Response ofmaize (*Zea mays* L.) to seed priming with zinc and boronon nutrient content and their uptake

ABSTRACT

Aims: To study the effect of seed priming with zinc (Zn)and boron (B) on nutrient content and their uptake by maize crop.

Study design: Randomized block design.

Place and Duration of Study: One yearfield experiment atResearch Farm, School of Agriculture, Abhilashi University, ChailChowk, Mandi, (H.P.), during*kharif*of 2023.

Methodology: The experiment was conducted with three replications and seven treatments *viz.* T_1= Absolute control, T_2= Seed priming with water, T_3= Seed priming with 0.5% $ZnSO_4$, T_4= Seed priming with 1% $ZnSO_4$,T_5= Seed priming with 0.01% borax, T_6= Seed priming with 0.05% borax, T_7 = Seed priming with 0.1% borax.

Results: The data revealed that the highest contents of N, Pand Kin grains and stover of maize and their uptake by grains, stoverand total uptake by maizecrop was recorded undertreatment T_7, which was at par with treatment T_3. While, the highest zinc content in grains and stover of maize were found under treatment T_4, which wason par with T_3 and boron content in grains and stover of maize were highest in T_7 and it was at par with T_5 and T_6. Whereas, the highest uptake of zinc by grains, stover and total uptake was recorded under T_3, which was on par with T_4 and the uptake of boron by grains, stover and total uptake by maize crop was maximum under T_7 which was significantly superior to all treatments. However, the minimum content of all these nutrients in grains, stoverandtheir uptake by grains, stover and total uptake by maize crop was found under treatment T_1.

Conclusion: This study showed that the different micronutrients and their seed priming has significantly affected the content of nutrients and their uptake by maize crop.

***Keywords:** Maize, seed priming, zinc, boron, nutrient content and uptake.*

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most versatile emerging crop having the wider adaptability under varied agro-climatic conditions.Globally, maize is also known as 'queen of cereals" because it has a highest genetic yield potential among the cereals. It is a C_4 plant that can effectively utilize the CO_2 even at high intensity. Maize is the world's leading staple cereals. Maize was domesticated more than 9,000 years ago in southern Mexico **(Awika, 2011) [1]**. The global maize area amounts to 197 M ha, including substantial areas in sub-Saharan Africa (SSA), Asia and Latin America **(FAOStat, 2021) [2]**. Maize is an important food crop of humans in a many countries, especially in SSA, Latin America and a few countries in Asia, where maize crop is consumed as human food contributes over 20% of food calories **(Shiferaw et al. 2011) [3]**. As compare to rice and wheat, maize is more multi-purpose and versatile crop. In the developed economies it is primarily used as a feed crop for livestock with the different role as an industries. Maize is plays a diverse and dynamic role in the global agri-food system and food nutrition security**(Poole et al. 2021) [4]**. Maize can be used as food, feed, fodder and have industrial value making, it is a farmer's income boosting crop. It is a highly demand crop in the world due to its high demand as poultry feed, food processing, maize-based concentration for livestock population and rising the international prices due to diversion of grain of maize towards the

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biofuel production. In India, maize crop occupies an area 10.40 million hectare with production of 35.50 million metric tons with an average yield of 3.41 metric tons ha^{-1} **(Anonymous, 2024)[5]**.

Nutrient management in maize crop involves the managing the amount, source, placement, form and timing of the application of plant nutrients and soil amendments to increase the growth of the plant and yield while minimizing the environmental impact. The production of maize that heavily relies on the adequate amount of the nutrient management with nitrogen, phosphorus and potassium being the most critical nutrients. Nitrogen is vital for the growth of vegetative parts of the plant and grain yield, but its mismanagement can causethe environmental problems like leaching of nitrate and emission of greenhouse gases. Various nitrogen management practices, including split application during planting and vegetative stages, have been helpful for the improvement in the yield of maize and nitrogen use efficiency. Nitrogen fertilizer affects dry matter production of maize by influencing leaf area development, maintenance and photosynthetic efficiency **(Kaur et al. 2012) [6]**.Similarly, phosphorus plays a critical role in growth of roots, flowering and grain filling and its deficiency can results in poor quality of crop and reduces the yield. Phosphorus management practices, such as the testing of soil have been found to enhance the availability of phosphorus in the soil and improving the overall productivity of maize. However, potassium is essential for the osmoregulation, enzyme activation and process of photosynthesis and its deficiency can lead to reduced yield and increased susceptibility to biotic and abiotic stresses. **(Martineau et al. 2017) [7]**reported that the accumulation of sugars are accumulated during drought stress in maize which are reallocated with the optimum potassium nutrition, possibly due to an improvement in the photosynthesis and phloem transport of carbohydrate from leaves to roots. Zn function include catalyzing the process of oxidation in plant cells, which is critical for the transformation of the carbohydrates and it controls the chlorophyll formation, auxins and growth regulating compounds. Boron is an essential mineral for human being that plays a significant part in several biological processes. Boron is required for the growth of humans. There are evidence of this nutrient showing a variety of benefits for human such as formation of bones and maintenance. Seed priming is a process of regulating the germination process by managing the temperature and seed moisture content. The seed priming is a cost-effective process of supplementation of the micronutrients or we can say that priming is the process of controlled hydration of seeds to a level that permits pre-germinated the metabolic activity of seed. There are several benefits to seed priming and they includes: Faster speed of the emergence of seed, enables the seed to germinate and emerge even under adverse agro-climatic conditions. For examples in cold and wet or under hot conditions, improve the uniformity to optimize the efficiency of harvesting, increases vigor for the fast development of the plant. The seed priming also helps in increasing the yield of the crops.According to **(Koirala 2017)[8]**, seed priming helps in the faster emergence, better and uniform stands, less need for re-sow of seed, provides more vigorous plant, earlier flowering, prior to harvesting and higher staple grain yield in maize. Seed priming is a useful practice, applied prior to planting, which partially hydrates the seeds to a point of germination process initiation, followed by drying which prevent the radicle emergence. The primed seeds show increased germination rate and seedling establishment at sub optimal conditions **(Jafar et al. 2012)[9]**. The objective of this study was to evaluate the effect of various seed priming with micronutrientsZn and Bon maize crop..

The Zn is one of the essential micronutrient for plants as well as humans. It is among the most significant component of the metabolism of carbohydrates. It activates the most of the enzymes and it is necessary for the production of essential plant enzymes. Furthermore, it initiates a variety of enzymatic reactions **(Akay, 2011)[10].** It is essential for the protein and starch production, so a low concentration of zinc causes the accumulation of amino acids and a sugar content reduction in plant tissues. In zinc deficiency, many enzymes in which Zn plays an important role, resulting in accumulation of carbohydrates in plant leaves**(Taheri et al. 2011)[11]**. Furthermore, zinc aids pollination by playing a part in formation of the pollen tube **(Pandey et al. 2006)[12]**. The deficiency of zinc in plants resulted in many abnormalities that can be noticed as visible symptoms like stunted growth, reduced size of leaves, and chlorosis of leaves and sterility of spikelets. The micronutrient poverty such as Zn affects the quality of mature and harvested crop products, infection resulting from fungal or disease attack is increased **(Cakmak, 2000)[13]**. .Zn is such an essential nutrient in human health that even a minor deficiency is disastrous. In human being, a lack of zinc causes the anorexia, loss of appetite, loss of smell and taste and other symptoms occurs and it may affect the immune system or cause anemia. Zincdeficiency has been linked to pregnancy and childbirth complications and congenital defects in the fetus **(Black, 2001)[14]**. The risk is deficiency of zinc dominant in children (under the age of 5 year) because they have higher demands of zinc to completer their growth and for the process of their development **(Wessells & Brown, 2012)[15]**.

Boron is anessential micronutrient to the development and well-being of all crops. It is a part of the reproductive organs and cell walls of plants. Although it is not mobile in plants, it is mobile in the soil. One of the many important roles that boron performs in plants is in the production of cell walls. A lack of boron frequently causes fewer flowers per plant, empty pollen grains, and reduced pollen vitality. Root growth can also be hindered by low boron levels. Deficiency or toxicity of boron causes severe reduction in the yield of crop, which is due to the metabolic events involving boron.**Ahmad et al., 2009[16]** reported that the sexual reproduction in plants is more sensitive to boron deficiency as compared to vegetative growth of crop.It helps regulate the metabolism and support the healthy bones intensity. It also plays an important role in brain functions, immune system function and antioxidant properties for different body systems. In humans, boron deficiency signs and symptoms have not been firmly established. Limited data suggest that boron deficiency might affect the function of brain by reducing mental alertness and impairing executive functions of brain.

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.2. MATERIAL AND METHODS

A field experiment was carried out at the Research Farm of the School of Agriculture, Abhilashi University, Chail Chowk, Mandi (H.P.) during the *Kharif* of 2023. The experimental farm is situated at 30^0 32' N latitude and 74^0 53' E longitudes, with an elevation of 1391 m above mean sea level. The soil of the experimental field was slightly acidic in reaction, medium in organic carbon, low in available nitrogen and medium in available phosphorus and potassium. The pH of the experimental soil was slightly acidic in reaction, which is 6.30 with an electrical conductivity of 0.08dS m^{-1}), medium in organic carbon (0.63%), low in available nitrogen (198.61 kg ha^{-1}), medium in available phosphorus (10.37 kg ha^{-1}) and potassium (288.15 kg ha^{-1}), deficient in Zn (0.86 mg kg^{-1}) and B (0.74 mg kg^{-1}). The spacing for the tested variety (Hybrid corn-9220) was 60 × 20 cm row to row and plant to plant. The experiment was laid out in a randomized block design (RBD) with seven treatments and three replications. The treatments, *viz*,T_1= Absolute control, T_2= Seed priming with water, T_3= Seed priming with 0.5% $ZnSO_4$, T_4= Seed priming with 1% $ZnSO_4$, T_5= Seed priming with 0.01% borax, T_6= Seed priming with 0.05% borax and T_7= Seed priming with 0.1% borax. For seed priming the solution of micronutrients (zinc and boron) were mixed in 50 litre of water in which seed of maize will be soaked for 24 hours before sowing of crop. Plant samples were collected from the each treatment after harvest of the crop and they were cleaned and shade dried. Later, the shade dried samples were oven dried at 60 ± 50º C for 24 hours till their weight were constant and the samples than finely powdered using a mixer grinder. The finely grind plant samples were used for the analysis of N, P, K, Zn and B content and their uptake by maize crop. The estimation of the nitrogen content in the plant samples was done by the modified Kjeldahl's digestion and distillation method as described by **(Jackson, 1973)[17]**..The phosphorus content in the plant was determined by the venadomolybdate phosphoric yellow color method and the phosphorus content in the plant samples was estimated using a spectrophotometer as described by **(Jackson, 1973)[17]**. Potassium content in plant sample of maize was determined by using flame photometer **(Jackson, 1973)[17]**. The zinc content in plant samples was determine by di acid method with estimation by AAS **(Lindsay and Norvell, 1978)[18]**. The boron content in sample of maize is determined by using the Azomethine-H method by **(Gupta 1979)[19]**. The N, P, K (kg ha^{-1}), Zn, B (mg ha^{-1}) uptake by grains and stover of maize in each treatment was calculated by multiplying the N,P,K (%) and Zn, B (mg kg^{-1}) with yields of grains and stover (q ha^{-1}). The total uptake of different nutrients was calculated after sum of their uptake by grain and stover of maize crop..

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3. RESULTS AND DISCUSSION

3.1 Nitrogen (N) content (%) and uptake (kg ha^{-1})

The nitrogen content and their uptake by maize crop are presented in Table1 and depicted in Fig.1.The nitrogen content in grains and stover of maize crop were significantly increased by the seed priming treatments in this study. However, the mean value of data showed that the maximum N content in grains and stoverof maize crop were recorded in treatment T_7(Seed priming with 0.1% borax), which was statistically at par with T_3(Seed priming with 0.5% $ZnSO_4$). While, minimum nitrogen content in grains and stoverwere noted under the T_1 (Absolute control).

Like the nitrogen content, their uptake by grains and stoveras well as total uptake by maize crop were also recorded highest in T_7(Seed priming with 0.1% borax) which was significantly on par with treatment T_3(Seed priming with 0.5% $ZnSO_4$). Whereas, the minimum nitrogen uptake by grains and stover of maize crop was recorded under the treatment T_1(Absolute control).

The nitrogencontent and uptakewas increased with Zn and B seed priming which might be associated with the enhanced enzymatic activities which are responsible for the better nitrogen uptake in the crop. The aim of nutrient seed priming is to increase the nitrogen content along with the priming effect to improve the seed quality and better crop establishment (**Imran et al. 2013)[20]**. This is particularly important since seedling growth is maintained by seed mineral nutrient reserves until root uptakes commences supplying the nutrients for grains and stover of crop **(Muhammad et al. 2015)[21]**. The total nitrogen uptake was high in seed priming with boron. B influences nitrogen metabolism and uptake through its effects on enzymes, membrane function, and nutrient interactions. The results is correlated by **(Asokon, 2005)[22]**.

Table 1. Effect of seed priming with zinc and boron on nitrogen content (%) and uptake (kg ha^{-1}) by maize crop

S.N.	Treatments	Nitrogen content (%)		Nitrogen uptake (kg ha^{-1})		
		Grains	Stover	Grains	Stover	Total
T_1	Absolute control	1.06	0.33	29.33	13.00	42.33
T_2	Seed priming with water	1.08	0.39	50.22	22.79	73.01
T_3	Seed priming with 0.5% $ZnSO_4$	1.22	0.47	63.84	32.08	95.92
T_4	Seed priming with 1% $ZnSO_4$	1.10	0.40	51.94	24.26	76.20
T_5	Seed priming with 0.01% Borax	1.12	0.42	54.89	27.04	81.93
T_6	Seed priming with 0.05% Borax	1.11	0.41	53.77	25.24	79.01
T_7	Seed priming with 0.1% Borax	1.24	0.48	66.22	33.80	100.02
SE(m)±		**0.03**	**0.01**	**0.78**	**0.78**	**2.40**
CD (P=0.05)		**0.04**	**0.04**	**5.41**	**2.48**	**7.48**

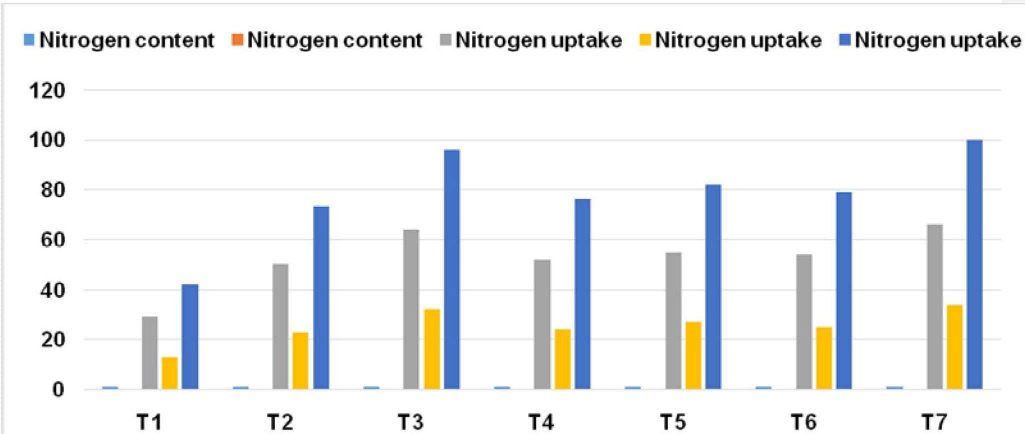

Fig.1.Effect of seed priming with zinc and boron on nitrogen content (%) and uptake (kg ha^{-1}) by maize crop

3.2 Phosphorus (P) content (%) and uptake (kg ha^{-1})

The phosphorus content and their uptake by maize are shown in Table 2 and illustrated in Fig. 2. The study states that there were significant difference in the P content and their uptake by the grains,stoverand total uptake by maize through seed priming with zinc and boron. The highest P content in grains and stover of maize crop was noted under the treatment T_7(Seed priming with 0.1% borax), which was statistically at par with T_3(Seed priming with 0.5% $ZnSO_4$).However, the lowest P content in grains and stover of maize was recorded under the treatment T_1(Absolute control). During the study, the highest P uptake by grains,stoverand total uptake bymaize crop was recordedunder treatment T_7 (Seed priming with 0.1% borax), which was statistically on par with treatment T_3(Seed priming with 0.5% $ZnSO_4$). Whereas, the minimum P uptake by maize grains,stover and total uptake was observed in treatment T_1 (Absolute control) during field study.

The content and uptake of phosphorus were found higher with seed priming with zinc and boron, which enhance the various enzymatic activity and nitrogen in crop plants which mightimprove the efficacy of phosphorus absorbing mechanisms and encourages the root growth, which helps in the phosphorus uptake by the crop of maize. Some comparable outcomes were also discovered by**(Farooq et al. 2019)[23]**.

Table 2. Effect of seed priming with zinc and boron on phosphorus content (%) and uptake (kg ha^{-1}) by maize crop

S.N.	Treatments	Phosphorus content (%)		Phosphorus uptake (kg ha^{-1})		
		Grains	Stover	Grains	Stover	Total
T_1	Absolute control	0.11	0.121	3.04	4.77	7.81
T_2	Seed priming with water	0.15	0.123	6.98	7.21	14.19
T_3	Seed priming with 0.5% $ZnSO_4$	0.25	0.145	13.08	9.87	22.95
T_4	Seed priming with 1% $ZnSO_4$	0.17	0.125	8.03	7.58	15.61
T_5	Seed priming with 0.01% Borax	0.20	0.100	9.80	6.39	16.19
T_6	Seed priming with 0.05% Borax	0.19	0.128	9.20	7.88	17.08
T_7	Seed priming with 0.1% Borax	0.26	0.149	13.88	10.51	24.39
SE(m)±		**0.01**	**0.04**	**0.77**	**0.47**	**0.89**
CD (P=0.05)		**0.02**	**0.01**	**2.40**	**1.48**	**2.77**

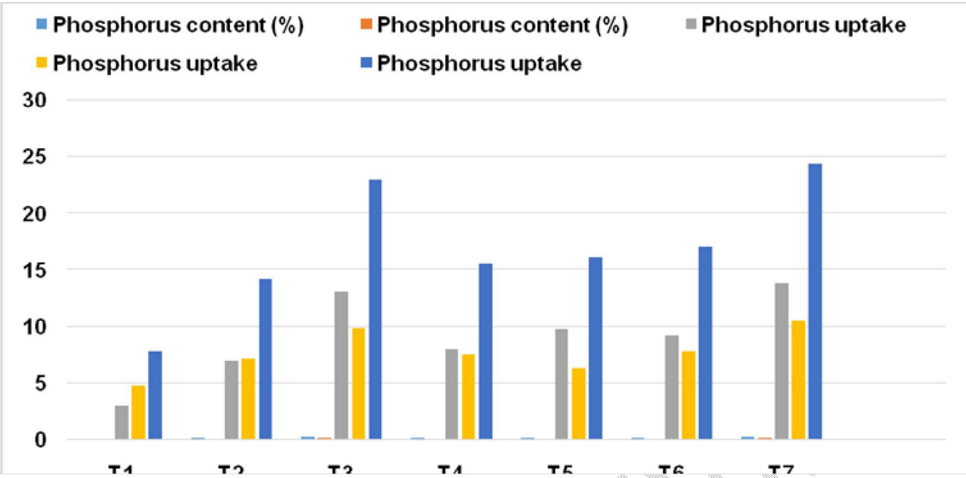

Fig 2. Effect of seed priming with zinc and boron on phosphorus content and their uptake by maize crop

3.3 Potassium (K) content (%) and uptake (kg ha^{-1})

The potassium content and their uptake by the maize crop are shown in Table 3 and presented in the Fig.3. The study of the data revealed that the data were significant to application of seed priming treatments with Zn and B. The maximum K content in grains and stover of the maize crop was recorded under the treatment T_7 (Seed priming with 0.1% borax), which was significantly at par with the treatment T_3(Seed priming with 0.5% $ZnSO_4$). However, the lowest K content in grains and stover of maize was noted under the treatment T_1 (Absolute control).

The maximum K uptake by grains,stoverand total uptake by maize crop was recorded under the treatment T_7 (Seed priming with 0.1% borax), which was statistically on par with treatment T_3 (Seed priming with 0.5% $ZnSO_4$) during the period of study. However, the minimum uptake of K in grains, stoverand total uptake by maizecrop were recorded under the treatment T_1 (Absolute control) during the field experiment.

The potassium content and uptake by maize crop was increasedwith seed priming of zinc and boron which might be due to the zinc and boron priming stimulated the activity of the different seed enzymes which enhances the content of potassium in maize crop. The similar results was given by **(Johnson et al. 2005)[24]**.

S.N.	Treatments	Potassium content (%)		Potassium uptake (kg ha^{-1})		
		Grains	Stover	Grains	Stover	Total
T_1	Absolute control	0.20	1.01	5.53	39.79	45.33
T_2	Seed priming with water	0.25	1.03	11.63	60.18	71.81
T_3	Seed priming with 0.5% $ZnSO_4$	0.36	1.17	18.84	79.63	98.46
T_4	Seed priming with 1% $ZnSO_4$	0.28	1.05	13.22	63.47	76.79
T_5	Seed priming with 0.01% Borax	0.32	1.07	15.68	68.56	84.25
T_6	Seed priming with 0.05% Borax	0.30	1.06	14.53	65.25	79.79
T_7	Seed priming with 0.1% Borax	0.37	1.19	19.76	84.02	103.78

SE(m)±	0.01	0.03	1.05	1.90	2.39
CD (P=0.05)	0.03	0.09	3.27	5.92	7.46

Table 3. Effect of seed priming with zinc and boron on potassium content (%) and uptake (kg ha^{-1}) by maize crop

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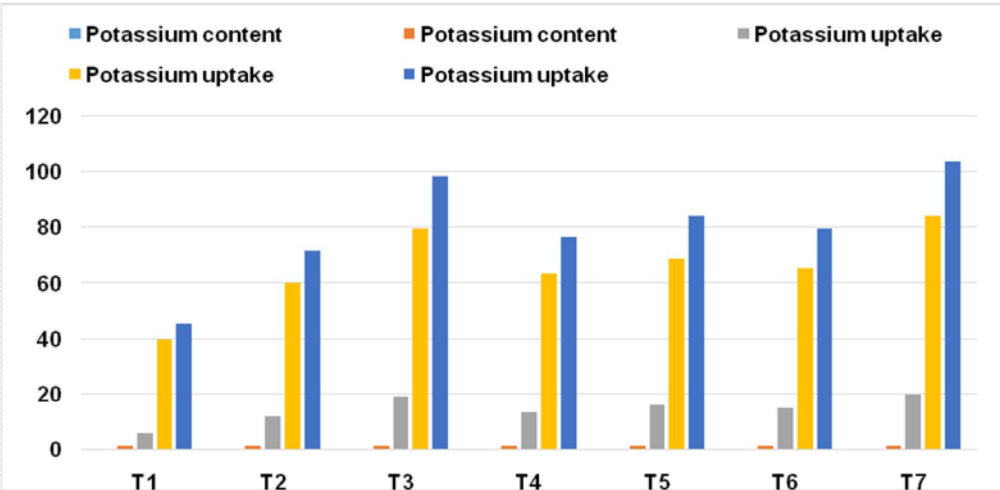

Fig 3. Effect of seed priming with zinc and boron on potassium content and their uptake by maizecrop

3.4Zinc (Zn) content(mg kg^{-1})and Zinc (Zn) uptake (mg ha^{-1})

The zinc content and their uptake by maize crop are presented in Table 4 and illustrated in Fig. 4. The study of the data states that theZn content in grains and stover of maize crop were significant to application of seed priming with Zn and B. However, the maximum Zn content in grains and stoverof maize crop was recorded under the treatment T_4(Seed priming with 1% $ZnSO_4$), which was statistically at par with the treatment T_3(Seed priming with 0.5% $ZnSO_4$). While, the minimum Zn content in grains and stover of maize crop were noted under the treatment T_1 (Absolute control) during field study.

The uptake of Zn by grains and stoveras well as total uptake was recorded significantly under treatment T_3 (Seed priming with 0.5% $ZnSO_4$),which was on par with treatment T_4 (Seed priming with 1% $ZnSO_4$)during the experiment. However, the minimum Zn uptake by grains,stover and total uptake by maize crop was found in treatment T_1(Absolute control).

Application of seed priming with Zn might enhance the root development and enzyme activity, facilitating the absorption of Zn by the crop of maize which might be the reason for higher content and uptake of zinc by maize crop. Zn is essential for various metabolic activity in plants, including the photosynthesis, formation of sugars, protein synthesis, fertilization and seed development. It regulates the physiological and molecular mechanisms, such as the response to the regulation of the hormones. Zn stimulates the production of chlorophyll, activity of photosynthesis, nutrient uptake, and protein biosynthesis in maize. Additionally, seed priming with Zn is helps in the ensuring a higher uptake by the maize crop. The results are similar with **(Shreshta et al 2019)[25]**..

S.N.	Treatments	Zinc content (mg kg^{-1})	Zinc uptake (mg ha^{-1})

		Grains	Stover	Grains	Stover	Total
T_1	Absolute control	32.23	35.98	891.79	1417.73	2309.52
T_2	Seed priming with water	37.97	41.86	1765.45	2445.88	4211.33
T_3	Seed priming with 0.5% $ZnSO_4$	47.03	55.36	2463.17	3778.55	6241.72
T_4	Seed priming with 1% $ZnSO_4$	49.14	59.16	2320.55	3587.55	5907.81
T_5	Seed priming with 0.01% Borax	39.48	45.23	1934.91	2889.29	4824.20
T_6	Seed priming with 0.05% Borax	39.56	45.69	1916.29	2812.68	4728.97
T_7	Seed priming with 0.1% Borax	39.61	45.71	2115.17	3218.44	5333.61
SE(m)±		**1.18**	**1.42**	**57.77**	**83.57**	**152.86**
CD (P=0.05)		**3.68**	**4.45**	**179.97**	**260.38**	**476.24**

Table 4. Effect of seed priming with zinc and boron on zinc content (mg kg^{-1}) and uptake (mg ha^{-1}) by maize crop

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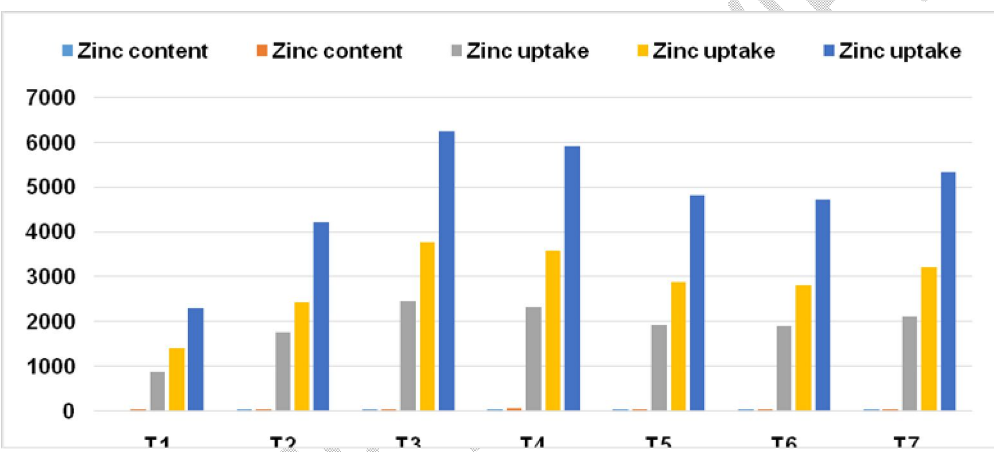

Fig 4. Effect of seed priming with zinc and boron on zinc content and their uptake by maize crop

3.5 Boron (B) content (mg kg^{-1})and uptake (mg ha^{-1})

The boroncontent and their uptake by maize crop are presented in Table 5 and illustrated in Fig. 5. The content of B in grains and stover of the maize crop were significantly affected by application of seed priming with Zn and B treatments used in this study duration. The maximum B content in grains and stover of the maize crop was recorded under the treatment T_7(Seed priming with 0.1% borax)which was at par with treatment T_5(Seed priming with 0.01% borax) and T_6(Seed priming with 0.05 borax).However, the minimum boron content in grains and stover of maize crop were recorded under the treatment T_1(Absolute control).

The uptake of boron by grains and stover of maize crop was recorded significantly maximum under the treatment T_7 (Seed priming with 0.1% borax). Whereas, the total uptake of boron was maximum under the treatment T_7 (Seed priming with 0.1% borax) was recorded. However, the minimum boron uptake by grains, stover and total uptake of maize crop was noted under treatment T_1 (Absolute control).

Application of boron with seed priming might enhance the content and uptake of the maize grain and stover, which might due to the boron plays a vital role in hormone metabolism in plants, it plays a role in synthesis and distribution of auxins, affecting the overall growth and yield which might facilitated thehigher boron content and uptake. Boron is also essential for the cell wall formation and strength. It contributes to the structural integrity of the plant cells, including in the maize. The boron application through seed priming has the content and uptake is higher than the application of Zn seed priming on crop of maize. The similar finding is given by **(Brown and Shelp, 1997)[26]**.

Table 5: Effect of seed priming with zinc and boron on boron content (mg kg^{-1}) and uptake (mg ha^{-1}) by maize crop

S.N.	Treatments	Boron content (mg kg^{-1})		Boron uptake (mg ha^{-1})		
		Grains	Stover	Grains	Stover	Total
T_1	Absolute control	12.08	8.76	334.25	345.28	679.53
T_2	Seed priming with water	16.45	10.18	764.93	594.82	1359.75
T_3	Seed priming with 0.5% $ZnSO_4$	17.30	11.82	905.48	806.49	1711.97
T_4	Seed priming with 1% $ZnSO_4$	17.34	12.60	818.79	764.06	1582.85
T_5	Seed priming with 0.01% Borax	20.60	15.87	1009.61	1013.78	2023.39
T_6	Seed priming with 0.05% Borax	21.33	16.89	1033.23	1039.75	2072.98
T_7	Seed priming with 0.1% Borax	22.23	17.04	1187.08	1199.86	2386.94
SE(m)±		**0.54**	**0.43**	**27.59**	**26.22**	**53.78**
CD @ 5%		**1.68**	**1.35**	**85.96**	**81.68**	**167.55**

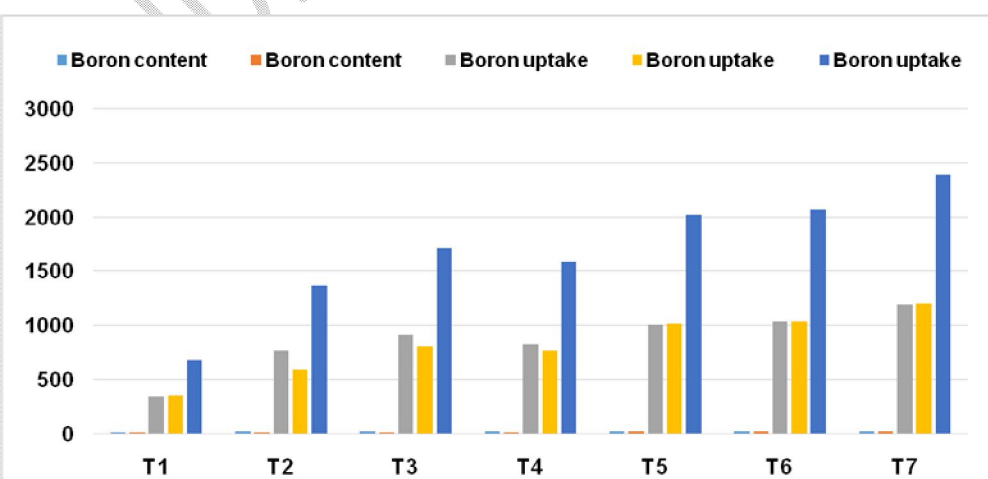

Fig 5. Effect of seed priming with zinc and boron on boron content and their uptake by maize crop

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4. CONCLUSION

This study concluded that the application of zinc and boron through seed priming method at different concentrations showed the significant effects on the content of various nutrients *viz.*- nitrogen, phosphorus, potassium, zinc and boron as well as their uptake by maize crop. The seed priming of maize crop by seed priming with 0.1% borax recorded the best values of nitrogen, phosphorus and potassium content in grains and stover of maize crop and this treatment also recorded the highest uptake of these nutrients by grains, stover as well as their total uptake by maize crop and it was statistically at par with the seed priming with 0.5% $ZnSO_4$. The zinc application by seed priming with 1% $ZnSO_4$ noted the higher content of zinc in grains and stover of maize which was on par with the application of seed priming with 0.5% $ZnSO_4$. However, uptake of zinc by grains, stover and total uptake by maize crop found maximum with 0.5% $ZnSO_4$ seed priming and was at par with 1% $ZnSO_4$ seed priming. The highest content of boron in grains and stover of maize crop were observed by 0.1% borax seed priming which was statistically comparable with seed priming of maize with 0.01% and 0.05% borax, however, significantly maximum uptake of boron by grains, stover and total uptake was recorded with 0.1% borax seed priming. Whereas, the minimum content of the nitrogen, phosphorus, potassium, zinc and boron in grains and stover of maize and their uptake by grains, stover as well as total uptake by maize crop were recorded with absolute control treatment during the field experiment.

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Comment [S20]: it is best to complete it with data

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