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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(3): 282-287

www.thepharmajournal.com
Received: 19-01-2020
Accepted: 23-02-2020

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# Effect of different doses and methods of boron application on days to sprouting, plant height and yield per plant of potato (*Solanum tuberosum* L.) cv. Kufri Surya in varied altitudes of Andhra Pradesh

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**Abstract**
A field experiment was conducted 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.) in varied altitudes of Andhra Pradesh. 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 minimum number of days taken to sprouting, maximum plant height at 30 DAP, 60 DAP, before harvesting (80 DAP) and yield per plant 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.

**Keywords:** potato, boron, sprouting, plant height, yield, Andhra Pradesh

## Introduction
The potato (*Solanum tuberosum* L.) 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 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 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) [6]. 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) [20]. 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) [7].
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

A field experiment 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 % one day before planting and foliar application of borax @ 100, 200 and 300 ppm at 30 DAP and a control treatment. The present investigation was carried out with potato variety Kufri Surya. 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 30$^{th}$), at Pandirimamidi on (November 1$^{st}$) and at Chintapalli on (November 4$^{th}$). 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 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) [12]. 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 days taken to sprouting, plant height at 30 days, 60 days, before harvest (80 days) and yield per plant are given below.

### Days taken to sprouting

The data pertaining to days taken to sprouting as influenced by boron doses and method of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas showed significant difference in all the three locations are presented in Table 1.

At Venkataramannagudem, minimum number of days taken to sprouting (17.20, 13.73, 15.47) 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 maximum number of days taken to sprouting (20.07, 17.13, 18.60) was recorded in control ($T_1$) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Pandirimamidi, minimum number of days taken to sprouting (14.47, 9.80, 12.13) 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 maximum number of days taken to sprouting (18.33, 13.87, 16.10) was recorded with foliar application of borax @ 200 ppm ($T_9$) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

At Chintapalli, minimum number of days taken to sprouting (11.20, 7.87, 9.53) 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 maximum number of days taken to sprouting (14.27, 11.13, 12.70) was recorded with foliar application of borax @ 200 ppm ($T_9$) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

Among the three locations, Chintapalli recorded the minimum number of days to sprouting compared to Pandirimamidi and Venkataramannagudem during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis.

The earliness in days to sprouting (3 days) of potato tuber was observed in soil application of borax @ 20 kg $ha^{-1}$ as compared to control in all the locations. It could be attributed to activation of hydrolytic enzymes by boron nutrient which stored in the tuber helps in rapid hydrolysis of starch into sugars and increased the respiration rate. Boron nutrient also improved the auxin levels in the tuber, thereby promoted earliness in tuber sprouting when compared to other treatments as earlier reported by Singh, 2017 [17]. These findings were supported by Bari *et al*. in potato (2001) [1], Kumar *et al*. in gladiolus (2003) [8] and Sud (1996) [18] in potato.

### Plant Height (cm) at 30 DAP

The data pertaining to plant height at 30 DAP as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas showed significant difference in all the three locations are presented in Table 2.

At Venkataramannagudem, significantly maximum plant height at 30 DAP (21.72 cm, 25.17 cm, 23.45 cm) 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 plant height at 30 DAP (14.25 cm) was recorded in control ($T_1$) during the year 2016-17, whereas minimum plant height (16.09 cm and 15.21 cm) was recorded in foliar application of borax @ 200 ppm ($T_9$) during the year 2017-18 and in pooled analysis respectively.

At Pandirimamidi, maximum plant height at 30 DAP (24.75 cm, 30.25 cm, 27.50 cm) 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 plant height at 30 DAP (16.36 cm, 19.45 cm, 17.91 cm) 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 plant height at 30 DAP (27.19 cm, 31.57 cm, 29.38 cm) 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 plant height at 30 DAP (19.29 cm, 20.75 cm) was recorded in control ($T_1$) during the year 2016-17 and in pooled analysis respectively whereas minimum plant height (22.11 cm) was recorded with foliar application of borax @ 200 ppm ($T_9$) during the year 2017-18.

**Plant height (cm) at 60 DAP**

The data pertaining to plant height at 60 DAP as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas showed significant difference in all the three locations are presented in Table 3.

At Venkataramannagudem, maximum plant height at 60 DAP (44.93 cm, 50.43 cm, 47.68 cm) 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 plant height at 60 DAP (33.93 cm, 38.02 cm, 35.97 cm) 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 plant height at 60 DAP (50.11 cm, 55.31 cm, 52.71 cm) 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 plant height at 60 DAP (38.51 cm, 43.51 cm, 41.01 cm) 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 plant height at 60 DAP (55.59 cm, 60.24 cm, 57.92 cm) 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 plant height at 60 DAP (44.21 cm, 49.90 cm, 47.06 cm) was recorded in control ($T_1$) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

**Plant height (cm) before harvest (80 DAP)**

The data pertaining to plant height before harvest (80 DAP) as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas showed significant difference in all the three locations are presented in Table 4.

At Venkataramannagudem, maximum plant height before harvest (80 DAP) (66.53 cm, 68.97 cm, 67.75 cm) 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 plant height before harvest (80 DAP) (52.53 cm, 52.29 cm, 52.41 cm) 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 plant height before harvest (80 DAP) (75.02 cm, 81.35 cm, 78.18 cm) 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 plant height before harvest (80 DAP) (59.77 cm, 65.18 cm, 62.47 cm) 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 plant height before harvest (80 DAP) (82.13 cm, 88.79 cm, 85.46 cm) 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 plant height before harvest (80 DAP) (66.55 cm, 73.35 cm, 69.95 cm) was recorded in control ($T_1$) during both the years of experimentation (2016-17 and 2017-18) and in pooled analysis respectively.

Irrespective of the locations, plant height was increased linearly with an advancement in age. Among the locations, the highest plant height 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.

Plant height is a very important morphological trait which may influence the yield of tubers by rapid canopy development as photosynthetic activities are more in a vigorous plant than in control. Plant height was significantly increased with the application of boron during both years of experimentation. It might be due to application of boron in the form of borax to the soil, which indirectly increased photosynthetic activity in plants and resulted in vigorous growth of the plant. It might also be due to the higher uptake of nutrients from the soil and also due to rapid translocation of assimilates to the meristamatic tissue helps in rapid cell division and cell elongation which resulted in an increase in plant height. Similar results were also reported by Bari *et al.* in potato (2001) [1], Farouk in potato (2015) [5], Moinuddin *et al.* in potato (2017) [10], Naga *et al.* in tomato (2013) [11], Sahar *et al.* in potato (2013) [13], Sharma (1999) [15] in radish, Sud (1996) [18] in potato and Tantawy *et al.* in potato (2017) [19].

**Yield per plant (g)**

The data pertaining to yield per plant (g) as influenced by boron doses and methods of application at Venkataramannagudem, Pandirimamidi and Chintapalli areas are presented in Table 5. The data showed significant difference in all the three locations.

At Venkataramannagudem, maximum yield per plant (256.87 g, 422.33 g, 339.60 g) 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 plant (154.00 g, 325.67 g, 239.83 g) 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 plant (350.67 g, 729.67 g, 540.17g) 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 plant (221.27 g, 553.00 g, 387.13 g) 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 plant (589.53 g, 922.00 g, 755.77 g) 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 plant (433.87 g, 665.00 g, 549.43 g) 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 irrespective of location. 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 plant height, maximum number of branches, highest number of leaves and leaf area which might have aided in the synthesis of more photosynthates. The same treatment also recorded the highest tuber parameters like maximum number of tubers, tuber weight, length of the tuber, girth of the tuber and volume of the tuber.

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) [14] in potato, Singh *et al.* (2014) [16] in tomato and Lawson (2013) [9] in potato.

**Table 1:** Effect of different doses and methods of boron application on days taken to sprouting 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 | 20.07 | 17.13 | 18.60 | 17.93 | 13.60 | 15.77 | 13.93 | 10.93 | 12.43 |
| $T_2$ | Soil Application 10 kg/ha | 18.60 | 15.40 | 17.00 | 17.33 | 12.80 | 15.07 | 13.40 | 10.40 | 11.90 |
| $T_3$ | Soil Application 15 kg/ha | 18.47 | 15.07 | 16.77 | 16.00 | 11.40 | 13.70 | 12.00 | 9.00 | 10.50 |
| $T_4$ | Soil Application 20 kg/ha | 17.20 | 13.73 | 15.47 | 14.47 | 9.80 | 12.13 | 11.20 | 7.87 | 9.53 |
| $T_5$ | Tuber dipping 0.2 % | 19.20 | 16.13 | 17.67 | 17.80 | 13.33 | 15.57 | 13.80 | 10.80 | 12.30 |
| $T_6$ | Tuber dipping 0.4 % | 19.13 | 16.00 | 17.57 | 17.00 | 12.53 | 14.77 | 13.00 | 10.00 | 11.50 |
| $T_7$ | Tuber dipping 0.6 % | 18.40 | 15.07 | 16.73 | 16.73 | 12.13 | 14.43 | 12.73 | 9.53 | 11.13 |
| $T_8$ | Foliar Application 100 ppm | 19.47 | 16.33 | 17.90 | 17.47 | 12.93 | 15.20 | 14.00 | 11.00 | 12.50 |
| $T_9$ | Foliar Application 200 ppm | 19.40 | 16.33 | 17.87 | 18.33 | 13.87 | 16.10 | 14.27 | 11.13 | 12.70 |
| $T_{10}$ | Foliar Application 300 ppm | 19.80 | 16.67 | 18.23 | 18.00 | 13.47 | 15.73 | 13.73 | 10.73 | 12.23 |
| S.Em± | | 0.49 | 0.54 | 0.37 | 0.63 | 0.65 | 0.45 | 0.47 | 0.40 | 0.31 |
| C.D. at 5% | | 1.47 | 1.60 | 1.05 | 1.88 | 1.92 | 1.30 | 1.41 | 1.19 | 0.89 |

**Table 2:** Effect of different doses and methods of boron application on plant height (cm) @ 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 | 14.25 | 16.36 | 15.30 | 16.40 | 19.47 | 17.94 | 19.29 | 22.21 | 20.75 |
| $T_2$ | Soil Application 10 kg/ha | 18.49 | 20.71 | 19.60 | 19.96 | 25.13 | 22.55 | 24.57 | 27.89 | 26.23 |
| $T_3$ | Soil Application 15 kg/ha | 19.90 | 22.87 | 21.38 | 22.29 | 28.11 | 25.20 | 26.62 | 29.74 | 28.18 |
| $T_4$ | Soil Application 20 kg/ha | 21.72 | 25.17 | 23.45 | 24.75 | 30.25 | 27.50 | 27.19 | 31.57 | 29.38 |
| $T_5$ | Tuber dipping 0.2 % | 16.50 | 19.58 | 18.04 | 17.84 | 23.21 | 20.52 | 22.49 | 25.81 | 24.15 |
| $T_6$ | Tuber dipping 0.4 % | 17.81 | 21.05 | 19.43 | 20.18 | 25.93 | 23.05 | 24.55 | 27.71 | 26.13 |
| $T_7$ | Tuber dipping 0.6 % | 19.37 | 22.49 | 20.93 | 22.50 | 27.55 | 25.03 | 26.23 | 28.95 | 27.59 |
| $T_8$ | Foliar Application 100 ppm | 14.37 | 16.40 | 15.39 | 16.39 | 19.53 | 17.96 | 19.39 | 22.16 | 20.78 |
| $T_9$ | Foliar Application 200 ppm | 14.33 | 16.09 | 15.21 | 16.45 | 19.51 | 17.98 | 19.68 | 22.11 | 20.90 |
| $T_{10}$ | Foliar Application 300 ppm | 14.39 | 16.33 | 15.36 | 16.36 | 19.45 | 17.91 | 19.92 | 22.22 | 21.07 |
| S.Em± | | 0.40 | 0.59 | 0.35 | 0.55 | 0.93 | 0.54 | 0.75 | 1.04 | 0.64 |
| C.D. at 5% | | 1.19 | 1.74 | 1.02 | 1.64 | 2.75 | 1.55 | 2.23 | 3.09 | 1.84 |

**Table 3:** Effect of different doses and methods of boron application on plant height (cm) @ 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 | 33.93 | 38.02 | 35.97 | 38.51 | 43.51 | 41.01 | 44.21 | 49.90 | 47.06 |
| $T_2$ | Soil Application 10 kg/ha | 39.38 | 43.98 | 41.68 | 44.64 | 49.99 | 47.32 | 51.13 | 56.24 | 53.68 |
| $T_3$ | Soil Application 15 kg/ha | 40.66 | 45.74 | 43.20 | 46.57 | 51.91 | 49.24 | 53.68 | 58.80 | 56.24 |
| $T_4$ | Soil Application 20 kg/ha | 44.93 | 50.43 | 47.68 | 50.11 | 55.31 | 52.71 | 55.59 | 60.24 | 57.92 |
| $T_5$ | Tuber dipping 0.2 % | 37.22 | 41.37 | 39.30 | 42.81 | 47.97 | 45.39 | 48.85 | 54.35 | 51.60 |
| $T_6$ | Tuber dipping 0.4 % | 39.19 | 43.89 | 41.54 | 44.85 | 50.21 | 47.53 | 50.58 | 55.56 | 53.07 |
| $T_7$ | Tuber dipping 0.6 % | 41.67 | 46.56 | 44.12 | 47.09 | 52.25 | 49.67 | 52.23 | 57.54 | 54.89 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $T_8$ | Foliar Application 100 ppm | 35.97 | 40.20 | 38.09 | 40.66 | 45.79 | 43.22 | 46.55 | 51.32 | 48.93 |
| $T_9$ | Foliar Application 200 ppm | 37.73 | 42.75 | 40.24 | 42.39 | 47.59 | 44.99 | 48.89 | 53.82 | 51.35 |
| $T_{10}$ | Foliar Application 300 ppm | 39.87 | 45.05 | 42.46 | 44.98 | 50.00 | 47.49 | 50.80 | 56.28 | 53.54 |
| S.Em± | | 1.34 | 1.92 | 1.17 | 2.11 | 2.14 | 1.50 | 2.10 | 2.01 | 1.45 |
| C.D. at 5% | | 3.97 | 5.71 | 3.36 | 6.27 | 6.37 | 4.31 | 6.24 | 5.98 | 4.17 |

**Table 4:** Effect of different doses and methods of boron application on plant height (cm) @ 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 | 52.53 | 52.29 | 52.41 | 59.77 | 65.18 | 62.47 | 66.55 | 73.35 | 69.95 |
| $T_2$ | Soil Application 10 kg/ha | 60.74 | 59.97 | 60.36 | 68.87 | 74.61 | 71.74 | 75.43 | 81.82 | 78.63 |
| $T_3$ | Soil Application 15 kg/ha | 63.33 | 63.01 | 63.17 | 72.07 | 77.63 | 74.85 | 78.65 | 84.34 | 81.49 |
| $T_4$ | Soil Application 20 kg/ha | 66.53 | 68.97 | 67.75 | 75.02 | 81.35 | 78.18 | 82.13 | 88.79 | 85.46 |
| $T_5$ | Tuber dipping 0.2 % | 58.04 | 57.96 | 58.00 | 65.92 | 71.61 | 68.76 | 73.73 | 79.43 | 76.58 |
| $T_6$ | Tuber dipping 0.4 % | 60.61 | 60.76 | 60.68 | 69.28 | 74.59 | 71.93 | 77.03 | 82.45 | 79.74 |
| $T_7$ | Tuber dipping 0.6 % | 63.09 | 65.75 | 64.42 | 71.96 | 77.59 | 74.77 | 79.38 | 85.19 | 82.28 |
| $T_8$ | Foliar Application 100 ppm | 54.41 | 55.69 | 55.05 | 62.87 | 68.11 | 65.49 | 70.51 | 76.47 | 73.49 |
| $T_9$ | Foliar Application 200 ppm | 57.71 | 58.77 | 58.24 | 65.97 | 71.80 | 68.88 | 73.24 | 79.36 | 76.30 |
| $T_{10}$ | Foliar Application 300 ppm | 60.17 | 62.93 | 61.55 | 68.62 | 74.69 | 71.66 | 76.87 | 82.65 | 79.76 |
| S.Em± | | 2.07 | 2.44 | 1.60 | 2.58 | 2.47 | 1.79 | 2.81 | 2.82 | 1.99 |
| C.D. at 5% | | 6.16 | 7.24 | 4.59 | 7.67 | 7.33 | 5.12 | 8.35 | 8.37 | 5.70 |

**Table 5:** Effect of different doses and methods of boron application on yield per plant (g) 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 | 154.00 | 325.67 | 239.83 | 221.27 | 553.00 | 387.13 | 433.87 | 665.00 | 549.43 |
| $T_2$ | Soil Application 10 kg/ha | 189.67 | 350.00 | 269.83 | 266.47 | 611.00 | 438.73 | 478.60 | 735.00 | 606.80 |
| $T_3$ | Soil Application 15 kg/ha | 227.27 | 384.80 | 306.03 | 309.40 | 673.00 | 491.20 | 536.33 | 815.00 | 675.67 |
| $T_4$ | Soil Application 20 kg/ha | 256.87 | 422.33 | 339.60 | 350.67 | 729.67 | 540.17 | 589.53 | 922.00 | 755.77 |
| $T_5$ | Tuber dipping 0.2 % | 175.73 | 339.33 | 257.53 | 245.00 | 579.33 | 412.17 | 461.73 | 700.00 | 580.87 |
| $T_6$ | Tuber dipping 0.4 % | 206.07 | 372.60 | 289.33 | 283.73 | 653.00 | 468.37 | 515.73 | 780.00 | 647.87 |
| $T_7$ | Tuber dipping 0.6 % | 225.07 | 401.60 | 313.33 | 324.53 | 721.00 | 522.77 | 569.13 | 885.00 | 727.07 |
| $T_8$ | Foliar Application 100 ppm | 166.00 | 334.67 | 250.33 | 234.47 | 576.00 | 405.23 | 451.47 | 680.00 | 565.73 |
| $T_9$ | Foliar Application 200 ppm | 195.20 | 368.67 | 281.93 | 272.27 | 643.00 | 457.63 | 504.93 | 760.00 | 632.47 |
| $T_{10}$ | Foliar Application 300 ppm | 212.27 | 394.93 | 303.60 | 310.47 | 711.00 | 510.73 | 558.67 | 898.33 | 728.50 |
| S.Em± | | 17.90 | 20.19 | 13.49 | 26.60 | 40.38 | 24.18 | 33.76 | 51.83 | 30.93 |
| C.D. at 5% | | 53.17 | 60.00 | 38.70 | 79.03 | 119.98 | 69.34 | 100.30 | 153.99 | 88.70 |

## Conclusion

From the present study 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 days taken to germination, plant height and yield per plant. 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.

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