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Assessment of zinc application on yield, quality, productivity and profitability of Potato (*Solanum Tuberosum* L.)

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ABSTRACT

A field experiment was conducted at Potato Research Station, S.D. Agril. University, Deesa during 2014-15 and 2015-16 to assess the effect of zinc application on yield, quality and profitability of potato cv. Kufri Badshah. Results indicated that various levels of zinc had no significant influence on total tuber yields and its total number of tubers. However, application of recommended dose of fertilizer (275-140-275 kg N-P_2O_5-K_2O/ha) along with 4.5 kg Zn/ha had marked improvement in tuber yields of grade 25-50 g (9.99 t/ha) and 50-75 g (25.68 t/ha). Highest per cent dry matter of tuber was registered with application of recommended dose of fertilizer along with 1.5 kg Zn/ha, but dry matter tuber yield remained statistically unaffected by different levels of zinc. Crop, water and partial nutrient productivity did not varied significantly due to various levels of zinc. In terms of economic profitability, application of recommended dose of fertilizer (NPK) along with 4.5 kg Zn/ha was the best among which was closely

Key words : Dry matter, Kufri Badshah, productivity, profitability, tuber yield

Zinc deficiency is most widely spread in Indian soils, with almost half of the country is poor in zinc. In Gujarat, several districts namely Banaskantha, Ahmedabad, Jamnagar and Bahruch are reported deficient in zinc (Anonymous, 2011). Zn is also vital for protein metabolism, auxin metabolism, pollen formation, maintenance of the integrity of biological membranes and those related to the resistance to infection by certain pathogens (Alloway, 2008). To improve productivity, potato plant requires a balance dose of NPK along with adequate amount of micronutrients like, zinc, boron and manganese (Sati *et al.*, 2017). There are many reports of marked improvement in potato yield and quality due to zinc application (Brahmachari *et al.* 2010; Rahaman *et al.*, 2011). Therefore, it is needed to evaluate the effect of zinc application on yield, quality, productivity and profitability of potato.

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MATERIALS AND METHODS

A field experiment was conducted at Potato Research Station, SDAU, Deesa (Gujarat) during *Rabi* seasons of 2014-15 and 2015-16 to study the effect of zinc application on yield, qualities and economics of potato variety Kufri Badshah. The soil was loamy sand in texture, low in organic carbon (0.31%), available nitrogen (170.02 kg/ha), medium in available phosphorus (29.92 kg P/ha) and available potassium (297.00 kg K_2O/ha). Five treatments *viz*; RDF of NPK (RDF_{NPK}), RDF_{NPK} + 1.5kg Zn/ha, RDF_{NPK} + 3.0 kg Zn/ha, RDF_{NPK} + 4.5 kg Zn/ha and RDF_{NPK} + 6.0 kg Zn/ha were laid out in randomized block design and replicated four times. The RDF_{NPK} 275:140:275 kg N: P_2O_5: K_2O/ha was given to potato crop in all treatments. Source of zinc was zinc sulphate heptahydrate and applied in soil at the time of planting. Potato variety Kufri Badshah was sown on November 15, 2014 and 2015 using seed rate of 3000 kg/ha with spacing of 50 cm x 20 cm. Recommended package of practice was followed for planting potato crop during the experiment. Plant emergence at 30 DAP was recorded. Total tuber yield was harvest from each net plot of size 3.0 m x 4.0 m, which was further grouped into different grades *i.e*; 0-25 g, 25-50 g, 50-75 g and >75 g and then expressed in t/ha. Dry matter content was determined by chopping and mixing of tubers in to small pieces and drying of 100 gram sample in hot air oven at 80° C for first six hours and then at 65° C till constant weight was obtained (Kumar *et al.*, 2006). Grade-wise number of tubers per plot were recorded and then expressed in terms of number in per ha. Crop productivity was calculated by using formula:

$$\text{Crop productivity (kg/ha/day)} = \frac{\text{Total yield (kg/ha)}}{\text{Total crop duration (days)}}$$

The total duration of crop and quantity of irrigation water applied was 125 days and 700 mm, respectively during all the years of experimentation. Water productivity (WP) was calculated by using formula:

$$\text{WP} = \frac{\text{Total yield (kg/ha)}}{\text{Total amount of irrigation water applied (mm)}}$$

$$\text{Partial factor productivity (PFP) of N, P and K} = \frac{\text{Total yield in kg/ha (Y)}}{\text{Nutrient applied in kg/ha (N, P, K)}}$$

Net returns and benefit: cost ratio were calculated. Data were statistically analysed using OPSTAT of CCSHAU, Hisar and interpreted accordingly.

RESULTS AND DISCUSSION

Plant emergence, tuber yield and tuber number

Perusal of the data (Table 1) revealed that plant emergence was not significantly influenced by different treatments. In case of grade-wise tuber yields were significantly influenced by different zinc treatments, except 0-25 g and >75 g grade tuber yields. Application of RDF_{NPK} + 4.5 kg Zn/ha recorded highest 25-50 g (9.99 t/ha), which was statistically at par with all other treatments, except RDF_{NPK} + 1.5 kg Zn/ha. In case of 50-75 g, highest tuber yield (25.68 t/ha) was observed under RDF_{NPK} + 4.5 kg Zn/ha, which was statistically higher than other treatments, except RDF_{NPK} and RDF_{NPK} + 1.5 kg Zn/ha. However, total tuber yield did not varied significantly due to different levels of zinc. These results are in accordance with several reports across different regions of India (Anomymous, 2013-14 and 2014-15). Maximum value of total tuber yield was observed under RDF_{NPK} + 4.5 kg Zn/ha (63.41 t/ha). Highest 0-25 g grade number of tuber was recorded under RDF_{NPK} + 3.0 kg Zn/ha, which was statistically better than rest of treatments, except RDF_{NPK} + 1.5 kg Zn/ha and RDF_{NPK} + 6.0 kg Zn/ha. However, remaining grade-wise tuber and total tuber numbers remained statistically unaffected by different treatments.

Quality, productivity and profitability

Highest % dry matter was recorded under RDF_{NPK} + 1.5 kg Zn/ha (11.49 %) which was statistically higher than rest of treatments except, RDF_{NPK} + 6.0 kg Zn/ha (Table 2). However, tuber dry matter yield was not significantly affected by different levels of zinc. Highest tuber dry matter was recorded under RDF_{NPK} + 1.5 kg Zn/ha.

Crop and water productivity did not vary statistically due to different zinc treatments (Table 2). However, highest values of both crop and water productivity were registered under RDF_{NPK} + 4.5 kg Zn/ha. Similar trend was also noted for partial nutrient productivity of NPK. However, highest values of partial nutrient productivity of NPK were recorded under RDF_{NPK} + 4.5 kg Zn/ha. These might be attributed to higher tuber yield under RDF_{NPK} + 4.5 kg Zn/ha.

Highest gross return was recorded under RDF_{NPK} + 4.5 kg Zn/ha (^{1} 34.88 x 10^4) which was followed by RDF_{NPK} + 1.5 kg Zn/ha (^{1} 34.49 x 10^4). Similarly, application of RDF_{NPK} + 4.5 kg Zn/ha had highest net return (^{1} 25.69 x 10^4/ha) which was closely followed by RDF_{NPK} + 1.5 kg Zn/ha (^{1} 25.36 x 10^4/ha). Maximum value of BCR (2.79) was registered under application of RDF_{NPK} + 4.5 kg Zn/ha, which was closely followed by RDF_{NPK} + 1.5 kg Zn/ha 2.78). Highest gross, net return and BCR under RDF_{NPK} + 4.5 kg Zn/ha could be attributed to highest tuber yield with lower total cost of cultivation among all treatments. Similar findings were reported by Banerjee *et al.* (2016).

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Table1 Plant Emergence, tuber yields and tuber number of potato variety Kufri Badshah as influenced by different levels of zinc

Treatment	Plant Emergence (%)	Grade-wise tuber yield (t/ha)					Number of tubers ('0000/ha)				
		0-25 g	25-50 g	50-75 g	>75 g	Total	0-25 g	25-50 g	50-75 g	>75 g	Total
RDF_{NPK}	91.30	2.85	9.18	23.89	25.53	61.45	21.82	27.59	40.03	26.02	115.47
RDF_{NPK} + 1.5 kg Zn/ha	91.40	3.37	7.14	23.89	28.31	62.71	26.09	22.04	40.00	29.25	117.39
RDF_{NPK} + 3.0 kg Zn/ha	90.81	3.74	9.47	20.01	27.56	60.77	29.07	28.22	34.23	28.03	119.55
RDF_{NPK} + 4.5 kg Zn/ha	90.73	2.80	9.99	25.68	24.94	63.41	21.16	30.06	43.07	25.30	119.59
RDF_{NPK} + 6.0 kg Zn/ha	90.30	3.53	9.97	20.96	24.09	58.56	27.35	29.64	35.70	24.27	116.96
S. Ed ±	1.30	0.45	0.89	1.52	2.65	3.09	1.82	3.69	3.12	2.82	4.18
CD (P=0.05)	NS	NS	1.97	3.34	NS	NS	4.01	NS	NS	NS	NS

Table 2 Quality parameters, productivity, nutrient use efficiencies and economics of potato variety Kufri Badshah as influenced by different levels of zinc

Treatment	Tuber dry matter (%)	Tuber Dry matter yield (t/ha)	Crop) productivity (kg/ha/day	Water productivity (kg/ha/mm)	Partial Nutrient productivity (kg tuber per kg nutrient retum applied)			Gross retum (₹ x 10⁴/ha)	Net (₹ x 10⁴/ha)	BCR
					N	P	K			
RDF_{NPK}	10.33	6.40	491.57	87.78	223.44	438.90	223.44	33.80	24.70	2.71
RDF_{NPK} + 1.5 kg Zn/ha	11.49	6.97	501.72	89.59	228.05	447.96	228.05	34.49	25.36	2.78
RDF_{NPK} + 3.0 kg Zn/ha	10.38	6.18	486.19	86.82	221.00	434.10	221.00	33.43	24.26	2.65
RDF_{NPK} + 4.5 kg Zn/ha	10.37	6.27	507.32	90.59	230.60	452.96	230.60	34.88	25.69	2.79
RDF_{NPK} + 6.0 kg Zn/ha	11.11	6.75	468.48	83.66	212.95	418.29	212.95	32.21	22.99	2.49
S. Ed ±	0.26	0.37	24.68	4.41	11.22	22.04	11.22			
CD (P=0.05)	0.57	NS	NS	NS	NS	NS	NS			

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