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FOLIAR APPLICATION OF ZINC AND MANGANESE AND THEIR EFFECT ON YIELD AND QUALITY CHARACTERS OF POTATO (*SOLANUM TUBEROSUM L.*) CV. KUFRI PUKHRAJ

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Abstract

A field experiment was conducted to study the effect of foliar fertilization of zinc and manganese on growth and yield potential of potato at the experimental farm, School of Agriculture, Lovely Professional University, Phagwara during winter season of 2017- 18. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. There were ten treatments used in which one control and remaining treatment consists combination of zinc and manganese. Growth parameters were recorded at two different intervals *viz.*: 45 and 60 days after planting and yield parameters were recorded at the time of harvest. Growth parameter were plant height, leaf number while yield parameters were tuber weight, number of tuber, size of tubers per plot and yield were recorded. Quality parameters were protein; protien and TSS were recorded after harvesting. The results showed that the application of (Zinc 10.00 ppm and Manganese 10.00 ppm) showed significant positive impact on plant height, number of tuber, tuber weight and yield of potato. The application of Zinc (10.00 ppm) and Manganese (10.00 ppm) also shows significant impact on quality parameter *viz.*. protein and TSS.

Key words: Plant height, Protein, TSS, Potato.

Introduction

Potato (*Solanum tuberosum L.*) is one of the important and popular tuber crop grown in India after wheat, maize and rice contributing to food and nutrition security in the world. The potato is a dicot plant belonging to family solanaceae and the genus *solanum.* Potato contain 80% of water and 20% dry matter consisting of 14% starch, 2% sugar, 2% protein, 1% minerals, 0.6% fibre, 0.1% fat and vitamin B and C in adequate amount. In India potato is grown in area of 2.06 mha with production of 46.3 mt (Indian Horticulture Database, 2017).

Potato is considered a heavy nutrient requiring crop because of its bulk yield within a short growing season. Most of the Indian soils are widely deficient in micronutrients especially Zn, Mn, B and Fe (Parmar *et al*., 2016.,) The farmers are applying only major nutrients *i.e.* nitrogen, phosphorus and potash, that too in improper ratio, which causes ill effects on the soil health and ultimately reduces the crop yield as well as quality of tubers. Micronutrients play a specific role in the growth and development of a plant. Even though, these elements are needed in only minute traces, many soils do not supply them in sufficient quantity for healthy growth and optimum yield of potato. Most of the Indian soils are widely deficient in micronutrients especially Zn, Mn, B and Fe. In most of the productive bowls of the world the yield levels of different crops are showing declining trends in spite of addition of sufficient quantity of fertilizers carrying macro and micronutrients. (Parmar *et al*., 2016).

One of the most important issues about increase of crop yield and improving the quality of agricultural products is balanced plant nutrition. Foliar application of nutrients has become an efficient way to increase yield and quality of crops (El-fouly *et al.*, 1990). Foliar application of elements e.g. Zn, Mn, Cu and Mn is better than direct application of them in soil due to removing nutrient shortage very fast, easy utilization, decrease poisonousness when gathering and prevention from stabilization of elements in soil (Sayed *et al.*, 2007). Generally, foliar application is very fast method for providing required element in plants because nutrients

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are absorbing quickly in compare with absorption that through plant roots (Hashemymajd *et al.*, 1998).

Materials and method

The experiment was conducted at the experimental Farm of the Department of Agriculture, Lovely Professional University, Jalandhar, Punjab (India) during 2017-18. The latitude 31°22'31.81'N and 75°23'03.02 E longitude with altitude of 252 m above sea level, which falls under the central plain zone of Agra climate zone of Punjab. The soil wassandy loam with pH 7.7. The available N, P and K content of soil were 224, 14.8 and 272.4 kg ha^{-1}, respectively with organic carbon 0.55% and electrical conductivity 0.28 (dSm^{-1}).

The experiment was laid out in randomized block design with three replications. There were 10 treatments, (T_0- Absolute control, T_1- Zinc 0ppm + Manganese 4.0 ppm, T_2- Zinc 0ppm + Manganese 6.0 ppm, T_3- Zinc 0ppm + Manganese 8.0 ppm, T_4- Zinc 5.0 ppm + Manganese 0ppm, T_5- Zinc 5.0 ppm + Manganese 6.0 ppm, T_6- Zinc 5.0 ppm + Manganese 8.0 ppm , T_7 – Zinc 10.0 ppm + Manganese 4.0 ppm, T_8- Zinc 10.0 ppm + Manganese 8.0 ppm, T_9- Zinc 10.0 ppm + Manganese 10.0 ppm). Potato variety Kufri Pukhraj was used in this research work. The recommended dose of NPK (180:65:65) was used in this research work. In addition to this, half dose of nitrogen and full dose of phosphorus and potassium were also applied as per treatment through urea, SSP and muriate of potash, respectively. The remaining half dose of nitrogen was applied at the time of earthing up. Potato tubers were planted with spacing of 20.0 cm plant to plant distance while 60.0 cm apart from row to row in the November 2017.

Results and discussion

Growth attributes

Number of leaves

The highest value (110.33) of number of leaves was recorded in treatment T_9 (Zn 10ppm + Mn 10ppm) followed by treatment T_6 (Zn 5ppm + Mn 8ppm) *i.e.* 106.93. The lowest number of leaves (83.06) was recorded in control. The range of number of leaves at 60 DAS varied from 93 to 128.90. The highest value (128.90) of number of leaves was recorded in treatment T_9 (Zn 10ppm + Mn10pp) followed by treatment T_8 (Zn 5ppm + Mn 8ppm) *i.e.* 124.23. The lowest number of leaves (93) was recorded in control. This might be due to adequate supply of zinc, which accelerates the activity of enzyme and auxin Metabolism in plants. The similar results were found by Babaeian *et al.*, 2011 and Kohnaward *et al.*, 2012.

Table 1: Effect of Micronutrient (Zn & Mn) on growth, yield and qualities attributes characters of potato (Kufri Pukhraj) at different intervals.

Treatments	Number of leaves ($plant^{-1}$)		Plant height (cm)		Tuber weight (g $plant^{-1}$)	Yield (tonnes ha^{-1})	TSS	Protein (%)
	45 DAS Mean	60 DAS Mean	45 DAS Mean	60 DAS Mean	Mean	Mean	Mean	Mean
T_0	83.1	93.9	16.3	28.3	317.1	22.8	3.7	5.7
T_1	92.3	109.0	17.3	29.2	324.5	23.4	4.3	7.3
T_2	94.9	114.7	17.6	29.7	339.3	24.4	4.7	7.8
T_3	97.8	114.9	18.0	30.2	348.1	25.1	4.2	7.3
T_4	93.8	111.8	18.1	29.5	334.7	24.1	4.5	7.5
T_5	102.8	121.4	18.5	30.2	352.3	25.4	5.0	8.3
T_6	106.9	124.2	19.0	30.8	361.6	26.0	5.1	8.4
T_7	99.2	116.1	19.4	30.2	354.6	25.5	5.0	8.1
T_8	104.3	123.0	20.2	31.7	363.0	26.2	4.6	8.4
T_9	110.3	128.9	21.7	33.7	376.4	27.1	4.9	8.9
C.D.	2.4	3.5	0.3	0.5	4.1	0.3	0.3	0.6
SE(m)	0.8	1.2	0.1	0.2	1.4	0.1	0.1	0.2
SE(d)	1.1	1.6	0.2	0.2	1.9	0.1	0.1	0.3
C.V.	1.4	1.7	1.1	1.0	0.7	0.7	3.6	4.8

Plant height

The highest value (21.66) of plant height was recorded in treatment T_9 (Zn 10ppm + Mn 10ppm) followed by treatment T_8 (Zn 10ppm + Mn 8ppm) *i.e.* 20.16. The lowest number of leaves (16.33) was recorded in control. The range of plant height at 60 DAS varied from 28.26 to 33.73. The highest value (33.73) of plant height in was recorded in treatment T_9 (Zn 10ppm + Mn10pp) followed by treatment T_8 (Zn 10ppm + Mn 8ppm) *i.e.* 31.66. The lowest number of leaves (28.26) was recorded in control. This might be due to nano based Zn fertilizer release Zn slowly during the critical stages of crop growth thereby improving the growth parameters. Similar result was found by Yuvaraj and Subramanian (2014).

Yield attributes

Tuber weight ($plant^{-1}$)

Tuber weight of per plant was ranged from 317.12

to 376.38. The highest value (376.38) of tuber weight was recorded in treatment $\mathbf{T_{10}}$ (Zn 10ppm + Mn 10ppm) followed by treatment $\mathbf{T_8}$ (Zn 10ppm + Mn 8ppm) *i.e.* 362.96. The lowest weight of tuber (317.12) was recorded in control. This might be because zinc plays an important role in biosynthesis of IAA and initiation of primordial for reproductive part, which have favored the metabolic reaction within plant. Similar result was reported by Bozoglu *et al*. (2007).

Tuber yield (tonnes ha^{-1})

The highest value (27.11 tonnes ha^{-1}) of tuberyield was recorded in treatment $\mathbf{T_9}$ (Zn 10ppm + Mn 10ppm) followed by treatment $\mathbf{T_8}$ (Zn 10ppm + Mn 8ppm) *i.e.* 26.15 tonnes ha^{-1}. The lowest yield (22.83 tonnes ha^{-1}) was recorded in control. This may be metabolic role of Zn insynthesis of proteins, enzyme activation andmetabolism of carbohydrate, utilization offertilizers containing this element increases qualitative and quantitative performance of potato tubers. Similar results were found by Bozoglu et al (2007) and Mohamadi (2000).

Quality parameters

Total soluble solid (TSS)

The highest value (4.90) of TSS was recorded in treatment $\mathbf{T_9}$ (Zn 10ppm + Mn 10ppm) followed by treatment $\mathbf{T_7}$ (Zn 10ppm + Mn 4ppm) *i.e.* 4.96. The lowest TSS (3.73) was recorded in control. This might be due to increased carbohydrates production during the process of photosynthesis. Similar result was found by Acharya *et al*. (2015).

Protein content

The highest value (8.85) of protein was recorded in treatment $\mathbf{T_9}$ (Zn 10ppm + Mn 10ppm) followed by treatment $\mathbf{T_6}$ (Zn 5ppm + Mn 8ppm) *i.e.* 8.42. The lowest protein (5.65) was recorded in control. This may be due to because zinc play metabolic role in synthesis of protein. Similar result was found by Mousavi, *et al*. (2007).

Concusion

It can be concluded that combined foliar spray of Zinc (10.00 ppm) and Manganese (10.00 ppm) showed significantly higher plant height, number of leaves, tuber weight, size of tuber, yield, carbohydrate content, protein content and TSS content as compare to other treatments. So, these two micronutrients (zinc and manganese) along with normal doses of major nutrients may be recommended to the potato growers to get higher yields and to prevent losses and to increase the overall production of potato.

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