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IMPACT OF FOLIAR APPLICATION OF ZINC ON POTATO (*SOLANUM TUBEROSUM* L.) CV. KUFRI PUKHRAJ

Harmeet Singh, Sanjay Singh*, Dinesh Kumar and Shailesh Kumar Singh

*School of Agriculture, Lovely Professional University, Phagwada, Jalandhar–144411 (Punjab) India

Abstract

In order to study the response of potato cv. Kufri Pukhraj to foliar application of zinc, a field experiment was carried out at Main Experimental Farm of the Lovely Professional University Phagwara, Kapurthala, Punjab (India), during November-February cropping season of year 2017-2018. The experiment was conducted with eight different treatments namely; $\mathbf{T}_1$ - control, $\mathbf{T}_2$ – zinc @ 5 ppm, $\mathbf{T}_3$ - zinc @ 10 ppm, $\mathbf{T}_4$ - zinc @ 15 ppm, $\mathbf{T}_5$ - zinc @ 20 ppm, $\mathbf{T}_6$ - zinc @ 25 ppm, $\mathbf{T}_7$ - zinc @ 30 ppm and $\mathbf{T}_8$ - zinc @ 35 ppm, following Randomized Block Design with three replications. The observations recorded during the research, showed that foliar application of $\mathbf{T}_7$ - zinc @ 30 ppm had significant effect on growth, yield and quality characters of potato. The range of plant height (22.87cm and 31.91cm) and number of leaves (132.45 and 199.03) were recorded maximum in $\mathbf{T}_7$- zinc @ 30 ppm, at 45 and 75 days after sowing respectively. Tuber yield (18.89 t ha^{-1}), carbohydrate (19.52 g/100g) and TSS (7.55%) were also recoded maximum in $\mathbf{T}_7$ - zinc @ 30 ppm. Based upon the present investigation, it can be concluded that for commercial cultivation of potato cv. Kufri Pukhraj foliar application of Zn @ 30 ppm is very effective for getting the higher tuber yield with best quality tubers.

Key words: Potato, Zinc, Foliar application, TSS.

Introduction

Potato *(Solanum tuberosum* L.) popularly known as "The king of vegetables" is very important solanaceous vegetable crop grown all over world due to their richness in carbohydrates and proteins. Potato is considered as the staple food crop in around 40 nations of the world (Islam and Nahar, 2012) and in India it is the fourth important crop after maize, wheat and rice (Ahmed *et al.* 2013). It contains energy, carbohydrate, starch, fibre, fat, protein, vitamin B_6, calcium, iron, sodium and zinc; 77kcal, 17.48 g, 15.45g, 2.20 g, 0.10 g, 2g, 0.29 mg, 12.1 mg, 0.78 mg, 6.0 mg and 0.29 mg per 100 g of potato respectively (Cakmak, 2008).

There are lot of factors that influence the potato cultivation and availability of zinc and manganese is the most prominent factor to determine the growth and yield of potato. Zinc is very important crop nutrient that plays a vital role in growth and development of potato by enhancing the synthesis of growth hormone and chlorophyll (Ali *et al*., 2008; Graham *et al*., 2000). Zinc is present in various forms in the soil i.e. sulphate, water-dissolvable, exchangeable, associated with organic content and settled by the auxiliary clay minerals (Alloway, 2008).

Heavy fertilizer use in Indian agriculture give raise to soil health problems and deficiency of micronutrients especially Zinc, Manganese, Iron and Boron (Parmar *et al.*, 2016). Zinc deficiency is ranked eleventh as a risk factor for disability adjusted life years. It occurs mostly in the world's poor populations, and can be attributed to abnormal cognitive development. Zinc supplementation has been shown to have therapeutic effects on children with diarrhoea, pneumonia, measles, and malaria (Gibson 2006). Recent studies have shown potato mineralization with iron and zinc is heritable and therefore can be increased through breeding (Brown *et al.* 2011). The alternative approach is the application of these nutrients to plant leaves and stems through foliar fertilization. In this view, the present investigation was carried out to evaluate the response of potato crop to foliar application of zinc.

Author for correspondence : E-mail : sanjaydbtster@gmail.com

Materials and Methods

The experiments were conducted at Main Experimental Farm of the Lovely Professional University Phagwara, Kapurthala, Punjab (India), during November –February cropping season of year 2017-2018. Geographically, this site is situated 31^{0}5' 47'' North and 75^{0}35' 48'' East at an average elevation of 252 meters above mean sea level. Texture of soil was sandy loam having neutral pH (7.15), EC (0.38 ds/m), low available phosphorus (16.16 kg/ ha) and potassium (172.0 kg/ ha) content, low available nitrate nitrogen (265 mg /kg) and ammonical nitrogen (48 mg/kg). The investigation was conducted with use of potato variety, Kufri Pukhraj and eight treatments *viz.*, T_1- control, T_2-zinc @ 5 ppm, T_3- zinc @ 10 ppm , T_4- zinc @ 15 ppm, T_5- zinc @ 20 ppm, T_6- zinc @ 25 ppm, T_7- zinc @ 30 ppm and T_8- zinc @ 35 ppm.

The treatments were applied in Randomized Block Design (RBD) with three replications and sowing was done in row with spacing 60cm between rows and 20cm between plants. All the intercultural operations and fertilizer doses were applied as recommended by Punjab Agriculture University, Ludhiana (Punjab) for potato cultivation. The data was recorded for various growth, yield and quality attributes and subjected to analysis of variance as described by Panse and Sukhatme (1985) for randomized block design.

Results and Discussion

Results of present study indicated that application of zinc on potato as foliar spray had a significant effect on vegetative growth parameters of potato. 45 days after sowing highest plant height (22.87 cm) was observed in T_7 (Zn @ 30 ppm) and found to be significant over other treatments. At 75 days after sowing highest plant height (31.91 cm) also observed in T_7 (Zn @ 30 ppm) that was at par with T_6 (Zn @ 25 ppm; 31.65 cm). Lowest plant height 16.05 cm and 23.14 cm were observed in control at 45 DAS and 75 DAS respectively. The number of leaves per plant at 45 DAS (132.45) and 75 DAS (199.03) were observed significantly maximum in T_7 (Zn @ 30 ppm) and found to be at par with T_6 (Zn @ 25 ppm) 131.44 and 197.78, 45 DAS and 75 DAS respectively. While the lowest number of leaves 93.78 and 140.67 were observed in control at 45 and 75 days after sowing respectively. These results obtained might be due to efficiency of Zn to promote the uptake of macro-nutrients *viz.*, nitrogen, phosphorus and potassium, from soil that helps in better growth and development as compare to control (Sati *et al.*, 2017). Foliar Application of micronutrients as foliar spray enhances the physiological processes, cell division and elongation which promote the vegetative growth of potato. (Ali *et al.*, 2008). Similar results were also obtained by Ewais *et al.*, (2010) and Bari*et al.*, (2001).

Zinc application had also shown the significant results for yield parameters of potato. T7 (Zn @ 30 ppm) had shown the highest tuber yield per plant (262.32 g) and yield per hectare (18.89 t ha^{-1}) and found to be at par with T_6 (Zn @25ppm) (267.91g per plant and 18.86 t ha^{-1}). The lowest tuber yield was observed in T_1-control. Increase in tuber yield might be attributed to increased plant height and number of leaves per plant that promote the process of photosynthesis and faster translocation of photosynthates to potato tubers. Sati *et al.*, (2017) stated that zinc application on potato crop improves the size of potato tuber and number of tubers per plant, which directly leads to yield increase. These results are supported by

Table 1: Effect of foliar application of Zinc on growth, yield and quality of Potato

Treatment	Plant height (cm)		Number of leaves		Tuber yield par plant (g)	Yield par hectare (t ha^{-1})	Carbo-hydrate (g/100g)	Protein (g/100g)	TSS (%)
	45 DAS	75 DAS	45 DAS	75 DAS					
T_1	16.05	23.14	93.78	140.67	182.39	13.13	13.56	6.16	4.82
T_2	17.07	25.85	102.89	154.33	200.00	14.40	14.78	6.59	5.94
T_3	18.08	26.29	112.22	170.33	221.38	15.94	16.38	6.80	6.19
T_4	18.27	27.37	107.89	162.08	212.58	15.31	15.77	7.21	5.41
T_5	19.32	29.14	106.22	159.33	206.92	14.90	14.28	6.99	6.34
T_6	20.15	31.65	131.44	197.78	261.97	18.86	19.09	7.70	7.05
T_7	22.87	31.91	132.45	199.03	262.32	18.89	19.52	7.70	7.55
T_8	22.09	30.36	122.00	188.54	232.13	16.72	18.62	7.62	6.78
CD	**0.28**	**0.48**	**1.41**	**1.81**	**7.41**	**0.06**	**0.64**	**0.56**	**0.30**
SE (m)	**0.09**	**0.16**	**0.46**	**0.59**	**2.42**	**0.02**	**0.21**	**0.18**	**0.10**
C.V.	**0.83**	**0.96**	**0.70**	**0.60**	**1.89**	**0.21**	**2.20**	**4.66**	**2.69**

Note: T_1-control; T_2-Zn @5ppm; T_3- Zn @10ppm; T_4- Zn @15ppm; T_5- Zn @20ppm; T_6- Zn @25ppm; T_7- Zn @30ppm; T_8- Zn @35ppm.

the findings of Parmar *et al*., (2016) who reported that foliar application of zinc improves the tuber yield of potato. Similar observations were also recorded by Ahmed *et al*., (2011).

Application of zinc as foliar spray had also shown significant effect on the quality traits of potato *i.e.* carbohydrate, protein and TSS content of potato. The highest carbohydrate content (19.52 g/100g) was recorded in treatment $\mathbf{T_7}$ (Zn 30ppm) that was at par treatment $\mathbf{T_6}$ (Zn 25ppm) (19.09 g/100g). The lowest amount of carbohydrate (13.56 g/100g) was recorded in control. The protein content (7.70 g/100g) was found highest in $\mathbf{T_7}$ (Zn 30ppm) and $\mathbf{T_6}$ (Zn 25ppm) that were at par with $\mathbf{T_8}$ (Zn 35ppm) (7.62 g/100g) and $\mathbf{T_4}$ (Zn 15ppm) (7.21 g/100g). Lowest protein content (6.16 g/100g) was recorded in $\mathbf{T_1}$ (control).

Highest TSS content (7.55 %) was also observed in $\mathbf{T_7}$ (Zn 30ppm) and found to be significant over other treatments, whereas control treatment resulted in lowest TSS content (4.82 %). These results may be due to the efficiency of zinc to promote the growth of plant and formation of starch. Zinc has a positive impact on the growth promoting hormones and activity of enzymes that promote the process of photosynthesis and faster translocation of photosynthates to potato tubers and leads to synthesis of carbohydrates and proteins (Ewais *et al*., 2010). Similar results were also observed by Mohamadi (2000) and Al-Jobory and Al-Hadithy (2014), who observed that foliar application zinc improves the quality of potato tubers.

Conclusion

From the results of present research it can be concluded that $\mathbf{T_7}$ (Zn @ 30ppm) have positive impact on growth, yield and quality characters of potato followed by Zinc @ 25 ppm. Hence, due to the superiority in yield and quality of potato tubers with foliar application of Zinc @ 30 ppm in comparison to other treatments, it can be recommended for commercial cultivation of potato cv. Kufri Pukhraj in the Punjab region.

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