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EFFECT OF MICRONUTRIENTS ON THE YIELD OF WHEAT IN NWFP

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Field experiments were conducted to see the effect of Cu, Zn and B on the grain yield of wheat at Ratta Kulachi, D.I. Khan and Tarnab, Peshawar. Four levels of Cu, Zn and B were applied to the soils at 0, 2.5, 5.0 and 10.0 kg/ha. In addition Cu, Zn and B were used in different combinations. 135 kg of N and 100 kg of P_2O_5/ ha were used as a basic dose.

At both the locations a corresponding increase in the grain yield of wheat was obtained as the levels of Cu, Zn and B supply were increased. The individual favourable effect of Cu, Zn and B on the grain yield of wheat have further been enhanced significantly by the combined application of Cu, Zn and B at 5 kg/ha each.

Wheat *(Triticum vulgare* L.*)* is one of the most important cereal crops in Pakistan. The production of wheat per unit area in Pakistan is very low as compared with other wheat producing countries of the world. In view of the urgency of self-sufficiency in food, it is imperative to exploit the available land to the maximum through the use of chemical fertilizers. The adoption of intensive cultivation and introduction of high yielding varieties have further necessitated the required amounts of fertilizers. The efficiency of major nutrients in increasing wheat production has been well-documented. However, several micronutrients are also essential for increasing crop production. Each of the essential micronutrients perform a definite function in the growth and development of plants. The deficiency of any of these essential micronutrients results in abnormal conditions and upsets the growth of the plants.

Copper, among the other things, is concerned with the photoreaction in the plants. Copper deficiency causes accumulation of iron in the plant. The amount of copper in a plant in relation to the amounts of other heavy metals is of greater importance to proper functioning of plants. Zinc functions largely as a metal activator of several enzymes in plants. Boron is involved in carbohydrate metabolism and cell development[12]. Boron deficiency results in the disturbance of nucleic acid metabolism rather than carbohydrate metabolism[9].

Qureshi *et al.*[8] observed that the soils of the Punjab is deficient in micronutrients, especially in zinc. The availability of micronutrient to the plants not only depends upon the absolute quantity present in the soil but on other factors as well. Wear and Patterson[13] noted that boron uptake by plants was reduced with the increase in the soil pH and excessive dry weather. Micronutrients precipitated and occluded as oxides and hydroxides were solubilized by low pH and soil reduction[5,11]. Increase in the pH (pH 7.0–7.9) had little effect on the amount of zinc and copper extracted from the test soils[6]. Yoshida[14] concluded from his studies that due to the calcareous nature of most of the Pakistani soils they are deficient in one or more micronutrients.

Grist[3] observed favourable effects of zinc application on the nitrogen intake, C/N ratio of the plant and grain yield of the crops. It has been reported that differential zinc response in sorghum and wheat genotypes is related to their capacity in exploiting soil zinc under zinc stress conditions. However, all the wheat genotypes are susceptible to zinc deficiencies in soils[2,10]

These studies were carried out in order to see the response of wheat to copper, zinc and boron applied to the soils of Ratta Kulachi, D.I. Khan and Tarnab, Peshawar.

MATERIALS AND METHODS

Three field experiements were conducted to see the effect of Cu, Zn and B on the grain yield of wheat at Ratta Kulachi, D.I. Khan and Tarnab, Peshawar during 1975–76 and 1977–78. Four levels of Cu, Zn and B at 0, 2.5, 5.0 and 10.0 kg/ha were used. In addition different combinations of micronutrients were used at 5 kg Cu + 5 kg Zn; 5 kg Cu + 5 kg B; 5 kg Zn + 5 kg B; and 5 kg Cu + 5 kg Zn + 5 kg B/ha. Each treatment was repeated four times in a randomized complete block design.

Nitrogen and phosphorus at the rates of 135 kg of N and 100 kg of P_2O_5/ha were applied to all the experiemntal plots as a basic dose. Urea and DAP were used as the

Table 1. Wheat grain yields as influenced by different levels of copper, zinc, and boron.

Treatments (kg/ha)			Mean yield* (metric ton/ha)		
			Peshawar	D. I. Khan	
Cu	zn	B	1977–78	1975–76	1977–78
0	0	0	2.52 e	2.43 g	2.36 h
2.5	0	0	2.66 d	2.50 f	2.49 g
5.0	0	0	3.15 abcd	2.55 ef	2.87 e
10.0	0	0	3.27 ab	2.64 ed	3.01 cd
0	2.5	0	2.84 bcd	2.55 ef	2.56 g
0.	5.0	0	3.27 ab	2.61 e	2.97 d
0	10.0	0	3.31 ab	2.78 d	3.12 bc
0	0	2.5	2.72 cd	2.52 f	2.51 g
0	0	5.0	3.21 abc	2.54 ef	2.75 f
0	0	10.0	2.71 cd	2.71 d	3.08 c
5.0	5.0	0	3.35 a	3.17 c	3.20 b
5.0	0	5.0	3.12 abcd	3.37 b	3.04 cd
0	5.0	5.0	3.37 a	3.58 a	3.27 ab
5.0	5.0	5.0	3.38 a	3.62 a	3.30 a
	L.S.D.	5%	0.505	0.0700.078	
		1%	0.675	0.0990.107	

*Values in each column not followed by the same letter are significantly different at 0.05 probability.

sources of nitrogen and phosphorus. $CuSO_4.5H_2O$, $ZnSO_4.6H_2O$, and $Na_2B_4O_7.10H_2O$ were used as the sources of Cu, Zn and B respectively. All the nutrients were incorporated in to the soil at the time of seedling of the experiment. A well-adopted wheat variety, Tarnab-73, was used in this experiment.

The test soil of the experiment at Tarnab, was clay-loam with the properties: pH 7.9, $CaCO_3$ 11.1%, O.M. 0.97% and received a rainfall of 20.6 in (Nov. 77– May 78). The chemical analyses of soil at Ratta Kulachi, D.I. Khan, showed a calcareous, clay texture with pH 8.3, $CaCO_3$ 15.2% and O.M. 0.42%. The rainfall received was: 5.5 and 7.9 in. during 1975–76 and 1977-78 growing seasons respectively.

Each experimental plot was harvested individually at the time of physiological maturity. After harvesting the plants were threshed and the grain weights of individual plots were recorded. The yield data were statistically analysed in accordance with the methods recommended by Panse and Sukhatme [7].

RESULTS AND DISCUSSION

The status of micronutrients in the soils of N.W.F.P., is not known, therefore, studies were undertaken on the soils of Ratta Kulachi and Tarnab, based on wheat crop response to Cu, Zn and B fertilization. Yield data presented in Table 1 show that the soils of D.I. Khan and Peshawar gave a significant yield response to Cu, Zn and B fertilization. As the levels of Cu, Zn and B fertilization increased a corresponding increase in the grain yield of wheat was observed except for B at Peshawar. The effect of individual micronutrient on the yield of wheat indicated that Zn at the rate of 10 kg/ha gave numerically the highest yield at both the locations, followed by B at D.I. Khan and Cu at Peshawar with the same level of fertilization.

The individual favourable effects of Cu, Zn and B have further been enhanced significantly by the combined application of Cu, Zn and B to the crop. The highest grain yield of wheat was obtained from the plots receiving combined application, 5 kg each of Cu, Zn and B/ha, followed by Zn, B/ha and Cu, Zn/ha respectively. However, the combined effect of 5 kg/ha each of Cu, Zn and B was not significantly different from Zn, B at D.I. Khan and Peshawar and Cu, Zn at Peshawar only.

These studies indicated that our soils are deficient in Cu, Zn and B. The response of wheat to micronutrients emphasise the need of their application to the crop. In addition to nitrogen and phosphorus, application of Cu, Zn and B at five kg/ha each seems essential for getting higher grain yields of wheat. The response of wheat to micronutrients as observed in these studies suggests that this might be due to the deficiency of micronutrients in absolute quantity in the soils of D.I. Khan and Peshawar or due to the unfavourable conditions, their availabilities are hindered or reduced.

As our soils are mostly calcareous in nature, resulting in high pH of the soils and decreased the solubilities of micronutrients and hence plant uptake. It is reasonable to infer that high concentrations of Ca at the root zone area may have formed barrier in the way of micronutrients absorption by plants. A comparatively high response of wheat to micronutrients at D.I. Khan during the year, 1976–77 substantiated the effect of dry weather on the availability of micronutrients to the plant; which has been observed by Lindsay and Norvell[6].

A fairly high response of wheat at D.I. Khan and showing adverse effect at Peshawar to high level of B (10 kg/ha) application as observed in these studies suggested that the soils of D.I. Khan, clay in nature was having high levels of Ca and pH and prevailed dry weather (5.5–7.9 in rain) during the growing season, reduced the uptake of available B and hence no toxicity level was developed but an increase in yield was obtained from increasing the rate of B application. The soil at Peshawar contained comparatively low levels of Ca and pH, high content of O.M., an organic source of B and enough moisture (20.6 in rain) during the season, helped in the uptake of available B in large quantities and hence toxicity level was developed, which showed an adverse effect on the grain yield of wheat. This is reasonable in view of the findings of Khan[4] who noted that cereals in general and wheat in particular have low B requirements. Moreover, Agarwal and Talati[1] showed that plants were making normal growth only when a certain balance in the intake of Ca and B existed. If the intake of Ca was in large quantities then the B requirement increased whereas high levels of Ca and pH reduced B uptake. They further noted that B deficiency problem is likely to be accentuated by fine textural soils which is substantiated by the soils (clay) at D.I. Khan.

These studies indicated that the absolute level of an essential micronutrient in the rooting medium may not be the most important factor, within limits, in its relation to plant growth, more important are the amounts of the other elements in relation to one another, the soil and environmental factors.

In order to know the best possible use of micronutrients in the nutrition of wheat crop, correlation studies should be carried out on the soils of N.W.F.P., to find out the critical levels of each essential micronutrient for profitable wheat crop production.

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