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Influence of different doses and methods of boron application on number of branches and yield per plot of potato (*Solanum tuberosum* L.) cv. Kufri Surya in varied altitudes of Andhra Pradesh

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Abstract
The present investigation was carried out at three different locations of Andhra Pradesh during *rabi*, 2016 and 2017 to study the effect of different doses and methods of boron application on growth, yield and quality of potato (*Solanum tuberosum* L.). Plants were treated with different doses and three different methods of boron application *viz.*, soil application @ 10, 15, 20 kg ha^{-1}, tuber dipping in 0.2, 0.4 and 0.6 % borax solutions, foliar application of borax concentrations 100, 200 and 300 ppm were freshly prepared and were sprayed at 30 DAP and control treatment. The results revealed that maximum number of branches at 30 DAP, 60 DAP, before harvesting (80 DAP) and yield per plot were recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis.

Keywords: potato, boron, number of branches, yield, Andhra Pradesh

Introduction
Potato botanically *Solanum tuberosum* L. is the fourth most important food crop after rice, wheat and maize. It occupies a prominant place amongst the vegetable crops and acknowledge as the "King of Vegetables" due to its greater utility. Potato belongs to solanaceae (night shade) family. It is a unique crop which can supplement the food needs of the country in a substantial manner. Potato is native to the highland tropics of Andean mountains of Bolivia and Peru in South America and is believed to have been introduced into India most probably by Portuguese people during early seventeenth century. Potato is largely grown in cool regions, where mean daily temperatures does not normally exceed 18 ^{0}C. Optimum temperature required for potato growth and development ranges from 15 to 25 ^{0}C. Minimum night temperature is of great significance for tuberization and yield. Temperature below 21 ^{0}C is favourable for tuber formation. If night temperatures are above 21 ^{0}C there is a sharp fall in tuberization occurs. If night temperatures are above 29 ^{0}C allows no or little tuber formation in potato crop. To combat the above problem, CPRI had developed a heat tolerant potato variety Kufri Surya. Hence, potato variety Kufri Surya was selected for the present study to introduce the crop in the new areas of Andhra Pradesh and to see its performance in various altitudes.
Micronutrients are present in minute quantities in soil than macronutrients but are equally significant in plant nutrition, since, plants grown in micronutrient deficient soils show similar reductions in productivity as those grown in macronutrient deficient soils (Havlin *et al.*, 2005) [5]. The prerequisite criteria for improved growth, yield and quality of vegetables is obtained with balanced fertilization.
Boron is one of the essential micronutrient required for normal growth in most of the plants. In potato cultivation, boron helps in increasing the foliage coverage at initial growth stages and in later stages, the translocation of assimilates are responsible for higher yield (Trehan and Grewal, 1981) [15]. The application of boron in addition to essential major elements can play a good role in increasing the yield of potato crop (Islam *et al.*, 1986) [6].
Boron deficiency occurs over wide range of soils in Andhra Pradesh. Although boron as a micronutrient needed in trace amount, but many soils in Andhra Pradesh are incapable to supply them in adequate quantity for optimum yield. Keeping the above facts in mind, the present study was conducted to find out the optimum dose and method of boron application on

growth, yield and quality of potato (*Solanum tuberosum* L.) in varied altitudes of Andhra Pradesh".

Material and Methods

The present investigation entitled "Effect of different doses and methods of boron application on growth, yield and quality of potato (*Solanum tuberosum* L.) in varied altitudes of Andhra Pradesh" was carried out during *rabi* (2016-17 and 2017-18) seasons at three regions *viz.*, College farm, College of Horticulture, Venkataramannagudem (plains), Horticultural Research Station, Pandirimamidi (medium altitude area) and Horticultural Research Station, Chintapalli (high altitude area). The experiment was carried out with ten treatments with three replications in a randomized block design. The experiment consist of three different methods of boron (applied in the form of borax) application *viz.*, soil application of borax @ 10, 15 and 20 kg ha^{-1} applied during last ploughing, tuber dipping in borax solution @ 0.2, 0.4 and 0.6 % before one day planting and foliar application of borax @ 100, 200 and 300 ppm at 30 DAP and control. The present investigation was carried out with potato variety Kufri Surya. It is developed by Central Potato Research Institute (CPRI) in the year 2005. This is one of the popular and promising varieties of potato suitable for areas having high temperatures (heat tolerance). The experimental area was divided into 3 m x 2.7 m sized plots. One meter wide irrigation channels were provided between two replications. Potato tubers with 30 – 40 g weight were selected for planting at a depth of less than 5 cm on ridges with a spacing of 20 cm within the row and 60 cm between the rows. The potato seed rate required for planting one hectare was 20 quintals. The date of planting at Venkataramannagudem was on (October 30th), while at Pandirimamidi on (November 1st), while at Chintapalli on (November 4th) respectively. The crop is applied with recommended doses of manure and fertilizers and irrigation given at 6-8 days intervals depending upon water requirement. Data on the growth, yield, quality and nutrient uptake parameters were recorded during experimentation. Five plants were selected randomly in each plot and tagged for collection of data during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis and the mean values were worked out. The data recorded on various growth, yield and quality attributes were tabulated and were statistically analyzed by adopting the standard RBD procedures outlined by Panse and Sukatme (1985) [11]. The mean values were tested for significance at 5 % level of probability. The critical difference values were calculated at 5 % level of probability.

Results and Discussion

The results from the field experiment during the *rabi* season of the years 2016, 2017 and pooled analysis at three regions on number of branches per plant at 30 days, 60 days, before harvest (80 days) and yield per plot are given below.

Number of branches at 30 DAP

The data pertaining to number of branches at 30 DAP as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas are presented in Table 1. The data showed significant difference in all the three locations.

At Venkataramannagudem, maximum number of branches at 30 DAP (18.33, 20.33, 19.33) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches at 30 DAP (12.40, 14.47, 13.43) was recorded in foliar application of borax @ 300 ppm (T_{10}) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Pandirimamidi, maximum number of branches at 30 DAP (20.20, 22.20, 21.20) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches at 30 DAP (14.53, 16.40, 15.47) was recorded in foliar application of borax @ 300 ppm (T_{10}) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Chintapalli, maximum number of branches at 30 DAP (23.00, 25.40, 24.20) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches at 30 DAP (18.20, 19.87, 19.10) was recorded in control (T_1) and foliar application of borax @ 200 ppm (T_9) during 2016-17 while in foliar application of borax @ 100 ppm (T_8) during 2017-18 whereas in control (T_1) and foliar application of borax @ 100 ppm (T_8) in pooled analysis respectively.

Number of branches at 60 DAP

The data pertaining to number of branches at 60 DAP as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas are presented in Table 2. The data showed significant difference in all the three locations.

At Venkataramannagudem, maximum number of branches at 60 DAP (25.53, 29.87, 27.70) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches at 60 DAP (16.60, 20.00, 18.30) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Pandirimamidi, maximum number of branches at 60 DAP (31.00, 35.27, 33.13) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches at 60 DAP (21.53, 25.20, 23.37) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Chintapalli, maximum number of branches at 60 DAP (37.60, 41.60, 39.60) was recorded with soil application of borax 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches at 60 DAP (28.60, 32.27, 30.43) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

Number of branches before harvest (80 DAP)

The data pertaining to number of branches before harvest (80 DAP) as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas are presented in Table 3. The data showed significant difference in all the three locations.

At Venkataramannagudem, maximum number of branches

before harvest (80 DAP) (29.93, 33.53, 31.73) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches before harvest (80 DAP) (20.53, 23.20, 21.87) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Pandirimamidi, maximum number of branches before harvest (80 DAP) (37.00, 40.40, 38.70) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches before harvest (80 DAP) (26.00, 28.80, 27.40) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Chintapalli, maximum number of branches before harvest (80 DAP) (44.33, 48.20, 46.27) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum number of branches before harvest (80 DAP) (35.07, 38.93, 37.00) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

Irrespective of doses and method of boron application, the crop responds well to the application of boron and recorded maximum number of branches compared to control. The plants from the plot applied with borax @ 20 kg ha^{-1} as soil application recorded maximum number of branches.

Irrespective of the locations, number of branches per plant increased linearly with an advancement in age. Among the locations, the maximum number of branches per plant was recorded at Chintapalli during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis. This might be due to presence of congenial environmental conditions prevailed at that location.

The increase in number of branches per plant might be due to production of more number of sprouts on the tuber which resulted in more production of tillers and further resulted in more production of branches. The application of boron in soil enhances the recovery of nutrients from the applied fertilizer to potato crop and also supply of sugars stored in the tuber to the sprouts. These findings were supported by Bari *et al.* (2001) [1] in potato, Kumar *et al.* (2003) [7] in gladiolus, Moinuddin *et al.* (2017) [9] in potato, Muthana *et al.* (2017) [10] in potato and Sud (1996) [14] in potato.

Yield per plot (kg)

The data pertaining to yield per plot (kg) as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas are presented in Table 4. The data showed significant difference in all the three locations.

At Venkataramannagudem, maximum yield per plot (15.42 kg, 26.14 kg, 20.78 kg) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum yield per plot (9.24 kg, 19.55 kg, 14.40 kg) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Pandirimamidi, maximum yield per plot (21.05 kg, 43.80 kg, 32.42 kg) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum yield per plot (13.27 kg, 33.19 kg, 23.23 kg) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Chintapalli, maximum yield per plot (34.78 kg, 54.45 kg, 44.62 kg) was recorded with soil application of borax @ 20 kg ha^{-1} (T_4) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively. The minimum yield per plot (25.60 kg, 39.25 kg, 32.43 kg) was recorded in control (T_1) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

Irrespective of doses and method of boron application, the crop responds well to the application of boron and recorded higher yields compared to control. The crop harvested from the plot applied with borax @ 20 kg ha^{-1} as soil application recorded maximum yield.

Irrespective of location, higher yields were recorded during 2017-18 compared to 2016-17. This might be due to the impact of low temperatures prevailed during tuberization period during the period of experimentation. Low temperature especially night temperature might have created congenial conditions for tuberization, thereby recorded higher yields in 2017-18. Among the three locations, Chintapalli recorded the superior results over Pandirimamidi and Venkataramannagudem during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis. This might be due to congenial environmental conditions prevailed at that location compared to other locations.

The crop responds well to the application of boron. The highest yield was recorded in the crop applied with borax @ 20 kg ha^{-1} as soil application. The same treatment had recorded the higher nutrient uptake and played a significant role in recording the maximum number of branches which further resulted in increasing number of leaves, leaf area which might have aided in the synthesis of more photosynthates and increasing the yield.

The promotive effect of Boron on increasing potato yield might be due to its increased mobilization, uptake of nutrients, role in cell differentiation and development, translocation of photo assimilates from sources to sink. These results are in accordance with the findings of El-Dissoky and Abdel-Kadar (2013) [4] who documented that application of Boron significantly increased tuber yield in potato. Similar results were also reported by Bari *et al.* (2001) [1] in potato, Battacharyya *et al.* (2005) [2] in sunflower, El-Banna and El-Salam (2005) [3] in potato, Sarkar *et al.* (2017) [12] in potato, Singh *et al.* (2014) [13] in tomato and Lawson (2013) [8] in potato.

Table 1: Effect of different doses and methods of boron application on number of branches @ 30 DAP at Venkataramannagudem, Pandirimamidi and Chintapalli areas

Treat. No.	Treatment Name	Venkataramannagudem			Pandirimamidi			Chintapalli		
		2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	Control	13.00	15.07	14.03	15.00	16.80	15.90	18.20	20.00	19.10
T_2	Soil Application 10 kg/ha	15.07	17.00	16.03	17.00	18.73	17.87	20.40	22.40	21.40
T_3	Soil Application 15 kg/ha	16.27	18.20	17.23	18.27	20.00	19.13	21.40	23.60	22.50
T_4	Soil Application 20 kg/ha	18.33	20.33	19.33	20.20	22.20	21.20	23.00	25.40	24.20
T_5	Tuber dipping 0.2 %	14.20	16.07	15.13	16.20	18.00	17.10	19.40	21.40	20.40
T_6	Tuber dipping 0.4 %	14.80	16.80	15.80	17.00	19.00	18.00	20.40	22.40	21.40
T_7	Tuber dipping 0.6 %	16.80	18.67	17.73	19.00	20.67	19.83	21.80	23.80	22.80
T_8	Foliar Application 100 ppm	13.00	14.87	13.93	15.00	17.00	16.00	18.33	19.87	19.10
T_9	Foliar Application 200 ppm	12.80	14.87	13.83	14.80	16.60	15.70	18.20	20.20	19.20
T_{10}	Foliar Application 300 ppm	12.40	14.47	13.43	14.53	16.40	15.47	18.80	20.40	19.60
S.Em±		0.55	0.60	0.41	0.70	0.77	0.52	0.88	1.17	0.74
C.D. at 5%		1.63	1.79	1.17	2.09	2.30	1.50	2.63	3.49	2.11

Table 2: Effect of different doses and methods of boron application on number of branches @ 60 DAP at Venkataramannagudem, Pandirimamidi and Chintapalli areas

Treat. No.	Treatment Name	Venkataramannagudem			Pandirimamidi			Chintapalli		
		2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	Control	16.60	20.00	18.30	21.53	25.20	23.37	28.60	32.27	30.43
T_2	Soil Application 10 kg/ha	21.47	25.27	23.37	27.73	31.47	29.60	33.80	37.73	35.77
T_3	Soil Application 15 kg/ha	23.27	27.33	25.30	28.47	32.47	30.47	35.60	39.60	37.60
T_4	Soil Application 20 kg/ha	25.53	29.87	27.70	31.00	35.27	33.13	37.60	41.60	39.60
T_5	Tuber dipping 0.2 %	19.07	22.80	20.93	24.80	28.60	26.70	31.80	35.87	33.83
T_6	Tuber dipping 0.4 %	21.60	25.60	23.60	26.60	29.93	28.27	33.40	37.40	35.40
T_7	Tuber dipping 0.6 %	23.40	27.47	25.43	28.60	32.80	30.70	35.20	39.20	37.20
T_8	Foliar Application 100 ppm	18.00	21.80	19.90	23.20	27.80	25.50	30.00	33.73	31.87
T_9	Foliar Application 200 ppm	19.80	23.80	21.80	24.80	28.80	26.80	31.60	35.53	33.57
T_{10}	Foliar Application 300 ppm	21.67	25.80	23.73	26.60	30.80	28.70	33.40	37.33	35.37
S.Em±		0.85	1.09	0.69	1.09	1.26	0.83	1.72	1.68	1.20
C.D. at 5%		2.52	3.22	1.98	3.23	3.73	2.38	5.10	4.99	3.44

Table 3: Effect of different doses and methods of boron application on number of branches @ before harvest (80 DAP) at Venkataramannagudem, Pandirimamidi and Chintapalli areas

Treat. No.	Treatment Name	Venkataramannagudem			Pandirimamidi			Chintapalli		
		2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	Control	20.53	23.20	21.87	26.00	28.80	27.40	35.07	38.93	37.00
T_2	Soil Application 10 kg/ha	25.27	28.53	26.90	33.40	36.00	34.70	40.67	44.67	42.67
T_3	Soil Application 15 kg/ha	27.27	30.73	29.00	34.60	38.20	36.40	42.47	46.57	44.52
T_4	Soil Application 20 kg/ha	29.93	33.53	31.73	37.00	40.40	38.70	44.33	48.20	46.27
T_5	Tuber dipping 0.2 %	22.80	26.07	24.43	30.80	33.80	32.30	38.53	43.53	41.03
T_6	Tuber dipping 0.4 %	25.67	29.20	27.43	32.60	35.60	34.10	40.27	44.33	42.30
T_7	Tuber dipping 0.6 %	27.67	30.87	29.27	34.60	37.80	36.20	42.00	46.13	44.07
T_8	Foliar Application 100 ppm	21.93	25.07	23.50	29.40	32.40	30.90	36.73	40.67	38.70
T_9	Foliar Application 200 ppm	23.80	27.20	25.50	30.80	33.80	32.30	38.13	42.40	40.27
T_{10}	Foliar Application 300 ppm	25.80	29.20	27.50	32.60	35.60	34.10	40.27	44.27	42.27
S.Em±		1.22	1.65	1.03	1.60	1.48	1.09	1.68	1.71	1.20
C.D. at 5%		3.64	4.90	2.95	4.75	4.38	3.12	4.99	5.07	3.43

Table 4: Effect of different doses and methods of boron application on yield per plot (kg) at Venkataramannagudem, Pandirimamidi and Chintapalli areas

Treat. No.	Treatment Name	Venkataramannagudem			Pandirimamidi			Chintapalli		
		2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T_1	Control	9.24	19.55	14.40	13.27	33.19	23.23	25.60	39.25	32.43
T_2	Soil Application 10 kg/ha	11.38	21.01	16.20	15.99	36.70	26.34	28.24	43.38	35.81
T_3	Soil Application 15 kg/ha	13.64	23.10	18.37	18.57	40.39	29.48	31.65	48.10	39.88
T_4	Soil Application 20 kg/ha	15.42	26.14	20.78	21.05	43.80	32.42	34.78	54.45	44.62
T_5	Tuber dipping 0.2 %	10.55	20.37	15.46	14.71	35.17	24.94	27.25	41.31	34.28
T_6	Tuber dipping 0.4 %	12.36	22.37	17.36	17.03	39.20	28.11	30.44	46.03	38.24
T_7	Tuber dipping 0.6 %	13.50	24.10	18.80	19.47	43.27	31.37	33.58	51.89	42.74
T_8	Foliar Application 100 ppm	9.97	20.09	15.03	14.08	34.57	24.32	26.64	40.13	33.39
T_9	Foliar Application 200 ppm	11.71	22.13	16.92	16.34	38.59	27.46	29.80	44.85	37.33
T_{10}	Foliar Application 300 ppm	12.73	23.70	18.22	18.63	42.70	30.67	32.96	51.05	42.01
S.Em±		1.13	1.29	0.86	1.46	2.39	1.40	1.97	3.25	1.90
C.D. at 5%		3.37	3.85	2.47	4.33	7.11	4.02	5.84	9.66	5.45

Conclusion

From the present investigation it can be concluded that potato crop (var. Kufri Surya) can be cultivated in Andhra Pradesh. The results obtained from the present study revealed that, there is a great scope for cultivation of potato in varied altitudes of Andhra Pradesh. The crop applied with boron in the form of borax @ 20 kg ha^{-1} as soil application was found to be significantly superior over other concentrations for number of branches per plant and yield per plot. Among the different methods applied, soil application was found superior over tuber dipping and foliar application methods for all the characters. Irrespective of locations, Chintapalli has recorded the superior results over Pandirimamidi and Venkataramannagudem during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis. Superior results in Chintapalli might be due to prevailing of low temperatures compared with other locations which might resulted in extending the crop period which further resulted to record maximum growth, yield and quality characters.

References

1. Bari MS, Rabbani MG, Rahman MSq, Islam MJ, Hoque ATMR. Effect of zinc, boron, sulphur and magnesium on growth and yield of potato. Pakistan Journal of Biological Sciences. 2001; 4(9):1090-93.
2. Battacharyya K, Mandal J, Banerjee H, Alipatra A, Ray K, Phonglosa A. Boron fertilization in sunflower (*Helianthus annuus* L.) in an inceptisol of West Bengal, India. Communication of soil science and plant. 2005; 46:528-44.
3. El-Banna EN, El-Salam HZ. Response of potato plants for different sources of potassium with different foliar rates of boron and molybdenum. Journal of Agricultural Science. 2005; 30(10):6221-33.
4. El-Dissoky RA, Abdel Kadar AES. Effect of boron as a foliar application on some potato cultivars under Egyptian alluvial soil conditions. Research Journal of Agriculture and Biological Sciences. 2013; 9(5):232-40.
5. Havlin JL, Beatson JD, Tisdale SL, Nelson WL. Soil Fertility and Fertilizers-An Introduction to Nutrient Management, (7th ed.) Pearson Education, Inc., Pearson Prentice Hall, 2005.
6. Islam MS, Sarkar NI, Hossain KM, Altamash S, Sarkar JU. Effect of different elements on growth, yield and quality of potato. Bangladesh Journal of Agriculture. 1986; 7:53-56.
7. Kumar R, Singh GN, Mishra RL. Effect of boron, calcium and zinc on gladiolus. Journal of Ornamental Horticulture. 2003; 6(2):104-06.
8. Lawson V. Potato response to boron and sulfur fertilization when grown on two different soil types. Muscatine Island Research, 2013, p19-20.
9. Moinuddin G, Jash S, Sarkar A, Dasgupta S. Response of potato (*Solanum tuberosum* L.) to foliar application of macro and micronutrients in the Red and Lateritic Zone of West Bengal. Journal of Crop and Weed. 2017; 13(1):185-88.
10. Muthanna MA, Singh AK, Tiwari A, Jain VK, Padhi M. Effect of boron and sulphur application on plant growth and yield attributes of potato (*Solanum tuberosum* L.). International Journal of Current Microbiology and Applied Sciences. 2017; 6(10):399-04.
11. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research Publication, 1985, p87-89.
12. Sarkar S, Banerjee H, Chakraborty I, Sau S, Ray K, Ghosh D, *et al*. Assessment of growth, yield, tuber quality and profitability of potato. Journal of Environmental Biology. 2017; 39(1):1-8.
13. Singh DK, Rudra BC, Gangopadhyaya PK. Role of micronutrients in the productivity enhancement of tomato. Journal of Agricultural Technology. 2014; 1(1):68-69.
14. Sud KC. Effect of phosphorus and sulphur on potato nutrition in Shimla hills. Journal of the Indian Society of Soil Science. 1996; 44(3):440-44.
15. Trehan SP, Grewal JS. Comparitive efficiency of methods of application of zinc to potato. Indian Journal of Agricultural Sciences. 1981; 51:240-43.