop was harvested at physiological maturity. The observations were recorded on the desired parameters like plant height at early and later stage of plant growth, no. of leaf per plant, no. of branch plant⁻¹, no. of root per plant, root length at early (60 DAS) & later stage (90 DAS) of plant growth, no. of tuber per plant, tuber diameter, tuber weight, tuber yield, etc.

RESULTS AND DISCUSSION

The result presented in table 1 indicated the presence of significant variation among the micro and macronutrients treatments. Plant height both at early stage (60 DAS) and later stage (90 DAS) was increased significantly with application of micronutrient and macronutrient. The maximum plant height of 43.16 cm at 60 DAS and 45 cm at 90 DAS were recorded by application of micronutrient mixture of Zn, B, Fe, Mn and N P K together. This result confirmed the findings of Patil *et al.* (2008). However, plant height was lowest of 33.33 cm at 60 DAS and 35.33 cm at 90 DAS under the control treatment. However, plant height at 60 DAS followed the decreasing order of plant height with application of B, Mn, N-P-K, Zn, micro nutrient mixture, Fe. In case of plant height at 90 DAS it was like

application of B, micro nutrient mixture, Fe, Zn, Mn, N-P-K. Application of zinc, boron, micro nutrient mixture has been reported to increase plant height of tomato (Naga et al. 2013).

There was significant difference in no. of leaf per plant due to different treatments and it was maximum (82) at micronutrients mixture and N-P-K applied together followed by application of N-P-K, micronutrients mixture, Fe, Zn, B, Mn. Das and Sahoo (1975) got similar type of results in potato and tomato. Manna et al. (2014) reported that application of 0.5% boron & Zn significantly increased the no. of leaf of onion.

No. of branches per plants were maximum (13.65) in mixture of micronutrients and NPK closely followed by treatments with B, micro nutrient mixture, NPK, Zn, Fe, Mn and was lowest (10) at control treatment. Similar findings were obtained by application of zinc (Kiran et al. 2010), and micronutrients mixture (Hatwar et al. 2003).

Foliar application of Zn, B, Fe, Mn, NPK alone or mixture failed to register any significant effect on no. of roots per plant. It was maximum (20.6) with foliar application of B and lowest (14.23) with Fe treatment.

Root length of plant at early stage (60 DAS) was not significantly affected by different treatments of micronutrients and NPK. However at later stage of plant growth (90 DAS) micro nutrient and NPK treatment gave significant response to root length. This may be due more absorption of nutrients through roots resulting from foliar feeding of micro and macronutrients. Foliar spray of B registered highest root length of 22.55 cm followed by the treatments with micronutrient mixture with NPK, micronutrient mixture, Zn, Fe, NPK. Foliar spray of Mn gave the lowest result of 16.66 cm of root length.

Data represented in table 2 indicated that no. of tuber per plant was significantly affected due to foliar spray both at initial and later stage of plant growth. During early stage combined foliar application of micronutrients mixture and NPK recorded highest no. of tuber (3.67) per plant followed by treatments with micronutrients mixture, B, Zn, NPK, Mn and lowest at treatment with Fe which was statistically at par with control treatment. Whereas in case of later stage of plant growth (90 DAS) combined foliar application of micronutrients mixture (Zn, B, Fe, Mn mixture) and NPK recorded the highest no. of tuber (5.67) per plant followed by the treatment with micronutrients mixture, NPK, B, Mn, Fe, Zn and it was lowest (4.11) under control treatment. Mousavi et al. (2007) supported the similar type of results.

However data presented in table 2 indicated that application of micronutrient alone, or NPK alone or mixture also caused increase in tuber diameter over

control treatment. Foliar nutrition with combined application of micro nutrient mixture along with NPK gave maximum tuber diameter of 13.93 cm followed by treatment with NPK, B, micro nutrient mixture, Mn, Fe, Zn and was lowest of 11.48 cm at control. Potassium contained in NPK caused better transmission of photosynthetic product from source to sink which in turn helped in better tuber diameter as compare to other treatments.

Individual tuber weight was significantly influenced by different treatments with foliar application of micronutrients, NPK alone or in combination. It varied from 42.67 g under control treatment to 65.67 g under foliar application with micronutrients mixture and NPK. Better mineral utilization of plants along with enhanced photosynthesis and other metabolic activities due to foliar nutrition may cause increase in tuber weight. Salim et al. (2014) reported that foliar spray of different level of potassium increased the weight of individual tuber weight.

Results presented in table 2 indicated that foliar application exhibited significant difference in tuber yield over the control treatment. However highest tuber yield of 22.45 t ha⁻¹ was registered with combined foliar application of micronutrients mixture and NPK followed by the treatments with micronutrients mixture alone, B, Zn, Mn, Fe, NPK, control. The foliar nutrition with mineral fertilizers to potato crop increased tuber yield (Allison et al. 2001; Trehan and Sharma 2003; White et al. 2005). Manna et al. (2014) also confirmed the beneficial effect of foliar application of zinc and boron on bulb yield and quality of onion.

From the present study it can be concluded that either micronutrient alone or mixture or in combination with NPK enhanced most of the growth and yield parameters. Among the treatments, foliar application of micronutrients mixture i.e. mixture of Zn, B, Fe, Mn along with NPK produced the highest tuber yield of 22.45 t/ha which is 32.01 per cent higher than control plot yield.

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