

**Research article**

## Response of maize crop to various levels of micro-nutrient application under rain-fed conditions of Azad Kashmir

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### HIGHLIGHTS

- Response of maize crop to various levels of micro-nutrient application
- Effect of micro-nutrient on maize grain yield
- Economic analysis of maize grain yield

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### How to cite

Bashir, M. B., M. A. Almas and N. B. Khan. 2018. Response of maize crop to various levels of micro-nutrient application under rain-fed conditions of Azad Kashmir. Appl. Agric. Biotechnol., 3(1): 29-33

### ABSTRACT

The experiment was conducted to study the response of maize crop to various levels of micro-nutrient application under rain-fed conditions at three different locations of Azad Kashmir in 2016. The experiment layout was in randomized complete block design (RCBD) with 5 treatments and 4 replications. Treatments were different levels of micro-nutrients with basal dose of NPK. Analysis of results showed that application of micro-nutrient (Zn, B & Cu @ of 2:1:2 kg/ha) along with macro-nutrients in maize crop gave significantly high yields in District Muzaffarabad and Kotli. Value cost ratio showed that farmers can get 2 to 4 time more profit by the use of Zn, B & Cu in maize crop. Relationship of nutrients in plant and soil gave positive co-relation ( $P=0.05$ ), that means greater the nutrients in the soil more nutrient will be absorb by the plants.

**Key words:** Maize, rain-fed, micro-nutrient, value cost ratio, zinc, boron, copper

### 1. Introduction

Maize (*Zea mays*) is the third most important cereal of the world after wheat and rice (Fageria et al, 1979). It is also a major crop of AJK and is cultivated on an area of 249181 acres. Its average production is 687 Kg per acre in AJK but is carried out without any information of the nutritional status of the soil

resulting into imbalance use of fertilizer that not only restrict the farmers to obtain optimum yields but it might cause environmental problems. Maize is grown as mono-crop in the uplands of northern part of the state that receives more than 1600 mm of rain with very cold winter and mild summer. Maize and wheat are grown in rotation in southern part of AJK where temperature is relatively high.

Large number of experiments conducted on response of maize crop to macro and micro nutrients has shown a significant response of crop to the nutrients applied. Maize grain yield was significantly increased by combined application of Zn and Cu @ 5kg ha<sup>-1</sup> each over NPK (Bhatti et.al. 1985). A maximum yield of 5676 kg ha<sup>-1</sup> was obtained in the treatment where Zn and potash was applied @ 10 and 90 kg ha<sup>-1</sup> respectively. Significant response of Zn was noted at 10 kg ha<sup>-1</sup> over NPK (Afzal, 2000). The response of maize crop to micro-nutrient Zn, Cu, Fe, and Mn was studied during the year 1967-69, but no beneficial effect of any micro-nutrient was observed (Rashid et, Al. 1988). Keeping in view an experiment was conducted on maize crop at three locations (Kurti, Kotli and Rawalakot) to see the response of micro-nutrient on grain yield of maize.

## 2. Materials and methods

The experiment was conducted in 2016 at three locations. Two trails were conducted in Kotli district (one on departmental farm and one on farmer's field). Third trail was conducted on farmer's field at Rawalakot. One another trail was also conducted in Neelum Valley District in Neelum village but was failed due to very dry spell in the area. These trails were designed in randomized complete block design (RCBD) with 5 treatments and 4 replications in each trail as shown in table No. 1.

**Table 1:** Layout of the experiment (kg ha<sup>-1</sup>)

Treatment	N	P	K	Zn	B	Cu
T1	120	80	60	0	0	0
T2	120	80	60	2	0	0
T3	120	80	60	0	1	0
T4	120	80	60	0	0	2
T5	120	80	60	2	1	2

All NPK and micro nutrient were applied at sowing time in the form of Urea, DAP, SOP, ZnSO<sub>4</sub>, CuSO<sub>4</sub> and Borax. Soil samples were taken from each site of

the experimental areas and were analyzed in the laboratory for pH, texture, O.M, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, Zn, B and Cu according to the methods described in "Soil and Plant Analysis Laboratory Manual" by John R, G. Estefan and A. Rashid, 2001. The physio-chemical properties of experimental sites are given in table No. 2.

**Table 2:** Physio-Chemical Properties of the Soil

Parameters	Kurti Farm	Kotli	Rawalakot.
pH	6.5	6.8	6.4
Texture	Loam	Loam	Loam
P(ppm)	10	11	15
K (ppm)	80	90	100
Zn (ppm)	1.2	1.3	2
Cu (ppm)	0.3	0.4	0.8
B (ppm)	0.4	0.4	0.5

### 2.1 Maize Nutrient Indexing

Nutrient indexing of maize crop was carried out in district Muzaffarabad and Kotli. One hundred sites were selected randomly in each district where maize was grown. At each selected sited an area of 5m<sup>2</sup> was marked for plant sampling and 10 plants were selected. Ear leaf from the selected plants was collected for tissue analysis. Soil composite samples were also collected from the same locations. Soil samples were collected at a depth of 0 – 15 cm and 30 – 45 cm. Plant tissue were analyzed for N, P, K, Zn and soil samples were analyzed for texture, pH, O.M %, P, K and AB-DTPA extractable Zn, Fe, Cu, Mn, and HCl extractable B.

## 3. Results and discussion

The results of the experiment are shown in Table No. 3. Grain yield of maize was higher in the treatments where Zn, Cu and B were applied together with NPK. This treatment showed significantly higher yield as compared to all other treatments at two locations i.e.

Kurti and Kotli, where it was 4163 & 3677 Kg/ha respectively, while at Rawalakot the difference in yield was not significant although application of micro nutrient gave comparatively higher yield. However, these treatments gave significantly higher yields as compared to control or treatments where only B was applied. At Rawalakot the treatments did not showed any response of variation in micro-nutrients. Potarzycki et.al (2009) reported that grain yield increased by 18% (mean of three years) as compared to the treatments where only NPK was applied. Plants fertilized with 1.0 kg Zn/ha significantly increased both total N uptake and grain yield. Result of this study is supported by findings of Eteng et.al (2014). The result obtained in their study indicated that Cu and Zn significantly influenced maize grain yields.

**Table 3:** Effect of Micro-Nutrient on Maize Grain yield

Treatment Zn:B:Cu (Kg ha <sup>-1</sup> )	Location		
	Kotli	Kurti	Rawalakot
Control	3561 c	3264 c	2712 a
2 : 0 : 0	3705 b	3519 ab	2786 a
0 : 1 : 0	3496 c	3410 b	2670 a
0 : 0 : 2	3830 b	3492 b	2710 a
2 : 1 : 2	4163 a	3677 a	2804 a
LSD	189	167	169

(Mean within the column followed by different letters was statistically different from each other.)

### 3.1 Economic Analysis of maize grain yield

The value cost ratio (VCR) was calculated by the formula,

VCR = Value of increase yield obtained / Cost of micro nutrient fertilizer used.

The results of VCR calculated for each location is shown in table No. 4. It showed that value cost ratio at Kurti and Kotli is much higher where all the micro-nutrients were applied. This means that farmers of these locations can get 2 to 4 times more benefit by the use of these three micro-nutrients.

### 3.2 Maize Nutrient Indexing

Nutrient indexing of maize crop carried out in district Kotli and Muzaffarabad showed that most of the soils were deficient or low in Zn, Mn and Cu in both districts. As far as the micro-nutrient contents of maize plant leaves is concerned 45%, 80% and 48% samples were found deficient in Mn, Zn and Cu contents respectively.

### 3.3 Relationship between soil properties and nutrient contents of maize leaf blades

Co-relation co-efficient (r value) between various soil properties and nutrient contents of maize leaves are given in table No. 5. Most of these properties show positive relationship (i.e. r value ranges from 0.35 to 0.58 at 5% probability level). Phosphorus contents of maize plant leaves has shown in highly significant positive relationship (r = 0.54) with soil P contents. These results are in line with the findings reported by Sillanpaa (1982). Also maize plant K content has shown positive relationship with ammonium acetate extractable K contents of corresponding soil samples. Boron and Zn contents in the plant leaves were positively related with B and Zn contents of the soil samples respectively. Sakal (2001) also reported significantly positive co-relation between soil available B and leaf B contents.

## 4. Conclusion

On the basis of this finding it can be concluded that application of micro-nutrient (Zn, B & Cu) along with macro-nutrient @ of 2: 1: 2 Kg/ha in maize crop can give significantly high yield in District Muzaffarabad and Kotli, value cost ratio of their micro-nutrients Showed that farmers can get 2 to 4 time more profit by the use of Zn, B & Cu from the maize crop.

**Table 4:** Value Cost Ratio of the Maize Grain Yield

Treatment	Kotli			Kurti			Rawalakot		
	Gross Return	Net Return	VCR	Gross Return	Net Return	VCR	Gross Return	Net Return	VCR
Control	35160	0	0	3260	0	0	27120	0	0
2 : 0 : 0	37050	1890	3.78	35190	2550	5.10	27860	740	1.48
0 : 1 : 0	34960	0	0	34100	1460	3.65	26700	0	0
0 : 0 : 1	38300	3140	5.24	34920	2280	3.80	27100	0	0
2 : 1 : 2	41630	6470	4.32	36770	4130	2.76	28040	920	0.62

**Table 5:** Co-relation Co-efficient (r) between soil properties and nutrient contents of maize plant leave

Soil analysis	Maize leaf Nutrient Content				
	P	K	B	Zn	Cu
P	0.52*				
K		0.48*			
B			0.39*		
Zn				0.59*	
Cu					0.31*

\* = significant co-relation (P=0.05)

Relationship of nutrients in plant and soil gave positive relation. This means that greater the nutrient in the soil more the nutrient will be in the plant.

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