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Response of potato (*Solanum tuberosum*) var. Shalimar Potato-1 to zinc application

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Abstract
Potato (*Solanum tuberosum* L.) is a leading staple food in the diet of the world's population which is also used as animal feed (Eleiwa *et al*., 2012). Potato is an important staple food in the Mediterranean Basin, occupying an overall area of a little less than 1 million ha and producing 30 million t of tubers (FAOSTAT, 2017). Potato provides a part of daily caloric needs of human and delivers many essential nutrients and vitamins including potassium, phosphorus, manganese, magnesium, vitamin C and vitamine B-6 (Haynes *et al*., 2012). Potatoes provide a bulk dry matter and yield per unit area in comparison with other crops such as cereals, therefore Potato is considered as a heavy nutrient requiring crop (Haynes *et al*., 2012; Bari *et al*., 2001). A field experiment was conducted during 2015-17 at SKUAST-Kashmir to know the effect of zinc on tuber yield and economics of potato under temperate conditions of Kashmir. The experiment consisted of 5 treatments, T_1 (RFD of NPK), T_2 (RFD of NPK + 1.5 Kg Zn/ha), T_3 (RFD of NPK + 3.0 Kg Zn/ha), T_4 (RFD of NPK + 4.5 Kg Zn/ha), T_5 (RFD of NPK + 6.0 Kg Zn/ha). Pooled data over the years (2015-17) revealed that the potato tuber yield 33.99 t/ha increased with the treatment T_1 (RFD of NPK + 3.0 Kg Zn/ha) with net returns (Rs. 343304/ha) and higher benefit : cost ratio of 3.06.

Keywords: Potato, zinc, tuber yield and economics.

Introduction
Potato (*Solanum tuberosum* L.), is the most commonly cultivated tuber crop and fourth most important food crop in the world, after wheat, rice and maize (Haan *et al* 2016) [5]. Potato belongs to family solanaceae and genus Solanum, with a basic set of 12 chromosomes (x = 12) (Kazuo Watanabe, 2015) [7]. Potato is not only a widely used vegetable but also used for making processed foods. Potato biodiversity is enormous. Nearly 5000 varieties of potatoes have been detected. Potato is basically a temperate crop, but it is grown in various climates from the tropic to sub-polar and comprises a major food crop in many countries (Wright and Stack, 1990) [11]. Water has a special significance in the potato production as the plant has sparse and shallow root system (Sood and Sharma, 1993) [9]. Potato is a rich source of energy, with a starch content that accounts for 80% of the tuber's dry weight and with a high content of high quality protein and vitamin C (Scott *et al*., 2000) [8]. Potato yields on average more food, energy and protein per unit of land than cereals (Horton, 1988) [6]. Micronutrients are essential elements for plant growth and development which are utilized in trace amounts by plants. Among Zinc (Zn) play several physiological roles in plants. Zinc activator enzymes which are responsible for the synthesis of certain proteins. It is use in the formation of chlorophyll and some carbohydrates, conversion of starches to sugars and its presence in plant tissue helps the plant to withstand cold temperature. Zinc is essential in the formation of auxin, which help with growth regulation and stem elongation.

Material and methods
The field experiment was carried out from the years 2015 to 2017 at Experimental Field of the Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar. The experimental field (site) is situated at 34.1° North latitude and 74.89° East longitude with an altitude of 1587 meters above mean sea level. The experimental material consisted of one variety of potato crop i.e Shalimar Potato-1, planted at the spacing of 60×20cm. Five treatments comprising of

- T_1 (RFD of NPK i.e 160:100:100),
- T_2 (RFD of NPK + 1.5 Kg Zn/ha),
- T_3 (RFD of NPK + 3.0 Kg Zn/ha),
- T_4 (RFD of NPK + 4.5 Kg Zn/ha),
- T_5 (RFD of NPK + 6.0 Kg Zn/ha)
-

were tried under RBD with 4 replications. Plot size was 3.6m × 3.6m. Data on growth and economics was recorded and statistically analyzed.

Results

According to the data over the years (2015-17) revealed that the potato yield increased with the application of zinc @ 3 Kg/ha along with the recommended dose of fertilizers. Maximum yield of 33.99 t/ha with net returns (Rs. 343304/ha) and benefit : cost ratio of 3.06, followed by the application of 1.5 Kg Zn/ha recording the tuber yield of 32.14 t/ha with return of (317908/ha) and benefit: cost ratio of 2.93.

Treatment combination	Tuber yield t/ha 2015	Tuber yield t/ha 2016	Tuber yield t/ha 2017	Mean over years (t/ha)	Net returns (Rs.)	B:C ratio
RFD of NPK	22.64	31.39	29.72	27.91	257260	2.59
RFD of NPK + 1.5Kg Zn/ha	29.14	34.28	33.01	32.14	317908	2.93
RFD of NPK + 3.0 Kg Zn/ha	31.46	36.24	34.28	33.99	343304	3.06
RFD of NPK + 4.5 Kg Zn/ha	28.15	33.54	33.28	31.65	307829	2.84
RFD of NPK + 6.0 Kg Zn/ha	23.62	32.76	32.35	29.57	275571	2.63
CD at 5%				1.705	-	-
CV (%)				3.525	-	-

The ultimate objective in almost all the agronomy studies is obtain the optimum yield Taya *et al.* (1994) [10]. Application of zinc significantly increased the yield, which may be because the micronutrients are essential elements for plant growth and development which are utilized in trace amounts by plants. Among micro nutrients, Zinc (Zn) play several physiological roles in plants. Zinc activator enzymes which are responsible for the synthesis of certain proteins. It is use in the formation of chlorophyll and some carbohydrates, conversion of starches to sugars and its presence in plant tissue helps the plant to withstand cold temperature. Zinc is essential in the formation of auxin, which help with growth regulation and stem elongation, due to which plant growth is increased which contributes to higher yield of potato.

Conclusion

Pooled data over the years (2015-17) revealed that the potato tuber yield increased with the application of Zinc @ 3 Kg Zn/ha along with the recommended dose of NPK fertilizers. Maximum tuber yield of 33.99 t/ha was recorded with the application of Zn at the planting time @ 3.0 Kg Zn/ha with net returns (Rs. 343304/ha) and higher benefit: cost ratio of 3.06, followed by application of 1.5 Kg Zn and application of 4.5 Kg Zn/ha recording the tuber yield of 32.14 t/ha and 31.65 t/ha respectively.

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