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RIPENING OF RICE AS INFLUENCED BY MICRO-NUTRIENTS, Cu, Zn AND Fe, WHEN THE NITROGEN SOURCE WAS AMMONIUM SULPHATE

Fateh M. Chaudhry and Shaukat Ali

Department of Agronomy, University of Agriculture, Faisalabad

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Studies on the ripening of rice as influenced by the micronutrients Zn, Cu and Fe, were carried out in pots at the University of Agriculture, Faisalabad in the 1982. Micronutrients, Zn, Cu and Fe, were applied at the rates of 10, 10 and 100 ppm respectively. The micronutrients were applied singly and in different combinations at the time of transplanting. The results have shown that Zn, Cu and Fe, when used singly or in combination of twos, had a favourable effect and resulted in substantial increase in per panicle spikelets and per units grain weight. Sterility also decreased with the application of these micronutrients. A combination of all three micronutrients did not affect the grain yield and yield components favourably which may be attributed to the probable antagonistic effect of these elements towards each other.

INTRODUCTION

For obtaining better yields of rice, all macro-as well as micro-nutrients must be present in the soil in fairly available amounts and in proper proportion. Application of macronutrients at present is being practised on a large scale but unfortunately very little attention has been given to the use of micronutrients so far [2, 3].

Micronutrients are as essential for plant growth and seed production as the macronutrients. Recently, plants have started showing deficiency symptoms for micronutrionts like zinc, copper and iron in rice growing areas [7]. This affects rice yields adversely. It appears that these soils have run short of these essential nutrients as a result of their continuous removal without any artificial replenishment. Moreover, with the introduction of high yielding IRRI rice varieties, a greater amount of plant nutrients is needed, particularly when the rice soils are already exhausted and plants are showing the deficiency symptoms for micronutrients. It was, therefore, contemplated in this study to see the influence of Zinc, copper and iron, singly and in combination on the ripening behaviour and yield characteristics of rice in a soil obtained from Kala Shah Kaku, District Sheikhupura, a well known rice growing area.

MATERIALS AND METHODS

The research reported here was carried out to investigate the effect of Zn, Cu and Fe on the ripening and yield characteristics of rice grown in earthen pots (22.5 cm dia, 25 cm depth) during the year 1982 at the Agronomic Research Farm, University of Agriculture, Faisalabad. Each pot was filled with 10 kg of soil obtained from a rice growing tract (Kala Shah Kaku). Before filling in the soil, the inner side of each pot was lined with polyethlene sheets to avoid any contamination of micronutrients from the earthen pots. The physico-chemical characteristics of the soil used are given below:

1.	DTAP extractable	Zn =	2.4	(ppm)
2.	" "	Cu =	5.6	(ppm)
3.	" "	Fe =	40.8	(ppm)
4.	Saturation percentage	=	50.0	
5.	pH	=	7.65	
6.	EC x 10^3	=	5.50	m/moles
7.	Ca	=	1.05	me/100 gm
8.	Mg	=	0.36	me/100 gm
9.	Na	=	4.33	me/100 gm
10.	K		0.085	me/100 gm
11.	CO_3	=	Nil	
12.	HCO_3	=	5.75	me/100 gm
13.	C	=	6.00	me/100 gm
14.	N	=	0.12%	
15.	P	=	10.00	(ppm)

The experiment was laid out according to completely randomized design with three replic replications the treatments carried out are given below:

Treatments

a. *Variety*

IR-6

b. *Micronutrients*

1. Zinc (in zine sulphate)
2. Copper (in copper sulphate)
3. Ferrous (in ferrous sulphate)

These micronutrients were applied singly and in combination as follows. The rates maintained included the available quantities of nutrients already present in the soil.

Treatment	*Rates of Application*
Control	0
Zn	10 ppm
Cu	10 "
Fe	100 "
Zn + Cu	10 + 10 "
Zn + Fe	10 + 100 "
Cu + Fe	10 + 100 "
Zn + Cu + Fe	10 + 10 + 100 "

Puddling in the pots was done 2 days before transplanting to create field conditions. Nitrogen as ammonium sulphate at the rate of 90 kg/ha and phosphorus as single super phosphate at the rate of 30 kg/ha were applied as a basal dose. The doses of fertilizers and micronutrients were calculated on soil weight basis. Simultaneously, all doses of the micronutrients were applied and incorporated in the soil before transplating. Five cm. of irrigation water on the soil surface was maintained in each pot from transplanting till maturity.

Duncan's multiple range test was used to determine the significance of various treatments at 5% probability.

RESULTS AND DISCUSSION

Number of spikelets per panicle: It can be seen from the data shown in Table 1 that all treatments, except Zn + Cu + Fe, produced more spikelets per panicle than the control. Furthermore, there is conclusive evidence to show that micronutrients, when applied alone or in combination, particularly of twos, had a positive effect on the number of spikelets per panicle. This probably was due to the fact that pronounced effects of nitrogen and phosphorus would be expected only when the micronutrients are available in required ratio and quantity. Comparatively lesser increase in Zn + Cu +Fe treatment might be attributed to the probable antagonistic effect and interaction of these elements towards each other when applied in a combination of threes. These results concur with those of Majid [3] and Westfall *et al* 6].

Table 1. Number of Spikelets per Pancile

A. Analysis of variance

S.O.V.	D.F.	S.S.	M.S.	F.R.	S.E.
Treatment	7	1486.74	355.22	10.98**	
Error	16	517.58	32.34		3.28
Total	23	3004.32			

** = Highly significant.

B. Individual comparison of treatment means

Treatment	Mean
1. Fe	91.98 a
2. Cu + Fe	88.62 a
3. Zn	87.66 a
4. Zn + Cu	86.51 a
5. Zn + Fe	85.09 a
6. Cu	83.08 a
7. Zn + Cu + Fe	71.30 b
8. Control	59.45 c

Variety = IR-6

Duncan's Multiple Range Test at 5% probability. Any two mans not sharing a letter differ significantly.

Sterility percentage: Data given in Table 2 reveal that sterility was significantly affected by the application of all three micronutrients. The higher sterility rate recorded in Cu + Fe, Zn + Cu & Zn treatments might be on account of more spikelets per panicle under these treatments, which caused a severe competition among the spikelets for the photosynthates during this stage. Under such conditions when the source is less and sink is more the spikelets, particularly studied at lower locations of the panicle being at a disadvantageous position, cannot flower and turn out as sterile florets. The occurrence of sterility in the case of more spikelets is, therefore, very likely and frequent. More sterility in the control might be attributed to the non-availability of micronutrients in required quantities. These findings are supported by Nagato and Chaudhry [4] and Chaudhry and Nagato [1], who claimed that in the case of more spikelets per panicle, the per spikelets carbohydrate is

reduced and a severe competition among the spikelets occurs.

Table 2. Sterility percentage

A. Analysis of variance

S.O.V.	D.F.	S.S.	M.S.	F.R.	S.E.
Treatment	7	1009.06	144.15	4.66**	
Error	16	494.45	30.90		3.20
Total	23	1503.51			

**Highly significant.

B. Individual comparison of treatment means

Treatment	Mean
1. Cu + Fe	35.68 a
2. Control	34.77 a
3. Zn	34.55 a
4. Zn + Cu	32.71 ab
5. Zn + Fe	32.28 bc
6. Zn + Cu + Fe	23.82 bc
7. Fe	21.12 c
8. Cu	18.32 c

Grain weight per pot: It can be observed from the data given in Table 3 that the addition of micronutrients influenced grain weight per pot considerably and treatments with Cu, Fe and Zn + Cu resulted in more grain weight as compared to the control, but there was no variability within the rest of the treatments. The increase in grain per pot appears to be due to the more favourable effects of Cu, Fe and Zn + Cu on the yield components. However, the differences in the yield components due to the remaining micronutrient combinations probably were not large enough to cause significant effect on the yield as compared to that of the control. These findings are in agreement with those obtained by Tahir [5] and Yamada *et al.* [8].

Table 3. Grain weight/pot (g)

(A. Analysis of variance

S.O.V.	D.F.	S.S.	M.S.	F.R.	S.E.
Treatment	7	722.01	103.15	2.76*	
Error	16	521.82	37.27		3.52
Total	23	1443.83			

* = Significant.

B. Individual comparison of treatment means

Treatment	Mean
1. Cu	34.42 a
2. Fe	30.72 a
3. Zn + Cu	28.81 a
4. Zn + Cu + Fe	25.31 ab
5. Zn	25.23 ab
6. Cu + Fe	24.64 ab
7. Zn + Fe	24.34
8. Control	14.43 b

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