Effect of NPK, Boron, Zinc and Sulphur application on growth and yield of potato (Solanum tuberosumL) Cv. Kufri Khyati

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Abstract: An experiment was conducted at the Horticulture Research Farm, Janta College, Bakewar, Etawah during Rabi season of 2023-24 and 2024-2025. The experimental site is located approximately 23 km east of the district headquarters in Etawah. The site is located at 26.661565°N, 79.170517°E at an elevation of 142 m above mean sea level and falls under the sub-tropical climate zone. The region gets an average of 1143 mm of rain every year. The experiment was laid out in a Randomized Block Design with seventeen treatments replicated thrice. The results revealed that in comparison with other given treatments T17 application of recommended dose of NPK through chemical fertilizer + Boron @ 2 kg/hac + Sulphur @ 30 kg/hac + Zinc @ 15 kg/ha to potato plants cv. Kufri Khyati under the UP conditions can relatively lead to enhanced vegetative growth and yield of the potato.

Key words: Zinc, Boron, Sulphur, Potato, Yield

Introduction

Potato (Solanum tuberosumL.) is one of the most popular staple foods of the world and the fourth most valuable agricultural product after rice, wheat and maize. Because of its multifarious uses in various cuisines, it is rightly regarded as the King of Vegetables. An excellent food for nutritional security, potato holds a special place in the world vegetable production. Potato finds its origin in the highland tropical areas of the Andean mountains and later its cultivation spread to almost all parts of the world. As far as India is concerned, potato was introduced in our country by the Portuguese early in the seventeenth century. Potatoes are a great source of vitamin C, thiamine, and folic acid, among at least 12 other essential vitamins and minerals. Being rich in carbohydrates, these manage a higher protein: calorie ratio (17g protein: 1000 kcal) and can be grown in a shorter span as compared to other vegetables **(Navarre, Roy & Goyer 2009).**

The total area under potato cultivation is approximately 19.30 million hectares putting up a cumulative yield of 388.19 million tons and an astonishing productivity of

20.11 tons per hectare. In India, a total of 2.22 million hectares of area is under potato cultivation with a cumulative production of 53.6 million MT in 2020-2021. As far as Uttar Pradesh isconcerned, total area under potato cultivation is 0.61 million ha, producing 13.9 million tons with a productivity of 22.7 t/ha **(Anonymous, 2020-2021).**
The application of inorganic and organic fertilizers is considered essential to produce high tuber yield **(Xu, F., 2025).** To improve productivity, potato plant requires a balanced dose of NPK along with adequate amount of micronutrients and macronutrients like zinc, boron and sulphur. Micronutrients are essential for plant survival and are only needed in small quantities **(Kanwar 1985 and Yadav 2024)**. Widespread deficiency of Boron, an important micronutrient, in soils was found in eastern Uttar Pradesh **(Singh et al., 2020)**.

Materials and Methods

Experimental site

In the Rabi season of 2023–2024 and 2024–2025, the experiment was carried out in the Horticulture Research Farm, Janta College, Bakewar, Etawah. The trial location is approximately 23 kilometers east of Etawah's district headquarters.

Topography and climatic conditions

The location, which is 142 meters above mean sea level and falls within the sub-tropical climate zone, is 26.661565°N, 79.170517°E. The area receives an average of 1143 mm of precipitation annually, primarily from the south-west monsoon from June to mid-October and from the north-east monsoon throughout the winter months. The current experimental season's meteorological conditions are listed in the table.

Meteorological conditions during crop season

The distribution of rainfall, high and low temperatures, relative humidity, wind speed, evaporation rate, and sunshine hours were all recorded during the crop period by the university's main campus meteorological observatory.

Details of treatments

The experiment was laid out in a Randomized Block Design with seventeen treatments replicated thrice.T_1Control(Application of recommended dose of NPK through chemical fertilizer (150-80-100) kg NPK/ha), T_2Application of recommended dose of NPK through chemical fertilizer + Boron @ 1 Kg /ha,T_3Application of recommended dose of NPK through chemical fertilizer + Boron @2 Kg /ha, T_4Application of recommended dose of NPK through chemical fertilizer + Sulphur @ 15 kg/ha,T_5 Application of recommended dose of NPK through chemical fertilizer + Sulphur @ 30 kg/ha, T_6Application of recommended dose of NPK through chemical fertilizer + Zinc @ 7.5 kg/ha, T_7Application of recommended dose of NPK through chemical fertilizer + Zinc @ 15 kg/ha, T_8Application

of half dose of NPK through chemical fertilizer + Boron @ 1kg/ha, T_9Application of half dose of NPK through chemical fertilizer + Boron @ 2 kg/ha, T_{10}Application of half dose of NPK through chemical fertilizer + Sulphur @ 15 kg/ha,T_{11}Application of half dose of NPK through chemical fertilizer + Sulphur @ 30 kg/ha, T_{12}Application of half dose of NPK through chemical fertilizer + Zinc @ 7.5 kg/ha, **T_{13}**Application of half dose of NPK through chemical fertilizer + Zinc @ 15 kg/ha, **T_{14}**Application of half dose of NPK through chemical fertilizer + Boron @ 1 kg/ha + Sulphur @ 15 kg/ha + Zinc @ 7.5 kg/ha, **T_{15}**Application of half dose of NPK through chemical fertilizer + Boron @ 2 kg/ha + Sulphur @ 30 kg/ha + Zinc @ 15 kg/ha, **T_{16}**Application of recommended dose of NPK through chemical fertilizer + Boron @ 1 kg/ha + Sulphur @ 15 kg/ha + Zinc @ 7.5 kg/ha, **T_{17}**Application of recommended dose of NPK through chemical fertilizer + Boron @ 2 kg/ha + Sulphur @ 30 kg/ha + Zinc @ 15 kg/ha

Observations Recorded

During the Study Observation was recorded on growth parameters at 40 and 60 after sowing using standard methods of data recording. All other cultural practices remained same for the all the treatments.

Statistical analysis

Observations recorded on different variables (parameters) during 2023-24 and 2024-24 were tabulated and pooled for statistical analysis using OPSTAT software. The significance of various treatments was evaluated using the F-test in two ways ANOVA (analysis of variance) at 0.05 significance level ($\alpha = 0.05$).

Results

Emergence percent

Maximum emergence percentage 94.44 per cent, 94.97 per cent and 94.71 per cent for first year, second year and pooled estimates respectively, was recorded under treatment T_{17} (Application of recommended dose of NPK through chemical fertilizer + Boron @ 2 kg/hac + Sulphur @ 30 kg/hac + Zinc @ 15 kg/ha) Lowest emergence percentage was recorded under the treatment control (T_1).

Plant height

The maximum plant height was measured with T_{17} (RDF + Boron @ 2 kg/ha + Sulphur @ 30 kg/ha + Zinc @ 15 kg/ha) at all the observational stages of potato crop both years, with pooled values of 25.58 cm (30 DAS) and 59.97 cm (60 DAS).

Number of shoots per plant

The maximum number of shoots per plant (5.71) and (5.83) was recorded in first year and second year respectively in (T_{17}: B @ 2 kg/ha, S @ 30 kg/ha, Zn @ 15 kg/ha) whereas the lowest shoot counts (3.44) were observed in T_8, T_9, T_{12}, and T_{13}, where only half doses of NPK were applied even with one micronutrient.

Number of branches per plant

The maximum number of branches per plant (5.05 at 60 DAS) and (5.38 at 60 DAS) was recorded in T_{17}, which involved the recommended dose of NPK along with Boron (2 kg/ha), Sulphur (30 kg/ha), and Zinc (15 kg/ha) in first year and second year respectively.

Number of tubers per plant

During the 2023-24, 2024-25 and pooled basic maximum number of tubers per plant (7.33), (7.67) and (7.50tubers) was recorded in T_{17}, which involved the recommended dose of NPK along with Boron (2 kg/ha), Sulphur (30 kg/ha), and Zinc (15 kg/ha).

Fresh weight of tubers per plant (g)

The fresh weight of tubers per plant ranged from 244.67 g (T_8) to 516.72 g (T_{17}). In 2024-25, the fresh weight ranged from 230.66 g (T_8) to 522.05 g (T_{17}). The pooled data over the two years showed a similar trend, with the fresh weight ranging from 237.66 g (T_8) to 519.38 g (T_{17}). T_{17} was significantly superior to all other treatments, followed by T_{16} (501.66 g) and T_5 (451.24 g). The treatment T_8 consistently exhibited the lowest fresh weight of tubers per plant.

Yield (quintal per hectare)

Highest yield (413.45 q ha^{-1}) (424.15 q ha^{-1}), 418.85 q $ha^{-1}$was recorded in T_{17}, which involved the recommended dose of NPK along with Boron (2 kg/ha), Sulphur (30 kg/ha), and Zinc (15 kg/ha) followed closely by T_{16} (400.56 q ha^{-1} whereas the lowest yield (204.91 q ha^{-1}) was observed in T_8.

Discussion

Balanced application of NPK, boron, zinc, and sulphur play a pivotal role in enhancing potato yield parameters by simultaneously improving source capacity (photosynthate production) and sink strength (tuber initiation and bulking). Nitrogen supports chlorophyll and protein synthesis, leading to vigorous canopy growth and sustained assimilate supply, while phosphorus accelerates root and stolon development and provides the ATP needed for starch biosynthesis, resulting in earlier and more uniform tuber set. Potassium is crucial for phloem loading, sucrose translocation, osmotic regulation, and enzyme activation, ensuring efficient carbohydrate movement into tubers and promoting

bulking. Sulphur improves nitrogen use efficiency, amino acid synthesis, and metabolic activity, enhancing both tuber initiation and filling. Among micronutrients, boron facilitates sugar transport, strengthens cell walls, and regulates auxin movement, improving tuber number and shape, while zinc supports auxin biosynthesis, enzymatic activity, and canopy efficiency, leading to uniform and healthy tuber development.
The synergistic interaction of these nutrients increases tuber number per plant, average tuber weight, and marketable yield, while also improving size uniformity and reducing defects, ultimately translating into higher total yield per hectare and better-quality produce **(Sharma & Lal, 2019)**.

Conclusion

In conclusion, it can be summarized that Kufri Khyati, a prominent and high yielding variety of potato has the potential of performing outstandingly provided right combination of macro and micro-nutrients are provided as essential inputs for best performance of the plants. In our study over two cropping seasons, it can be concluded based on the data analyzed that application of recommended dose of NPK through chemical fertilizer + Boron @ 2 kg/hac + Sulphur @ 30 kg/hac + Zinc @ 15 kg/ha to potato plants cv. Kufri Khyati under the UP conditions can relatively lead to enhanced vegetative growth and yield of the potato. The results obtained in this experimental study will help to standardize the integrated application dose of macro and micro nutrients in potato cv. KufriKhyati and can surely lead to profitable harvest for the farmers.

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Table no. 1. Effect of NPK, Boron, Zinc and Sulphur application on percent emergence

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	91.53	92.41	91.97
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	91.79	91.44	91.62
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	92.06	93.11	92.59
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	92.98	92.85	92.92
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	93.64	92.76	93.20
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	92.59	93.38	92.99
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	92.59	93.38	92.99
T_8Half dose of NPK + Boron @ 1 kg/ha	89.67	89.23	89.45
T_9 Half dose of NPK + Boron @ 2 kg/ha	89.94	87.68	88.81
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	91.00	90.20	90.60
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	91.19	90.20	90.70
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	90.20	89.68	89.94
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	90.73	90.11	90.42
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	91.26	92.14	91.70
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	91.52	89.67	90.60
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	94.17	94.44	94.31
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	94.44	94.97	94.71
C.D. at 5%	5.53	4.58	5.09
SE(m)	1.92	1.61	1.77

Table no. 2. Effect of NPK, Boron, Zinc and Sulphur application on plant height (cm) at 30 DAS

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	22.83	21.55	22.19
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	22.99	22.05	22.52
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	23.55	22.49	23.02
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	24.10	25.55	24.83
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	24.38	25.94	25.16
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	23.55	24.05	23.80
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	23.60	25.11	24.36
T_8Half dose of NPK + Boron @ 1 kg/ha	16.49	16.49	16.49
T_9 Half dose of NPK + Boron @ 2 kg/ha	16.94	16.88	16.91
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	19.88	17.60	18.74
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	20.60	17.83	19.22
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	19.05	16.60	17.83
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	19.27	17.60	18.44
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	20.88	17.38	19.13
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	21.77	18.55	20.16
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	24.49	26.66	25.58
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	24.77	26.99	25.88
C.D. at 5%	1.67	2.86	2.27
SE(m)	0.57	0.99	0.78

Table no. 3. Effect of NPK, Boron, Zinc and Sulphur application on plant height (cm) at 60 DAS

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	54.11	55.72	54.91
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	54.89	56.99	55.94
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	55.44	57.36	56.40
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	56.27	58.44	57.35
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	57.16	58.99	58.07
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	55.61	58.77	57.19
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	55.83	58.39	57.11
T_8Half dose of NPK + Boron @ 1 kg/ha	47.16	47.72	47.44
T_9 Half dose of NPK + Boron @ 2 kg/ha	47.78	48.21	47.99
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	51.56	51.21	51.38
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	51.89	53.05	52.47
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	49.11	48.60	48.85
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	50.21	49.16	49.68
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	52.50	53.61	53.05
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	53.50	54.38	53.94
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	58.99	59.05	59.02
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	60.22	59.72	59.97
C.D. at 5%	3.514	3.542	3.528
SE(m)	1.214	1.224	1.219

Table no. 4. Effect of NPK, Boron, Zinc and Sulphur application on number of shoots per plant

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	3.95	4.77	4.36
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	3.99	4.88	4.44
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	4.07	4.94	4.51
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	4.55	5.22	4.89
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	5.11	5.33	5.22
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	4.10	5.16	4.63
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	4.50	5.21	4.86
T_8Half dose of NPK + Boron @ 1 kg/ha	3.44	3.44	3.44
T_9 Half dose of NPK + Boron @ 2 kg/ha	3.55	3.55	3.55
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	3.83	4.10	3.97
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	3.88	4.27	4.08
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	3.61	3.77	3.69
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	3.77	3.94	3.86
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	3.90	4.44	4.17
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	3.94	4.60	4.27
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	5.44	5.66	5.55
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	5.71	5.83	5.77
C.D. at 5%	1.21	1.00	1.11
SE(m)	0.41	0.34	0.38

Table no. 5. Effect of NPK, Boron, Zinc and Sulphur application on number of branches per plant at 40 DAS

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	1.77	1.73	1.75
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	1.82	1.76	1.79
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	1.83	1.96	1.89
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	1.90	2.13	2.01
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	2.38	2.17	2.27
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	1.88	2.03	1.95
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	1.94	2.11	2.02
T_8Half dose of NPK + Boron @ 1 kg/ha	1.22	1.39	1.30
T_9 Half dose of NPK + Boron @ 2 kg/ha	1.27	1.45	1.36
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	1.55	1.59	1.57
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	1.61	1.62	1.61
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	1.27	1.45	1.36
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	1.38	1.58	1.48
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	1.66	1.65	1.65
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	1.66	1.67	1.66
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	2.22	2.20	2.21
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	2.33	2.32	2.32
C.D. at 5%	0.83	0.45	0.64
SE(m)	0.29	0.15	0.22

Table no. 6. Effect of NPK, Boron, Zinc and Sulphur application on number of branches per plant at 60 DAS

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	3.83	4.21	4.02
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	3.94	4.22	4.08
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	4.21	4.33	4.27
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	4.44	4.61	4.52
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	4.77	4.44	4.60
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	4.22	4.37	4.29
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	4.33	4.49	4.41
T_8Half dose of NPK + Boron @ 1 kg/ha	2.99	3.55	3.27
T_9 Half dose of NPK + Boron @ 2 kg/ha	3.11	3.61	3.36
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	3.66	3.83	3.74
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	3.50	3.88	3.69
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	3.44	3.66	3.55
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	3.49	3.77	3.63
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	3.77	4.08	3.92
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	3.77	4.11	3.94
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	4.88	5.16	5.02
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	5.05	5.38	5.21
C.D. at 5%	1.43	1.68	1.55
SE(m)	0.50	0.59	0.54

Table no. 7. Effect of NPK, Boron, Zinc and Sulphur application on number of tubers per plant

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	5.00	7.00	6.00
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	6.33	6.00	6.16
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	6.67	5.67	6.17
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	6.61	6.11	6.36
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	6.20	6.93	6.56
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	6.00	6.50	6.25
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	5.16	7.05	6.10
T_8Half dose of NPK + Boron @ 1 kg/ha	4.67	5.38	5.02
T_9 Half dose of NPK + Boron @ 2 kg/ha	5.67	5.33	5.50
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	6.16	5.61	5.88
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	6.16	5.44	5.80
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	6.05	5.00	5.52
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	6.09	5.04	5.57
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	5.72	5.67	5.69
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	5.72	6.23	5.97
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	7.28	7.33	7.30
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	7.33	7.67	7.50
C.D. at 5%	1.83	2.72	2.28
SE(m)	0.92	0.92	0.92

Table no. 8. Effect of NPK, Boron, Zinc and Sulphur application on Fresh weight of tubers per plant (g)

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	354.67	400.33	377.50
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	363.68	411.66	387.67
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	366.28	414.28	390.28
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	415.44	472.66	444.05
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	421.05	481.44	451.24
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	376.94	417.33	397.13
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	410.38	446.33	428.35
T_8Half dose of NPK + Boron @ 1 kg/ha	244.67	230.66	237.66
T_9 Half dose of NPK + Boron @ 2 kg/ha	265.22	268.68	266.95
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	304.66	308.66	306.66
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	330.27	338.11	334.19
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	275.33	227.33	251.33
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	289.66	289.88	289.77
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	343.44	412.76	378.10
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	345.33	356.33	350.83
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	488.10	515.22	501.66
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	516.72	522.05	519.38
C.D. at 5%	NS	156.49	173.20
SE(m)	64.23	54.08	59.15

Table no.9. Effect of NPK, Boron, Zinc and Sulphur application on Fresh weight of tubers per plant (g)

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	354.67	400.33	377.50
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	363.68	411.66	387.67
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	366.28	414.28	390.28
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	415.44	472.66	444.05
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	421.05	481.44	451.24
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	376.94	417.33	397.13
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	410.38	446.33	428.35
T_8Half dose of NPK + Boron @ 1 kg/ha	244.67	230.66	237.66
T_9 Half dose of NPK + Boron @ 2 kg/ha	265.22	268.68	266.95
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	304.66	308.66	306.66
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	330.27	338.11	334.19
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	275.33	227.33	251.33
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	289.66	289.88	289.77
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	343.44	412.76	378.10
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	345.33	356.33	350.83
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	488.10	515.22	501.66
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	516.72	522.05	519.38
C.D. at 5%	NS	156.49	173.20
SE(m)	64.23	54.08	59.15

Table no. 10. Effect of NPK, Boron, Zinc and Sulphur application on Total tubers yield (qha^{-1})

Treatments	First Year	Second Year	Pooled
T_1 R.D.F. of NPK	334.49	333.14	333.81
T_2 R.D.F. of NPK + Boron @ 1 kg/ha	339.75	345.04	342.39
T_3 R.D.F. of NPK + Boron @ 2 kg/ha	345.04	349	347.02
T_4 R.D.F. of NPK + Sulphur @ 15 kg/ha	372.13	374.78	373.45
T_5 R.D.F. of NPK + Sulphur @ 30 kg/ha	385.36	389.32	387.34
T_6 R.D.F. of NPK + Zinc @ 7.5 kg/ha	353.63	357.6	355.61
T_7 R.D.F. of NPK + Zinc @ 15 kg/ha	362.88	368.83	365.85
T_8Half dose of NPK + Boron @ 1 kg/ha	204.91	208.21	206.56
T_9 Half dose of NPK + Boron @ 2 kg/ha	218.79	223.41	221.1
T_{10} Half dose of NPK + Sulphur @ 15 kg/ha	258.45	263.72	261.08
T_{11} Half dose of NPK + Sulphur @ 30 kg/ha	261.09	267.03	264.06
T_{12} Half dose of NPK + Zinc @ 7.5 kg/ha	237.29	239.94	238.61
T_{13} Half dose of NPK + Zinc @ 15 kg/ha	270.34	273.65	271.99
T_{14} Half dose of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	235.97	246.55	241.26
T_{15} Half dose of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	243.9	245.54	244.72
T_{16} R.D.F. of NPK + Boron @ 1 kg/ha+ Sulphur @ 15 kg/ha+ Zinc @ 7.5 kg/ha	400.56	401.51	401.03
T_{17} R.D.F. of NPK + Boron @ 2 kg/ha+ Sulphur @ 30 kg/ha+ Zinc @ 15 kg/ha	413.45	424.15	418.85
C.D. at 5%	16.09	14.86	15.47
SE(m)	5.56	5.13	5.34