Archives of Agriculture and Environmental Science 8(2): 157-161 (2023)
https://doi.org/10.26832/24566632.2023.0802010

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

ORIGINAL RESEARCH ARTICLE

Effect of zinc and boron on the performance of rainy season local potato variety "Sete" (*Solanum tuberosum* L.) at Rukumkot, Rukum East, Nepal

Dhaniraj Kohar[1], Akash Gupta[1*], Prem Prasad Siwakoti[2], Sandeep Gouli[1], Prajwol Shrestha[1] and Rajan Sah[1]

[1]Faculty of Agriculture, Agriculture and Forestry University (AFU), Rampur, Chitwan, NEPAL
[2]Institute of Agriculture and Animal Science (IAAS), Tribhuwan University (TU) Rupandehi, NEPAL
[*]Corresponding author's E-mail: agriculture.akash@gmail.com

ARTICLE HISTORY

Received: 26 April 2023
Revised received: 02 June 2023
Accepted: 15 June 2023

Keywords

Application
Micronutrients
Tuber
Vegetation
Yield

ABSTRACT

A field experiment was carried out at Rukumkot, Rukum East, Nepal during the rainy season of 2021 to study the effect of boron and zinc on vegetative growth and yield parameters of the local "Sete" variety of potato. The experiment was laid out in a randomized complete block design (RCBD) with 4 replications, and 7 treatments i.e., control, boron @2kg/ha soil application, zinc @4.5kg/ha soil application, boron @2kg/ha + zinc @4.5kg/ha soil application, 0.1% boron spray, 0.1% zinc spray and 0.1% boron+ 0.1% zinc spray. The highest tuber yield per hill and productivity was reported in boron @2kg/ha + zinc @4.5kg/ha soil application i.e., 2888.52 grams and 27.51 ton/ha, respectively. A similar result was shown by zinc @4.5kg/ha soil application. Plant height (26.33cm, 46.57cm), number of branches (4.85, 12.02) and number of leaves per plant (30.05, 73.70) were significantly high in boron @2kg/ha + zinc @4.5kg/ha soil application at both 45 DAP (days after planting) and 60DAP. Soil application of only boron, only zinc and boron + zinc increased the total yield of tubers by 10.23%, 24.66% and 25.66%, respectively over the control. The foliar application of only boron, only zinc and boron + zinc increased the total yield of tubers by 4.22%, 2.07% and 12.37%, respectively over the control. Hence, research suggested combined soil application of zinc and boron at the rate of 4.5kg/ha and 2kg/ha, respectively over the foliar cum solitary application of micronutrients for increasing number of medium and large sized tubers and get an overall high yield of potato.

Citation of this article: Kohar, D., Gupta, A., Siwakoti, P. P., Gouli, S., Shrestha, P., & Sah, R. (2023). Effect of zinc and boron on the performance of rainy season local potato variety "Sete" (*Solanum tuberosum* L.) at Rukumkot, Rukum East, Nepal. *Archives of Agriculture and Environmental Science*, *8*(2), 157-161, https://dx.doi.org/10.26832/24566632.2023.0802010

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the major crops in Nepal. It belongs to the family Solanaceae which is most popular after rice and wheat (Rokaya, 2020). Western South America is the primary center of potato crops and their wild relatives (Haan and Rodriguez, 2016). The cultivated area, production, and productivity of potatoes in Nepal are 193,997 ha, 3,112,947 tons and 16.04 tons/ha respectively (MoALD, 2020). Dolakha, Bara, Illam and Jhapa are the major potato-producing districts of Nepal (CBS, 2019). In terai, potato is used as a vegetable but in hills and mountains it is used as a staple food and source of income for smallholder farmers (Subedi *et al.*, 2019), (NPRP, 2014). Due to the presence of high starch (16.1/100g), protein (2.1/100g), vitamin C (17.1mg/100g) and essential amino acids in potatoes, it is consumed by Nepalese in the hills. Potato is fat-free, rich in minerals and produces more energy and protein per unit area than other major food crops (Lutaladio and Castaldi, 2009). It is most popular in rural and marginalized communities (Sapkota and Bajracharya, 2018). So, the demand for potatoes is increasing (Shrestha *et al.*, 2020). It is also a mode to solve nutritive and economic crises (Mustafa, 1997).

Favored by the agro-climatic condition of Napal, potato is grown upto three times a year from 60m to an altitude of

4,400m all year round (Khatri, 2006). Different varieties of potatoes have their own characters as in terms of emergence, flowering, maturation, biomass, and yield (Fantaw *et al.*, 2019). Production of potato depends upon varieties, sources of seed, farm size and farmers' access to training (Gairhe *et al.*, 2017). Zinc and boron are the important micronutrients used in improving tuber and total dry weight of potato (Lenka and Das, 2019). Zinc increases ascorbic acid, decreases tyrosine and phenol content which imparts good quality to potato. It enhances the productivity of potato (Banerjee *et al.*, 2019). Boron plays an important role in cell wall synthesis, sugar transport, cell division, cell development, auxin metabolism, synthesis of amino acids and proteins and regulation of carbohydrate metabolism. It exhibits superiority to potato regarding specific gravity, total soluble solids, tuber hardness, total acidity, Vitamin C, protein, and starch content with lowest phenol content (Singh and Singh, 2019). However, the knowledge base on way of using micronutrients for potatoes is lacking and efficacy of zinc and boron in enhancing the production is unknown. Similarly, unlike other fruits and vegetables, the productive part of potato remains underground. Hence, enroute of foliar application, the micronutrients being immobile in nature, might not play as crucial role as it would do in soil application. So, to solve these queries, this research was carried out by experimenting soil and foliar application of Zn and B in combined and solitary approaches.

MATERIALS AND METHODS

The research experiment was conducted at Sisne Rural Municipality, Rukumkot, Rukum (east) in Integrated Agriculture and Livestock Development Office (Potato Block), Rukumkot, Rukum (east). The elevation of the site was 2867-meter altitude from sea level (masl) and the geographical coordinates is 28°32'15" N latitude and 82°46'25" E longitude (GPS). The availability of Zn and B is directly affected by soil properties like soil pH and texture. Hence, chemical and physical analysis of the experimental soil was done before starting the experiment. The soil texture was silty and soil pH was 6.8. The NPK test by Soil Kit Box method showed each of them being available moderately. The experiment was laid out in Single Factor Randomized Complete Block Design (RCBD) with 4 replications having 7 treatments, viz:

T1: Control (water spray)
T2: 2.0 kg B/ha as soil application
T3: 4.5 kg Zn/ha as soil application
T4: 2.0 kg B/ha + 4.5 kg Zn/ha as soil application
T5: 0.1% boron solution as foliar application
T6: 0.1% zinc solution as foliar application
T7: 0.1% zinc solution + 0.1% boron solution as foliar application

The source for B was Boric Acid and for Zn was Zinc Sulphate. The sprays were done thrice at 40, 55 and 70 DAP (only after full foliage was observed; at an interval of 15 days) while the soil applications were done once during planting. The NPK were used on the basis of Nepal Government's recommended dose for potato cultivation. The area of each plot was allocated to be 2.8m×1.5m with total number of plots being 28. Local "Sete" variety was used as a planting material. Healthy seed tubers of 25-30 grams containing at least 2 eyes were planted. The tubers were planted under a ridge and furrow system. Four ridges were made in each plot at a distance of 70cm and each ridge contained 6 plants making a total of 24 plants per plot. Within the ridge, the tubers were planted at a depth of 3-4cm and at a spacing of 25 cm. Weeding and earthing up were done at 20 days after emergence and final earthing up was done after 30 days of first earthing up. Manual harvesting was done with the help of hoe at 120 DAP. Data for parameters like: Plant height, number of branches, number of leaves, number of tubers per hill, number and weight of small (<50-gram), medium (50-100 gram) and large sized tubers (> 100 gram), yield and productivity were taken from 10 randomly selected plants in each plot. The data obtained were entered into Microsoft Excel and the analyses were performed using RStudio. The means were analyzed for significance using ANOVA and means were separated and grouped using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Vegetative parameters

The results for plant height, number of branches and number of leaves at 45 DAP (days after planting) and 60 DAP is presented in Table 1.

Plant height

At 45 DAP, the highest plant height was seen in soil application of Boron @2kg/ha + Zinc @4.5kg/ha i.e., 26.33cm. This was followed up 0.1% boron + 0.1% zinc spray (i.e., 22.81cm), 0.1% Zn spray (i.e., 20.46cm), 0.1% B spray (i.e., 20.18cm). The least plant height was observed in control i.e., 14.1cm. At 60 DAP too, the highest plant height was recorded in plots with soil application of Boron @2kg/ha + Zinc @4.5kg/ha i.e., 46.57cm. This was followed up soil application of Zn @4.5kg/ha (i.e., 44.45cm), 0.1% boron + 0.1% zinc spray (i.e., 39.65cm) and 0.1% Zn spray. The least plant height was observed in control i.e., 32.01cm. Thus, soil application of Zn and B had positive effects on the plant height of potatoes. This might be due to the effect of zinc and boron in enhancing cell-division and the activity of indole acetic acid along with other growth enzymes (Rudani *et al.*, 2018) (Ahmad *et al.*, 2009). Similar result was given by Mahmoud *at al.* (2020) and Lenka and Das (2019).

Number of branches

A significant difference was observed in the number of branches plant because of treatments. The maximum number of branches per plant was observed in soil application of Boron @2kg/ha + Zinc @4.5kg/ha soil application i.e., 4.85 and 12.02 at 45 DAP and 60 DAP respectively. The least branching was observed in control i.e., 2.95 and 6.21 at 45 DAP and 60 DAP respectively. Additive function of zinc and boron increases uptake of iron and manganese which might have increased branch number (Aref, 2010). The foliar sprays of Zn and B had little effect on branching at both 45 DAP and 60 DAP. This was supported with results given by Khatun *et al.* (2020).

Table 1. Effect of Boron and Zinc on plant height, average number of branches and average number of leaves on local "Sete" variety of potato at Rukumkot, Rukum East, Nepal.

Treatment	Plant Height (cm)		Average number of branches		Average number of leaves	
	45 DAP	60 DAP	45 DAP	60 DAP	45 DAP	60 DAP
Control	14.10^{e}	32.01^{d}	2.95^{c}	6.21^{c}	20.28^{d}	51.27^{c}
Boron@2kg/ha soil application	18.49^{c}	35.78^{cd}	3.31^{bc}	6.77^{c}	22.34^{cd}	52.81^{c}
Zinc @4.5kg/ha soil application	16.23^{d}	44.45^{ab}	3.58^{b}	7.22^{c}	24.03^{bc}	58.19^{bc}
Boron @2kg/ha + Zinc @4.5kg/ha soil application	26.33^{a}	46.57^{a}	4.85^{a}	12.02^{a}	30.05^{a}	73.70^{a}
0.1% Boron spray	20.18^{c}	36.24^{cd}	3.21^{bc}	7.37^{c}	24.33^{bc}	60.39^{bc}
0.1% Zinc spray	20.46^{c}	39.39^{bc}	3.04^{c}	9.39^{b}	26.10^{b}	67.37^{ab}
0.1% Boron+ 0.1% Zinc spray	22.81^{b}	39.65^{bc}	3.02^{c}	9.32^{b}	26.41^{b}	70.26^{ab}
LSD (0.05)	2.11	6.26	0.44	1.79	3.42	13.31
SEM (±)	0.27	0.80	0.06	0.23	0.43	1.69
F-probability	<0.001***	0.0017**	<0.001***	<0.001***	<0.001***	0.014 *
CV%	7.16	10.76	8.74	14.49	9.28	14.45
Grand Mean	19.80	39.16	3.42	8.33	24.79	62

Note: LSD denotes Least Significant Difference, SEM denotes Standard Error of Mean, CV denotes Coefficient of Variation and *, ** & *** represents significance at α=5%, α=1% and α=0.01%, respectively.

Table 2. Effect of boron and zinc on grade-wise number and weight of tubers per hill of local "Sete" variety of potato at Rukumkot, Rukum East, Nepal.

Treatment	Grade-wise number of tubers			Grade-wise weight of tubers (gram)		
	<50 gram	50-100 gram	>100 gram	<50 gram	50-100 gram	>100 gram
Control	83.68^{c}	6.99^{d}	1.45^{d}	1484.73^{bc}	608.43^{c}	205.61^{d}
Boron@2kg/ha soil application	99.68^{a}	8.93^{cd}	2.36^{bc}	1537.36^{bc}	708.27^{bc}	288.24^{abc}
Zinc @4.5kg/ha soil application	91.77^{abc}	10.27^{bc}	2.69^{ab}	1788.19^{a}	769.96^{ab}	307.60^{ab}
Boron @2kg/ha + Zinc @4.5kg/ha soil application	94.11^{ab}	14.11^{a}	3.13^{a}	1717.87^{ab}	844.96^{a}	325.69^{a}
0.1% Boron spray	85.26^{c}	9.32^{cd}	1.69^{d}	1433.61^{c}	739.20^{ab}	325.69^{a}
0.1% Zinc spray	85.88^{bc}	11.18^{bc}	1.30^{d}	1359.02^{c}	790.38^{ab}	197.04^{d}
0.1% Born+ 0.1% Zinc spray	87.95^{bc}	11.69^{b}	1.90^{cd}	1529.38^{bc}	819.44^{ab}	234.39^{bcd}
LSD (0.05)	8.38	2.35	0.61	236.03	118.35	75.12
SEM (±)	1.07	0.30	0.08	30.03	15.06	9.56
F-probability	0.00888**	<0.001***	<0.001***	0.0144*	0.0107*	0.00815**
CV%	6.29	10.36	19.79	10.25	10.56	19.87
Grand Mean	89.76	10.36	2.07	1550.02	754.38	254.51

Note: LSD denotes Least Significant Difference, SEM denotes Standard Error of Mean, CV denotes Coefficient of Variation and *, ** & *** represents significance at α=5%, α=1% and α=0.01%.

Number of leaves

The leaf number of potato was significantly influenced by boron and zinc at 45 DAP (p<0.001%) and 60 DAP (p=0.0135%). The leaf number at 45 DAP varied from 20.28 to 30.05. The highest number of leaves at 45 DAP was found in the treatment Boron @2kg/ha + Zinc @4.5kg/ha as soil application and the lowest was found in Control. At 60 DAP the highest leaf number was observed in soil application of Boron @2kg/ha + Zinc @4.5kg/ha i.e., 73.70. The lowest number of leaves were observed in Control i.e., 51.27. These results were also supported by Lenka and Das (2019) and El-Dissoky and Kadar (2013).

Yield parameters

The results on number of tubers and weight of tubers under a grading of <50gram, 50-100gram and >100 gram is presented in Table 2.

Number of tubers per hill

The Zn and B application had a significant effect on numbers of tubers per hill. The highest number of tubers <50 gram (i.e., 99.68) was observed in Boron @2kg/ha soil application and lowest number of tubers <50 gram (i.e.,83.68) was observed in control respectively. Similar results were found in experiment conducted by Sarkar *et al.* (2018) citing that boron significantly increases tuber number. The highest number of medium sized tubers (50-100 gm) i.e., 14.11 was seen in Boron @2kg/ha + Zinc @4.5kg/ha soil application. The lowest number of medium sized tubers was seen under control i.e., 6.99. The highest number of tubers large sized tubers (>100gm) i.e., 3.13 was found in Boron @2kg/ha + Zinc @4.5kg/ha soil application. The lowest number of large sized tubers were observed in 0.1% Zinc spray. Lenka & Das (2019) observed that soil application of only boron, only zinc and boron + zinc increased the total number of tubers by 3.9, 3.5 and 12.0%, respectively over the control.

Table 3. Effect of boron and zinc on total yield per hill (gram) and productivity (ton/ha) of local "Sete" variety of potato at Rukumkot, Rukum East, Nepal.

Treatment	Yield per hill (gm)	Productivity (Ton/Ha)
Control	2298.78^{c}	21.89^{c}
Boron@2kg/ha soil application	2533.88^{bc}	24.13^{bc}
Zinc @4.5kg/ha soil application	2865.75^{a}	27.29^{a}
Boron @2kg/ha + Zinc @4.5kg/ha soil application	2888.52^{a}	27.51^{a}
0.1% Boron spray	2395.78^{bc}	22.82^{bc}
0.1% Zinc spray	2346.44^{bc}	22.35^{bc}
0.1% Born+ 0.1% Zinc spray	2583.20^{b}	24.60^{b}
LSD (0.05)	277.01	2.64
SEM (±)	35.24	0.34
F-probability	0.000819 ***	0.000819 ***
CV%	7.29	7.29
Grand Mean	2558.91	24.37

Note: LSD denotes Least Significant Difference, SEM denotes Standard Error of Mean, CV denotes Coefficient of Variation and *, ** & *** represents significance at α=5%, α=1% and α=0.01%.

Weight of tubers per hill

The highest weight of small sized tubers (<50gm) i.e., 1788.19 gram was given by Zinc @4.5kg/ha soil application and lowest weight of small sized tubers i.e., 1359.02 gram was seen under 0.1% Zinc spray. The highest weight of medium sized tubers (50-100gm) i.e., 844.96gram was found in Boron @2kg/ha + Zinc @4.5kg/ha soil application. The lowest weight of medium sized tubers was found in control i.e., 608.43 gram. The highest weight of large sized tubers (>100gm) i.e., 325.69gm was found in Boron @2kg/ha + Zinc @4.5kg/ha soil application. The lowest weight of large sized tubers i.e., 197.04 gram was observed in 0.1% Zinc spray. Similar results were observed by Thorat *et al.* (2018), who also stated that soil application of zinc is more beneficial than foliar application in production. Hence, to obtain large sized tubers combined soil application of zinc and boron were pivotal.

Total yield per hill and productivity

The results for total yield and productivity are presented in Table 3. The highest yield per hill i.e., 2888.52 gram was recorded under Boron @2kg/ha + Zinc @4.5kg/ha soil application which was statistically similar to the yield found in Zn @4.5kg/ha soil application i.e., 2865.75 gram. The same goes for productivity as well. The least yield per hill and productivity was recorded under control i.e., 2298.78 gm and 21.89 ton/ha. Thus, the foliar as well as soil application of zinc had an enhancing effect on yield per hill as well as productivity. However, the soil application of Zn+B had superior effect compared to foliar application. Similarly, the combined application of Zn+B had superior effect compared to solitary application. This might be owing to the fact that Boron and Zinc helped in increasing the tuber weight by enhancing the photosynthesis as well as increasing storage capacity of photosynthates (Murmu *at al.*, 2014) (Shnain and Saravana, 2014) (Ziaeyan and Rajaie, 2009). Another fact supporting the superiority of soil application over foliar application of micro-nutrients like B and Zn might be their time of application. The soil application had advantage over foliar spray as it was allowed to show its merit right from the start while the foliar application was given only at 45 DAP when the branches and leaves were developed enough to absorb Zn as well as B.

Conclusion

The combined and solitary application of Zn and B via soil and foliar applications had significant effect on vegetative and yield parameters of local “Sete” variety of potato at Rukumkot, Rukum East, Nepal during rainy season condition of 2021. At 45 DAP and 60 DAP, highest plant height (26.33cm and 46.57cm), highest number of leaves (30.05 and 73.7) and highest number of branches (4.85 and 12.02) were recorded for the soil application of Boron @2kg/ha + Zinc @4.5kg/ha obtained. The highest number of small sized tubers per hill (99.68) were obtained in B@2kg/ha soil application. The highest number of medium sized tubers per hill (14.11) and highest number of large sized tubers per hill (3.13) were observed in combined soil application of Boron @2kg/ha + Zinc @4.5kg/ha. The highest weight of small sized tubers per hill (1788.19 gm) was seen in soil application of Zn@4.5kg/ha. Similarly, the highest weight of medium sized tubers per hill (844.96 gm) and large sized tubers per hill (325.69 gm) were seen highest in soil application of Boron @2kg/ha + Zinc @4.5kg/ha. Overall, the highest yield of potatoes per hill (2888.52 gm) and productivity (27.51 ton/ha) was observed in the soil application of Boron @2kg/ha + Zinc @4.5kg/ha. The result of yield and productivity was statistically similar to the soil application of Zinc @4.5kg/ha. Hence, soil application of Boron @2kg/ha + Zinc @4.5kg/ha were found to be better for the vegetative growth, increased number of large and medium sized tubers and gave 25.65% more yield compared to control, 11.81% more yield compared to foliar application of 0.1% B + 0.1% Zn. Hence, potato farmers should opt for combined soil application of B and Zn rather than foliar application to get a higher yield of potato.

REFERENCES

Ahmad, W., Niaz, A., Kanwal, S., & Khalid, M. (2009, January). Role of boron in plant growth: a review. *Journal of Agricultural Research*, 329-338.

Aref, F. (2010). Zinc and boron fertilization on concentration and uptake of copper and nitrogen in the corn grain in acalcareous soil. *Life Science Journal*, 8(1), 337-343.

Banerjee, H., Sarkar, S., Deb, P., Dutta, S. K., Ray, K., Rana, L., & Majumdar, K. (2019, march). Impact of Zinc Fertilization on Potato (*Solanum tuberosum* L.) Yield, Zinc Use Efficiency, Quality and Economics in Entisol of West Bengal. *Journal of the Indian Society of Soil Science, 64*, 176-182.

CBS. (2019). *Central Bureau of Statistics*. Retrieved from https://cbs.gov.np/

El-Dissoky R. A., & Kadar, A. (2013). Effect of Boron as a Foliar Application on Some Potatoes Cultivars Under Egyptian Alluvial Soil Conditions. *Research Journal of Agriculture and Biological Sciences*(1816-1561), 232-240.

Fantaw, S., Zegeye, W. A., & Ayalew, A. (2019). Yield Performance of Potato (*Solanum tuberosum* L.) Varieties under Rainy Season at Wogera District, North-western Ethopia. *Journal of Academia and Industrial Research*, 7(11).

Gairhe, S., Gauchan, D., & Timsina, K. (2017). Adoption of Improved Potato Varieties in Nepal. *Journal of Nepal Agriculture Research Council*, *3*(38-44).

Haan, S. d., & Rodriguez, F. (2016). Potato Origin and Production. *Advances in Potato Chemistry and Technology*, 1-32.

Khatri, D. B. (2006). Improved Potato Farming. In D. B. Khatri, *Potato Cultivation in Nepal* (pp. 1-5). Khumaltar, Lalitpur: Nepal Agriculture Research Council.

Khatun, K., Mostarin, T., Afsun, J., Habiba, M., Haq, M., & Hossain, M. (2020). Combined Effect of Zinc and Boron with Fruit Thinning on the Quality Seed Production of Tomato. *Asian Plant Research Journal*, 8-24.

Lenka, B., & Das, S. K. (2019, march). Effect of boron and zinc application on growth and productivity of potato (Solanum tuberosum) at alluvial soil (Entisols) of India. *Indian Journal of Agronomy*, 129-137.

Lutaladio, N., & Castaldi, L. (2009). Potato: The hidden treasure. *Journal of Food Composition and Analysis*, *22*(6).

Mahmoud, W. A., Abdeldaym, E., Abdelaziz, S., Mottaleb, S., & El-Sawy, M. (2020). Synergetic Effect of Zinc, Boron, Silicon, and Zeolite Nanoparticles on Confer Tolerance in Potato Plants Subjected to Salinity. *Agronomy*, 10-19.

MoALD. (2020). Statstical information on nepalese agriculture. *Retrieved from https://www.moald.gov.np/publication/%20Agriculture%20Statistics*

Murmu, S., Saha, S., Saha, B., & Hazra, G. C. (2014, March). Influence of Zn and B on the yield and nutrition of two widely grown potato cultivars (*Solanum tuberosum* L.). *Annals of Biology*, *30*(1):37-41.

Mustafa, G. (1997). Input management of potatoes in Northen areas of Pakistan, *M.Sc. Thesis*.

NPRP. (2014). Annual Report 2070/71 (2013/14). *National Potato Reserch Program, NARC, Khumaltar, lalitpur, Nepal*.

Rokaya, C. P. (2020). Krishi Loksewa Sarathi. *Pratistha Prakashan P.v.t L.t.d., Kathmandu*

Rudani, K., Patel, V., & Prajapati, K. (2018, February). The importance of zinc in plant growth. *International Research Journal of Natural and Applied Sciences*, *5*(2), 38-48.

Sapkota, M., & Bajracharya, M. (2018). Resource use efficiency analysis for potato production in Nepal. *Journal of Nepal Agricultural Research Council*. https://doi.org/10.3126/jnarc.v4i1.19690), 54-59

Sarkar, S., Banerjee, H., Ray, K., & Ghosh, D. (2018, April 18). Boron fertilization effects in processing grade potato on an Inceptisol of West Bengal, India. *Journal of Plant Nutrition*, 1-15.

Shnain, R. S., & Saravana, S. S. (2014). Effect of zinc and boron on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill) cv. Heem Sohna, under protected cultivation. *European Academic Research*, 78-79.

Shrestha, K., Sah, S. K., Singh, R., & Devkota, Y. N. (2020). Performance of potato (*Solanum tuberosum* L.) varieties with and without straw mulch at Shankarpur, Kathmandu. *Journal of Agriculture and Natural Resources*.

Singh, P., & Singh, K. (2019). Role of micronutrients in potato cultivation. *Journal of Pharmacognosy and Phytochemistry*.

Subedi, S., Ghimire, Y. N., Gautam, S., & Poudel, H. K. (2019). Economics of potato (*Solanum tuberosum* L.) production of terai region of Nepal. *Archives of Agriculture and Environmental Science*, 57-62.

Thorat, M., Patil, M., Patil, S., & Deshpande, D. (2018). Effect of soil and foliar application of zinc on growth and yield parameters of sweet orange var. Nucellar (*Citrus sinensis* L. Osbeck). *Journal of Pharmacognosy and Phytochemistry*, *7*(5), 749-752.

Ziaeyan, A., & Rajaie, M. (2009, August). Combined effect of Zinc and Boron on yield and nutrients accumulation in corn. *International Journal of Plant Production*, 1735-6814.