

Effect of sources and levels of zinc on growth rate, grain yield and economics in shalimar QPMH-1 hybrid

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Abstract: Zinc deficiency can result in significant losses in the yield of maize. Therefore, an experimental field trial was conducted at the Agronomy Research Farm, located within the Faculty of Agriculture, Wadura, Sopore SKUAST-Kashmir during *kharif* season 2021 to study the impact of various sources and levels of zinc on growth and yield performance of Quality Protein maize. The experiment consisted of two sources of Zinc viz. Zinc Oxide, Zinc Sulphate and five levels of Zinc viz. control, 0.25%, 0.50%, 0.75% and 1.0%, the setup followed a factorial complete block design, consisting of 3 replications. Zinc was applied as foliar spray @ 50 DAS. The findings of the experiment revealed significant variations in terms of growth, yield and economics for various treatments under investigation. Among the various treatments, application of zinc oxide at a concentration of 1%, exhibited superior performance in terms of plant growth attributes, yield components, and overall yield. It recorded the highest grain yield amounting to 53.92 q/ha. Additionally, the application of zinc oxide @ 1%

resulted in the highest net returns and a favourable benefit-to-cost (B:C) ratio of 1.75 followed by application of zinc oxide @ 0.75% and zinc sulphate @ 1%. Among all the treatments, lowest plant growth, yield and economic suitability was recorded with control (ZnSO₄). Hence, application of zinc oxide @ 1% was found economically suitable and sustainable followed by application of zinc oxide @ 0.75% and zinc sulphate @ 1%.

Keywords: Foliar application · Growth · QPM · ZnO · ZnSO₄ · Yield

Introduction

In India and the rest of the globe, maize (*Zea mays* L.) holds position as the third most important cereal crop, following wheat and rice. Maize is called a “miracle crop” since it has greater productivity potential than any other cereal crop and can be grown in both tropical and temperate climates. It is an essential staple diet for those residing in Asia, Africa and Latin America as well as the most significant fodder cereal for cattle.

Lysine and tryptophan, the two crucial amino acids are deficient in maize grain thereby poses the risk of nutritional deficiencies that can cause neurological disorders, kwashiorkor disease, appetite loss, defective skeletal development, growth retardation and abnormal behaviour. Researchers detected several mutants in maize, specifically Opaque-2, which are responsible for increased lysine and tryptophan concentration. The cultivars that showed improved agronomic performance and protein quality were termed as Quality Protein Maize (QPM) (Vivek *et al.*, 2008).

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All across East Asia, pervasive zinc (Zn) deficiency has been identified, with India and Pakistan accounting for between 50 and 70% of cases. Cereal grains are found to be severely deficient in Zinc, particularly in areas where soils contain insufficient plant-available Zn (Shivay and Prasad, 2012). The majority of micronutrient deficiency issues are made worse by the use of high yielding crop varieties, which quickly exhaust the scarce soil nutrients (Martens and Lindsay, 1990). As a result, correcting Zn shortage in farming systems based on cereal is made more difficult.

As Zn is involved in auxin metabolism, enhanced assimilate partitioning towards reproductive portions, grain production depends on it in a critical way. Zn fertilization therefore enhances plant development and growth, yield characteristics, and yield. Zn contributes to protein biosynthesis, which is a key component in the growth of the maize crop since Zn is required for the structural and functional integrity of around 2,800 proteins (Broadley *et al.*, 2007). Better uptake and utilization of Zn can be achieved through proper method of nutrient application which includes the foliar spray of micronutrients that can efficiently enhance the crop productivity. To optimize the potential crop yield, one effective method is the application of micronutrients through foliar spraying. This approach offers a straightforward and rapid means to enhance the nutritional status of maize plants. Zn is delivered directly to the foliage in foliar sprays, which accounts for its efficacy. Numerous deciding factors, including as nutrient penetration, absorption, and translocation, influence plant response to the foliar application.

The application of Zn as foliar spray on quality protein maize may help to cater with nutritional deficiencies present in the crop. With all of these aspects in mind, it was thought worthwhile to conduct research on our hybrid to assess the performance under different zinc sources and levels.

Material and methods

The field investigation entitled “Performance of quality protein maize under different sources and levels of zinc” was conducted during the *kharif* season of 2021 at the Experimental Farm of the Division of Agronomy, Sopore, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir.

The experimental site, geographically, is situated at coordinates 34°21' N and 74°23' E, with an elevation of 1590 meters above mean sea level. The soil of the research trial exhibited a silty clay loam texture analysed by hydrometer method (Byoucoux *et al.*, 1962). It had moderate levels of organic carbon (0.76%), estimated with Walkley and Black's rapid titration method (Walkley and Black, 1934), sufficient amounts of available nitrogen, phosphorus, and potassium (308, 16.75, 177.65 kg/ha, respectively) estimated with Alkaline permanganate method (Subbiah and Asija, 1956), Olsen's method NaHCO_3 (Olsen *et al.*, 1954) and Ammonium acetate extract method (Jackson, 1973), respectively. However, it displayed deficient levels of available Zn (0.68 mg/kg) which was evaluated with DTPA (diethylenetriaminepentaacetic acid) extractable method (Lindsay and Norvell, 1978). The pH of the soil was neutral (6.74) with normal EC (0.37dS/m) determined with the help of Digital glass electrode pH meter (Jackson, 1973) and Solou-bridge conductivity meter (Jackson, 1973).

The data indicated that the weekly minimum temperature ranged from 7.3°C to 19.4°C, while the maximum temperature fluctuated between 24.4°C and 32.6°C. Throughout the entire cropping period in 2021, the total precipitation accumulated to 190.7 mm (Figure 1).

The experiment was set up with two factors with ten treatments (T_1 : ZnO @ 0.25%, T_2 : ZnO @ 0.50%, T_3 : ZnO @ 0.75%, T_4 : ZnO @ 1.0%, T_5 : ZnO Control, T_6 : ZnSO_4 @ 0.25%, T_7 : ZnSO_4 @ 0.50%, T_8 : ZnSO_4 @ 0.75%, T_9 : ZnSO_4 @ 1.0%, T_{10} : ZnSO_4 Control). The experiment was performed using a randomized complete block design and replicated three times. A regional hybrid called Shalimar QPMH-1 developed by SKUAST-Kashmir was used in the study. Different observation recorded with respect to growth and yield are as under:

Plant height: Plant height was assessed as mean of five randomly chosen and labelled plants, beginning from the base and extending up to the end tip of the flag leaf in net plot area of each treatment at 20, 40, 60, 80, 100 DAS and at harvest.

Relative growth rate: The relative growth rate was determined by using the given formula and expressed in mg/g/day (Watson *et al.*, 1952).

$$\text{RGR} = \frac{\ln w_2 - \ln w_1}{T_2 - T_1}$$

Where, W_1 and W_2 = plant dry weight (g) (at time T_1 and T_2 , respectively)

$T_2 - T_1$ = time interval of sampling (in days)

Ln = natural log

Crop growth rate: The crop growth rate was determined by using the provided formula (Redford, 1967) and was expressed in $g/m^2/day$.

$$CGR = \frac{w_2 - w_1}{T_2 - T_1}$$

Where, W_1 and W_2 are the plant dry weights (g) at times T_1 and T_2 , respectively.

$T_2 - T_1$ = time interval of sampling in days

Days taken to phenological stages: The number of days required from the sowing date to attain 50% of knee height, 50% of tasseling, 50% of emergence of silk were examined, counted and recorded from each treatment.

Cob diameter: Cob girth of five observational cobs in each plot was measured and the value was divided by 3.14. The results were averaged average and expressed as cob diameter in centimetres.

Number of kernel rows per cob: After summing the rows on each cob under observation, the mean value of kernel rows per cob was determined.

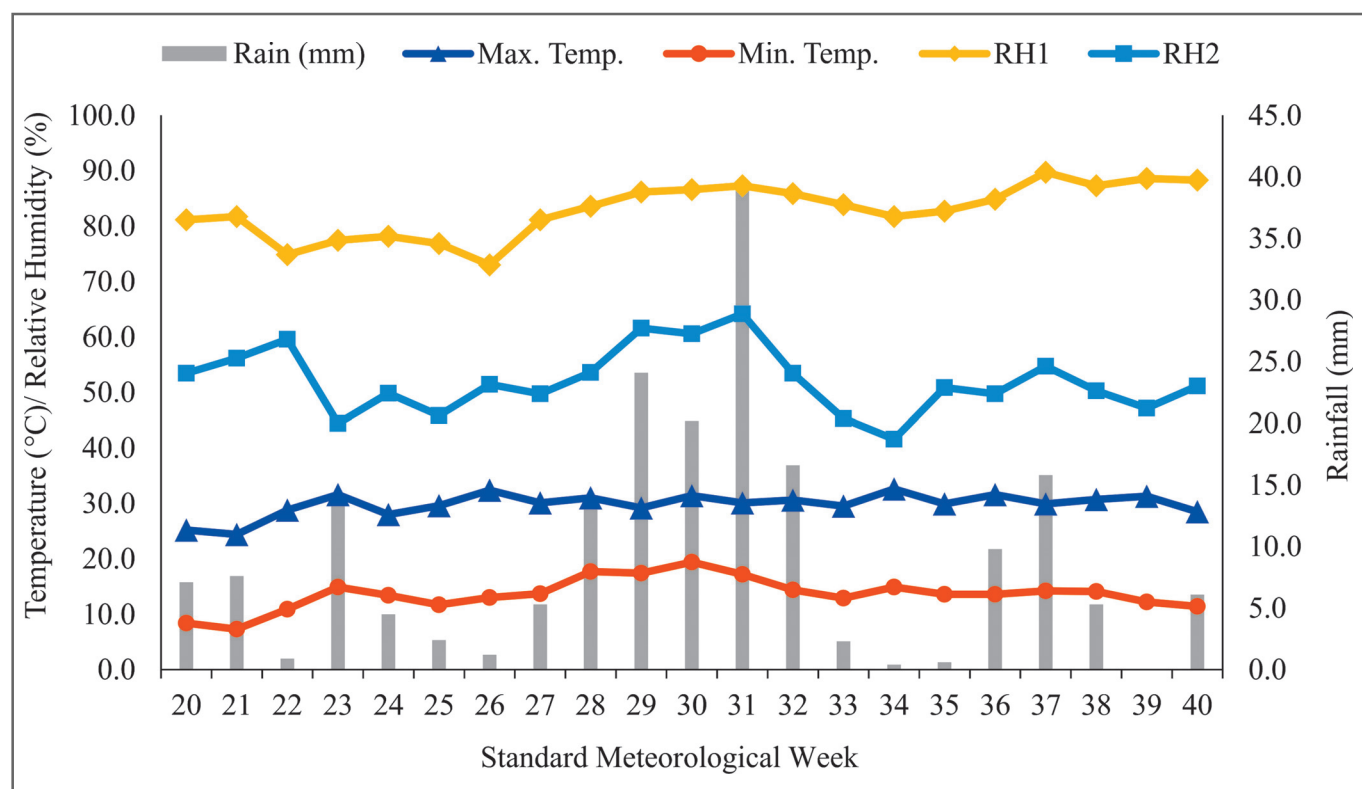
Grain yield: The cobs were manually shelled and properly sun dried after being collected from net plots. The cumulative weight was measured in kilograms and then demonstrated as grain yield in q/ha .

Harvest index: The ratio of economic yield (grain yield) to the biological yield (grain + stover yield) was used to determine the harvest index, represented as a percentage (Donald and Hamblin, 1976).

$$\text{Harvest index (HI)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Relative economics: For each treatment, the cultivation costs and gross profits were estimate during the prices of the current market. The following formula was used to calculate the benefit cost ratio:

$$\text{B:C ratio} = \frac{\text{Net returns}}{\text{Total cost of cultivation}}$$



*RH1 and Rh2 are morning and evening relative humidity

Figure 1. Mean weather condition during crop growing period (kharif 2021)

To assess the impact of zinc sources and levels upon the growth and productivity of QPM (Quality Protein Maize), the experimental data was evaluated through statistical analysis by applying analysis of variance (ANOVA) within a randomized complete block design (RCBD) in a factorial arrangement. The significance of treatments was evaluated adopting the F-test at 0.05 level of significance. The critical difference was estimated to compare the effects of various treatments in situations where statistically significant data were obtained $p < 0.05$.

Results and discussion

Growth parameters

Both sources and levels of zinc significantly influenced almost all the growth characters except in different phenological phases in case of sources of zinc and control treatment. Zinc oxide measured significantly greater plant height at 60 DAS (158.56 cm), 80 DAS (188.50 cm), 100 DAS (194.05 cm), and at harvest (195.36 cm) respectively, compared to zinc sulphate application, which recorded significantly lower plant height of 153.10 cm, 182.26 cm, 188.22 cm, 190.07 cm at 60 DAS, 80 DAS, 100 DAS and at harvest, respectively. Zinc application observed significantly higher plant height at 60 DAS, 80 DAS, 100 DAS and at harvest (166.21 cm, 197.79 cm, 203.85 cm and 204.44 cm) with the application of 1% solution than all other concentrations except with 0.75%. Lower plant height of 146.41 cm, 176.10 cm, 180.27

cm and 180.87 cm among the zinc levels was reported in control treatment at 60 DAS, 80 DAS, 100 DAS and at harvest, respectively.

Application of zinc oxide recorded significantly higher CGR at 40-60 DAS (26.76 g/m²/day), 60-80 DAS (26.91 g/m²/day) whereas, zinc sulphate application registered significantly lower CGR at 40-60 DAS (24.21 g/m²/day), 60-80 DAS (26.39 g/m²/day). Among the levels, significantly maximum value for CGR of 31.61 g/m²/day at 40-60 DAS, 5.87 g/m²/day at 80-100 DAS was recorded with application of 1% zinc. At 60-80 DAS significantly higher CGR of 28.55 g/m²/day was obtained with the application of 0.50% of zinc solution in terms of levels of zinc.

Application of zinc oxide registered significantly higher RGR of 39.26 mg/g/day at 40-60 DAS, 1.30 mg/g/day at 100-120 DAS. At 60-80 DAS and at 80-100 DAS application of zinc sulphate recorded higher value for RGR of 22.72 mg/g/day and 3.58 mg/g/day, respectively. Significantly lower value for RGR was registered with application of zinc sulphate at 40-60 DAS (36.99 mg/g/day) and at 100-120 DAS (mg/g/day). With the application of zinc oxide, significantly lower RGR was observed at 60-80 DAS and 80-100 DAS, with values of 22.02 mg/g/day and 3.19 mg/g/day, respectively. Among the levels of zinc, significantly higher value for RGR of 44.18 mg/g/day at 40-60 DAS was registered with 1% zinc concentration followed by application of 0.25% at 60-80 DAS (23.80 mg/g/day), control at 80-100 DAS (3.65 mg/g/day) and 0.25% at 100-120 DAS (1.34 mg/g/day).

Table 1. Effect of different sources and levels of zinc on plant height (cm) at different growth stages of QPM

Treatments	Plant height (cm)					
	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS
<i>Sources of zinc</i>						
ZnO	22.17	63.84	158.56	188.50	194.05	195.36
ZnSO ₄	22.19	61.44	153.10	182.26	188.22	190.07
SEm±	2.74	2.54	1.60	1.11	1.47	1.58
C.D(P≤0.05)	NS	NS	4.81	3.33	4.40	4.74
<i>Levels of zinc</i>						
Control	21.89	59.77	146.41	176.10	180.27	180.87
0.25%	22.12	61.55	151.60	178.76	184.36	187.71
0.50%	22.11	62.33	154.94	184.27	189.83	192.52
0.75%	22.39	63.38	159.99	189.99	197.37	198.05
1.0%	22.39	66.16	166.21	197.79	203.85	204.44
SEm±	4.33	4.02	2.54	1.75	2.32	2.50
C.D(P≤0.05)	NS	NS	7.61	5.26	6.96	7.50

Table 2. Effect of different sources and levels of zinc on CGR (g/m²/day)

Treatments	CGR (g/m ² /day)				
	20-40 DAS	40-60 DAS	60-80 DAS	80-100 DAS	100-120 DAS
<i>Sources of zinc</i>					
ZnO	15.28	26.76	26.91	4.91	2.14
ZnSO ₄	15.08	24.21	26.39	5.36	1.99
SEm±	0.11	0.77	0.18	0.20	0.18
C.D(P≤0.05)	NS	2.31	0.49	NS	NS
<i>Levels of zinc</i>					
Control	15.08	18.07	22.49	4.69	1.82
0.25%	15.08	24.01	27.83	5.04	2.12
0.50%	15.08	25.47	28.55	5.04	2.12
0.75%	15.33	28.25	27.64	5.05	2.12
1.0%	15.33	31.61	26.77	5.87	2.12
SEm±	0.14	1.22	0.33	0.25	0.22
C.D(P≤0.05)	NS	3.65	1.04	0.78	NS

Table 3. Effect different sources and levels of zinc on RGR (mg/g/day)

Treatments	RGR (mg/g/day)				
	20-40 DAS	40-60 DAS	60-80 DAS	80-100 DAS	100-120 DAS
<i>Sources of zinc</i>					
ZnO	58.59	39.26	22.02	3.19	1.30
ZnSO ₄	58.54	36.99	22.72	3.58	1.26
SEm±	0.66	0.62	0.22	0.07	0.01
C.D(P≤0.05)	NS	1.87	0.61	0.18	0.03
<i>Levels of zinc</i>					
Control	57.22	29.79	22.21	3.65	1.34
0.25%	58.99	37.07	23.80	3.33	1.34
0.50%	58.66	38.59	23.60	3.23	1.29
0.75%	58.96	41.01	21.94	3.16	1.25
1.0%	58.97	44.18	20.31	3.57	1.20
SEm±	1.04	1.02	0.33	0.11	0.02
C.D(P≤0.05)	NS	3.01	0.90	0.29	0.07

The enhancement in the growth characteristics viz., plant height, CGR, RGR recorded in present study could be attributed to activation of auxin metabolism due to zinc leads to vigorous growth of meristematic tissue through cell elongation and cell enlargement at the shoot apex. Similar results have been obtained by Krishnaraj *et al.* (2020) in maize. Enhanced plant height due to zinc oxide spray could be attributed to the reason that zinc oxide provides more zinc to the plant than zinc sulphate does. Torabian *et al.* (2016) reported that foliar zinc oxide spray enhanced the plant height in sunflower. Foliar zinc oxide spray improved the shoot length of plants as reported by

Sadak and Bakry (2020) in flax. Similar outcomes were found by Tariq *et al.* (2021) in onion.

Since zinc is an important co-factor of various enzymes, higher doses of zinc may favorably effect energy and carbohydrate metabolism, stress responses and internodal distance which may contribute to taller plants with application of higher doses of zinc and improved values of tryptophan, a precursor of auxin and indole acetic acid, may lead to increase in growth. The increased plant height could be attributed to involvement of zinc in growth and development due to its catalytic impact in the metabolism of nearly all crops as reported by

Ehsanullah *et al.* (2015). Yasin *et al.* (2017) reported that 1% foliar application of zinc considerably increased plant height in maize.

Duration of phenological stages

Days taken to attain knee height, 50% tasseling, and 50% silking did not significantly vary with the application of various sources of zinc. However, a significant impact was noted in days taken to attain seed maturity. Zinc sulphate application observed significantly less days to reach seed maturity (112.26) than zinc oxide application, which noted significantly more days (113.86).

Application of 1% solution of zinc took longest number of days to achieve 50% tasseling (68.66), 50% silking (72.81) and seed maturity (115.83) compared to all other levels of zinc application except with 0.75% which was statistically at par with 1%. Significantly lesser number to days were taken to reach 50% tasseling (64.61) and 50% silking (70.18) and seed maturity (108.83) under control.

The administration of various sources of zinc had no significant influence on the number of days needed to reach distinct phenological phases, such as 50% tasseling and 50% silking, with the exception of seed maturity, where significant influence of zinc sources was noticed. These results are in coherence with Noreen and Kamran (2019). This could be due to the fact that foliar zinc treatment improved zinc absorption which could lead to higher uptake of nitrogen causing enhanced vegetative

growth of plant prior to the reproductive stage. These findings obtained are in coherence with the Gul *et al.* (2011). The various phenophases took less number of days to complete under control, which could be attributed to the crop sensitivity to the zinc deficiency, thus reducing the calendar days of different phenological stages.

Yield attributes

Zinc oxide application recorded significantly greater cob diameter of 6.05 cm than zinc sulphate application which realised significantly lower cob diameter of 5.69 cm. However, number of kernel rows per cob was found non-significant with numerically higher number of rows per cob (12.50) was found with application of zinc oxide than with the application of zinc sulphate (12.13). Among the levels of zinc, 1% concentration recorded significantly more number of kernel rows per cob (12.77) and higher cob diameter (6.55 cm) compared to all other levels of zinc. Significantly lower number of kernel row per cob (11.99) and cob diameter (4.39 cm) was observed in absolute control. The foliar treatment of various sources of zinc using zinc oxide as opposed to zinc sulphate had a significant impact on cob diameter. However, the number of kernel rows per cob were not significantly influenced by the various zinc sources. It is possible that the higher values observed in yield-related parameters could be attributed to the stimulation of photosynthesis-related enzymes, assimilation, and by the transfer of photosynthates from source to sink. Enhanced crop

Table 4. Effect of different sources and levels of zinc on number of days taken to different phenological stages of QPM

Treatments	Phenological Stages			
	Knee high	Tasseling	Silking	Seed maturity
<i>Sources of zinc</i>				
ZnO	37.04	67.10	72.08	113.86
ZnSO ₄	35.81	66.79	71.81	112.26
SEm±	0.66	0.13	0.11	0.42
C.D(P≤0.05)	NS	NS	NS	1.27
<i>Levels of zinc</i>				
Control	35.60	64.61	70.18	108.83
0.25%	36.77	66.22	71.90	112.33
0.50%	36.21	67.09	72.09	113.50
0.75%	35.72	68.13	72.74	114.83
1.0%	37.83	68.66	72.81	115.83
SEm±	1.04	0.20	0.18	0.67
C.D(P≤0.05)	NS	0.61	0.54	2.02

metabolic activity, growth, and development as well as improved source activity brought on by zinc treatment to the foliage could also be attributed to the improved yield characteristics. Priya *et al.* (2020) has reported similar findings in maize crop. Among the different zinc levels, treatment with 1% solution observed significantly highest value for cob diameter and kernel rows per cob. Significantly lower values for these parameters were recorded under control treatment. Higher percentage of zinc might have enhanced partitioning of assimilates towards the reproductive part, improving the yield attributes. Anjum *et al.* (2017) and Peddapuli *et al.* (2021) both found comparable findings in maize.

Grain yield and harvest index

Zinc oxide application resulted in significantly higher grain (53.92 q/ha) yield than zinc sulphate which reported significantly lower grain (50.75 q/ha) yield. Application of 1% zinc solution produced significantly increased grain (59.10 q/ha) yield in comparison to all other concentrations of zinc. Lower grain (41.9 q/ha) yield was registered under control treatment.

Sources of zinc significantly influenced the harvest index of maize. Application of zinc oxide recorded higher harvest index value (41.87) than with the application of zinc sulphate (41.32). Among the zinc levels, application of 0.75% zinc solution resulted in significantly higher value of harvest index (42.23) which was noted to be

statistically at par with all the other treatments except control treatment. The harvest index of control treatment recorded significantly lower value (39.54).

The foliar application of various sources and concentrations of zinc had a significant influence on the grain yield of QPM. Notably, the use of zinc oxide as compared to zinc sulphate resulted in significantly increased grain yield produce along with harvest index. The larger proportion of zinc in zinc oxide compared to zinc sulphate might be the cause of the improved yield brought on by the application of zinc oxide. Sangma *et al.* (2017) reported that zinc oxide along with urea improved the yield in maize. The enhanced availability of zinc could be responsible for initiating pyrophosphates activities and enzymatic reactions (Anjum *et al.*, 2017) in maize. Foliar treatment of zinc increases the nitrogen absorption and protein quality which may improve the growth and yield parameters of the maize crop (Potarzycki and Grzebisz, 2009; Peddapuli *et al.*, 2021).

In terms of levels of zinc, application of 1% zinc recorded statistically higher grain yield than other concentrations except harvest index which was recorded highest with 0.75%. Control treatment resulted in significantly lower yield. Ruffo *et al.* (2015) reported that zinc application at higher levels recorded higher yield compared to control treatment in maize crop. The observed improvement in yield might be due to the optimization of zinc dosage in conjunction with a balanced application of NPK (nitrogen, phosphorus, and potassium),

Table 5. Effect of different sources and levels of zinc on yield attributes and yield of QPM

Treatments	Yield attributes		Yield	
	Cob diameter (cm)	No. of kernel rows/cob	Grain yield (q/ha)	Harvest index (%)
<i>Sources of zinc</i>				
ZnO	6.05	22.60	53.92	41.87
ZnSO ₄	5.69	21.61	50.75	41.32
SEm±	0.05	0.27	0.32	0.14
C.D(P≤0.05)	0.16	0.81	0.97	0.44
<i>Levels of zinc</i>				
Control	4.39	21.66	41.90	29.54
0.25%	6.02	22.07	50.25	41.77
0.50%	6.13	22.31	53.35	41.95
0.75%	6.28	22.53	57.10	42.23
1.0%	6.55	23.37	59.10	42.10
SEm±	0.07	0.58	0.51	0.34
C.D(P≤0.05)	0.22	NS	1.54	1.02
Interaction	NS	NS	NS	NS

Table 6. Effect of different sources and levels of zinc on relative economics of QPM

Treatments	Total cost (000 Rs./ha)	Gross returns (000 Rs./ha)	Net returns (000 Rs./ha)	B:C ratio
<i>ZnO</i>				
Control	60.199	120.149	59.950	1.00
0.25%	60.574	146.941	86.367	1.43
0.50%	60.949	157.549	96.600	1.58
0.75%	61.324	166.161	104.837	1.71
1.0%	61.699	170.023	108.324	1.75
<i>ZnSO₄</i>				
Control	60.199	117.703	57.504	0.96
0.25%	60.304	135.841	75.537	1.25
0.50%	60.409	142.061	81.652	1.35
0.75%	60.514	154.190	93.676	1.55
1.0%	60.619	161.725	101.106	1.67

Input cost: Seed= Rs. 120 kg/ha, Urea= Rs. 7 kg/ha, MOP= Rs. 19 kg/ha, DAP= Rs. 24 kg/ha, ZnO= Rs. 250 kg/ha, ZnSO₄= Rs. 90 kg/ha, labour= Rs. 400/day Output Cost: Grain= Rs. 25/kg, Stover= Rs. 2 kg/ha

which might improve developmental factors and yield characteristics. Yasin *et al.* (2017) specified that foliar application of zinc @ 1% considerably increased the yield of maize. These results are lined up with those of Amanullah *et al.* (2016); Waseem *et al.* (2011) in maize crop and by Dawar *et al.* (2022) in wheat.

Relative economics

The different sources and levels of zinc resulted in a significant impact on various economic parameters. Specifically, when 1% zinc oxide was applied, it led to higher cost of cultivation, gross and net returns along with highest benefit-to-cost (B:C) ratio of 1.75. However, it is important to note that these values were statistically similar to those obtained with 0.75% zinc oxide and 1% zinc sulphate. Compared to other treatments, lowest B:C ratio was observed with zinc sulphate control. Higher biomass accumulation, better utilization of zinc along with RDF and effective translocation to the reproductive portions due to a sufficient supply of zinc fertilizers might be the cause of the increased crop yield, which results in the highest possible gross and net returns. Sangma *et al.* (2017) reported that zinc oxide along with urea had a synergistic effect on the yield of maize which might lead to increased return of the crop. Kumar and Bohra (2014) also reported that application of zinc as zinc oxide along with RDF registered maximum gross returns, net returns and benefit cost ratio. Similar outcomes were also reported by Rodinpuia *et al.* (2019); Venkateswarlu *et al.* (2022) in maize.

Conclusion

Zinc is an important mineral involved in catalytic activity, energy and carbohydrate metabolism. The present study validated the premise that zinc fertilization could be favourably used to enhance yield and its components in maize. It is recommended that zinc oxide @ 1% should be incorporated in the package and practices for maize zinc fertilization for maize to get higher yield and yield components with better profitability in case of QPM hybrid.

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