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Effect of boron application on yield, quality and economics of Potato (*Solanum tuberosum* L.)

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ABSTRACT

Two years field experiment was conducted at Potato Research Station, S. D. Agricultural University, Deesa during 2014-15 and 2015-16 to study the effect of boron application on yield, quality and economics of potato cv. Kufri Chipsona-3. Results revealed that boron application had no significant influence on tuber yields and number of tubers. Quality parameters like per cent dry matter of tuber and dry matter tuber yield were not significantly influenced by boron application. However, least tuber cracking was recorded under application of recommended dose of fertilizer (NPK) along with foliar application of 0.1% boric acid at 40, 50 and 60 days after planting. In terms of economic remuneration, application of recommended dose of fertilizer (NPK) along with 0.1% boric acid foliar application at 40 and 60 days after planting was the best among all treatments.

Key words : Boron, dry matter, economics, Kufri Chipsona-3, tuber cracking.

Boron is one of the essential micro-nutrients which play a vital role for increasing both yield and quality of potato tubers. It reduces the oxidation of phenols thus preventing discolouration of tubers and improves calcium absorption and stabilizes calcium in cell wall (Singh *et al.*, 2018). About 90% of boron in plants is accumulated in cell walls specifically associated with cell wall formation, functioning and strength (Blevins and Lukaszewski, 1998). Deficiency of boron has been reported to induce cracking in tubers and increasing susceptibility to diseases. Boron deficiency induces the internal breakdown of tubers in sugarbeet, turnip and potatoes (Brown *et al.*, 2002). However, response to boron application varies with the variety and location. So, it is obligatory to find out the suitable dose and method of boron application to achieve potato tubers of high quality. Hence, an experiment was planned to evaluate the effect of boron application on tuber yield, qualities like % tuber dry matter, dry matter yield and cracking in tuber (weight and number) and economics of potato cv. Kufri Chipsona-3.

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MATERIALS AND METHODS

A field experiment was conducted at Potato Research Station, SDAU, Deesa (Gujarat) during *Rabi* season of 2014-15 and 2015-16 to study the effect of boron application on yield, qualities and economics of potato variety Kufri Chipsona-3. 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*; recommended dose of NPK (RDF_{NPK}), RDF_{NPK} +2.0 kg B/ha as soil application, RDF_{NPK} + 0.1% boric acid as foliar spray at 40 days after planting (DAP), RDF_{NPK} +0.1% boric acid as foliar spray in two equal splits at 40 and 60 DAP and RDF_{NPK} + 0.1% boric acid as foliar sprays in three times at 40, 50 and 60 DAP were laid out in randomized block design and replicated four times. The RDF_{NPK} of potato was 275:140:275 kg N: P_2O_5: K_2O/ha. Sources of boron for soil and foliar application were solubor and boric acid, respectively. Potato variety Kufri Chipsona-3 was sown on 15[th] November with seed rate of 3000 kg/ha at a spacing of 50 cm x 20 cm. Recommended package of practices were followed for potato crop

Table.1. Plant emergence, tuber yields and number of tubers of processing potato variety Kufri Chipsona-3 as influenced by different treatments of boron

Treatment	Plant emergence (%)	Grade-wise tuber yield (t/ha)					Number of tubers ('0000/ha)				
		0-40 g	40-100 g	100-150 g	>150 g	Total	0-40 g	40-100 g	100-150 g	>150 g	Total
RDF_{NPK}	91.54	3.38	15.00	23.22	14.42	56.02	16.78	21.33	18.31	6.34	16.78
RDF_{NPK} + 2 kg B/ha soil application	92.04	3.58	16.03	22.51	16.41	58.53	17.89	22.91	17.95	7.20	17.89
RDF_{NPK} + 0.1% boric acid foliar spray at 40 DAP	90.81	3.84	14.26	20.76	18.00	56.86	19.19	20.41	16.60	7.84	19.19
RDF_{NPK} + 0.1% boric acid foliar spray at 40 and 60 DAP	90.81	3.75	14.72	24.72	14.81	58.00	18.70	21.01	19.31	6.70	18.70
RDF_{NPK} + 0.1% boric acid foliar spray at 40, 50 and 60 DAP	91.07	3.76	16.01	21.93	15.58	57.28	18.79	22.83	17.68	7.06	18.79
SEm ±	0.77	0.40	1.11	0.55	0.67	1.25	2.33	2.31	0.97	0.56	3.70
CD (P=0.05)	NS	NS	NS	NS	2.08	NS	NS	NS	NS	NS	NS

Table.2. Quality parameters, tuber dry matter yield and economics of processing potato variety Kufri Chipsona-3 as influenced by different treatments of boron

Treatment	Tuber dry matter (%)	Grade-wise number of cracked tuber/ha					Tuber Dry matter yield (t/ha)	Gross return (₹ x 10^4/ha)	Net return (₹ x 10^4/ha)	BCR
		0-40 g	40-100 g	100-150 g	>150 g	Total				
RDF_{NPK}	11.38	208	2292	2396	938	5833	6.28	30.81	21.71	3.39
RDF_{NPK} + 2 kg B/ha soil application	10.58	0	1458	2708	313	4479	6.37	32.19	22.62	3.36
RDF_{NPK} + 0.1% boric acid foliar spray at 40 DAP	11.23	104	208	3229	1667	5208	6.39	31.27	22.14	3.42
RDF_{NPK} + 0.1% boric acid foliar spray at 40 and 60 DAP	11.29	0	208	2188	1146	3542	6.40	31.90	22.73	3.48
RDF_{NPK} + 0.1% boric acid foliar spray at 40, 50 and 60 DAP	11.31	104	938	729	1042	2813	6.36	31.51	22.30	3.42
SEm ±	0.28						0.16			
CD (P=0.05)	NS						NS			

during the experiment. Plant emergence per cent was recorded at 30 DAP. Total tuber yield at harvest from each net plots of size 3.0 m x 4.0 m was further classified into different grades *i.e:* 0-40 g, 40-100 g, 100-150 g and >150 g and later expressed in t/ha. Dry matter yield was determined by chopping and mixing of tubers into 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 and cracked tubers per plot were recorded and then expressed in terms of number per ha. Net returns and benefit: cost ratio were calculated by using formula:

Net return (₹/ha) = Gross return (/ha) – Total cost of cultivation (/ha)

Benefit cost ratio (BCR) = Gross return (/ha) / Total cost of cultivation (/ha)

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. Similarly, grade-wise tuber yield of potato were statistically unaffected by different boron treatments, except for >150 g grade tuber yield. Application of RDF_{NPK} + 0.1% boric acid foliar spray at 40 DAP recorded significantly highest >150 g grade tuber yield, which was at par with RDF_{NPK} + 2 kg B/ha soil application. In case of total tuber yield, there was no significant difference among all treatments. However, total tuber yield was highest under RDF_{NPK} + 2 kg B/ha soil application. Bari *et al.* (2001), Hopkins *et al.* (2007) and Singh *et al.* (2018) had studied the role of boron on yield of potato and reported a non-significant effect of soil or foliar application of boron. According to findings of Choudhary (2017), boron alone did not have direct influence on yield or related attributes of potato, however it played supplementary role when applied with other nutrients like sulphur, zinc etc. The grade-wise and total number of tubers remained statistically unaffected by different treatments. However, highest total number of tuber was registered under RDF_{NPK} + 0.1% boric acid foliar spray at 40 DAP.

Quality parameters and economics

It was evident from Table 2 that tuber dry matter per cent and tuber dry matter yield did not varied significantly due to different treatments. However, highest tuber dry matter per cent and tuber dry matter yield were recorded under RDF_{NPK} (11.38 %) and RDF_{NPK} + 0.1% boric acid foliar spray at 40 and 60 DAP (6.40 t/ha), respectively. Application of RDF_{NPK} + 0.1% boric acid foliar spray at 40, 50 and 60 DAP recorded least total number of cracked tubers, which was followed by RDF_{NPK} + 0.1% boric acid foliar spray at 40 and 60 DAP. Reduction in cracked tubers in these treatments might be due to enhanced availability of boron which further increased calcium absorption and accumulation in cell wall. Consequently, this might have improved formation of cell wall with better functioning and strength while reducing internal breakdown of tubers in potato. Similar findings were reported by Brown *et al.* (2002), Cakmak *et al.* (1995) and Pilbeam and Kirkby (1983).

Highest gross return was recorded under RDF_{NPK} + 2 kg B/ha soil application (32.19×10^4) which was followed by RDF_{NPK} + 0.1% boric acid foliar spray at 40 and 60 DAP (31.90×10^4). However, application of RDF_{NPK} + 0.1% boric acid foliar spray at 40 and 60 DAP had highest net return (22.73×10^4/ha) which was closely followed by RDF_{NPK} + 2 kg B/ha soil application (22.62×10^4/ha). Similarly, highest BCR (3.48) was registered under application of RDF_{NPK} + 0.1% boric acid foliar spray at 40 and 60 DAP which was attributed to higher tuber yield with lower number of cracked tubers with lower total cost of cultivation as compared to other treatments.

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