Agri. Res. J. Kerala 1969, 7 (2) : 61-66

EFFECT OF MICRONUTRIENTS ON PADDY IN A RED LOAM SOIL OF KERALA

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It is generally believed that in acid soils the availability of most of the micronutrients is sufficient to meet the requirements of crop growth and hence their application may not show adequate crop responses. But there are several instances wherein responses to micronutrients have been obtained in acid soils (Kanwar and Randhawa 1967). Moreover, the availability of these nutrients is not only controlled by the pH of the soil but also by a host of other factors like the rainfall of the locality, organic matter applied, texture of the soil and N. P. K. fertilizers added.

In most of the earlier studies on the effect of micronutrients on rice they were used either individually or in combination with all the nutrients. The few trials conducted with different combinations of the micronutrients showed that only certain combinations of these elements proved desirable while others exhibited an antagonistic effect (Anon 1960, Schweigart 1961, Mariakulandai and Chami 1964 and George and Sreedharan 1966). The present investigation was undertaken to study the effect of various combinations of the micronutrients boron, copper, manganese, molybdenum and zinc over a basal application of N.P.K. fertilizers and green manure, on paddy, in the red loam soils of Kerala.

Experimental

The effect of the different micronutrients on paddy was ascertained in a pot culture experiment repeated thrice during the second crop seasons (October-January) of 1964-65 to 1966-67, at the Agricultural College and Research Institute, Vellayani, Kerala State. PTB. 10 was the variety used. Green manure at 5000 kg/ha and the N. P. K. fertilizers at 40 : 30 : 30 kg/ha were uniformly applied to all the pots as basal dose, except N which was given in 2 split doses, half at the time of planting and the other half 3 weeks after planting. The micronutrients Bo, Cu, Mn, Mo and Zn were applied as borax at 11 kg, copper sulphate at 28 kg, manganese sulphate at 56 kg, sodium molybdate at 125 kg and zinc sulphate at 28 kg per hectare respectively as basal dose. There were 32 treatment combinations including control which were replicated twice in a randomised block design.

The soil used for the experiment was red loam with coarse sand 20.86, fine sand 21.45, silt 0.80, clay 51.90, loss on ignition 4.27, organic carbon 0.9 and nitrogen 0.06 per cent, all on oven dry basis and pH 6.0.

Results and Discussion

The results are presented in Tables 1 and 2. It is observed that Cu significantly increased the yield of grain in all the three years. The straw yield showed increase in two out of three years. The pooled analysis also showed that Cu increased the yield of both grain and straw significantly.

Similar responses with Cu in acid soils were earlier reported on wheat (Kanwar *et al* 1958-62). Increase in grain yield of paddy due to Cu application was recorded earlier in Konkan, Poona, Bangalore, Coimbatore and Warrangal (Bokde 1963).

The response of the plants to Cu has been variously attributed to increased availability of Cu when applied in conjunction with green manure (Joshi and Joshi 1952), increased uptake of P and K by paddy plant in the presence of adequate Cu (Dakhore *et al* 1963) and increased uptake of N when applied in conjunction with N. P. K. fertilizers (Gautam *et al* 1964).

Table 2 shows that production of straw was influenced significantly by Mn and Bo in two out of three years. The pooled analysis also showed that the application of these nutrients significantly increased the yield of paddy straw.

The beneficial effects of Bo and Mn in acid soils have been reported earlier on wheat (Kanwar 1964), cotton (Dastur and Singh 1953) and fodder sorghum (Datta and Bains 1959). The response to Bo has been attributed to the influence of this nutrient on dry matter production (Rao 1962) and increased availability of Bo to the crop when applied in conjunction with green manure (Joshi 1956). The clay loam texture of the soil and the moderately high rainfall (170 cm) appeared to cause the low availability of soil Bo as has been shown by Mandal *et al* (1956) and Kanwar and Singh (1961). In these circumstances the applied Bo appeared to have been utilised for crop production.

The increase in production recorded by Mn application may be attributed to the influence of the pH of the soil used in the study. In a soil where the pH is 6.0, as in this case, the absorption of Mn has been reported to be the highest (Mahendra Singh and Pathak 1968). It is also probable that the availability of applied Mn was considerably enhanced when fertilizers like ammonium sulphate, superphosphate, muriate of potash and the green manure were applied in conjunction with Mn (Mulder and Geretsen 1952, and Gopala Rao 1956).

Application of the nutrients Mo and Zn either individually or in combination did not influence the grain or straw yield. The lack of response to Mo in the soil under study may be due to the reduced availability of both applied as well as soil Mo in acid soils as reported by Kanwar and Randhawa (1967). Similarly the absence in response to Zn application may be due to the presence of readily available Zn in the soil at the pH range (Nair and Mehta 1959, Chatterji and Das 1964).

It may also be seen from the results that combined application of all the micronutrients did not increase the yield of either grain or straw in all the 3 years.

Table 1

Mean yield of rice grains in grams/pot under different manurial treatments

Treatments	1964-65	1965-66	1966-67	Mean
Control	20.64	13.68	11.13	15.15
Mn	11.17	15.77	13.77	13.57
Bo	18.13	14.34	16.20	16.22
Bo + Mn	18.64	22.64	15.47	18.91
Mo	18.09	13.59	12.65	14.78
Mo + Mn	17.23	18.86	12.68	16.25
Mo + Bo	9.64	17.96	9.51	12.37
Mo + Bo + Mn	20.58	17.61	16.55	18.25
Zn	12.28	11.72	14.23	12.74
Zn + Mn	14.35	16.02	13.43	14.60
Zn + Bo	20.68	20.79	16.0?	19.18
Zn + Bo + Mn	18.38	21.43	17.88	19.23
Zn + Mo	18.21	18.35	16.98	17.84
Zn + Mo + Mn	14.28	20.78	16.78	17.28
Zn + Mo + Bo	14.35	16.65	13.11	14.70
Zn + Mo + Bo + Mn	1642	17.42	11.38	15.07
Cu	21.48	20.07	23.30	21.61
Cu + Mn	15.50	19.91	19.13	18.34
Cu + Bo	24.15	23.15	22.70	23.33
Cu + Bo + Mn	22.00	22.59	22.67	22.42
Cu + Mo	27.05	18.13	21.73	22.30
Cu + Mo + Mn	26.67	25.75	20.84	24.42
Cu + Mo + Bo	15.85	14.85	18.53	16.41
Cu + Mo + Bo + Mn	24.31	15.15	16.35	18.60
Cu + Zn	13 38	13.03	14.36	13.59
Cu + Zn + Mn	16.16	13.90	13.53	14.53
Cu + Zn + Bo	26.62	20.89	22.19	23.23
Cu + Zn + Bo + Mn	29.37	28.26	26.95	28.19
Cu + Zn + Mo	23.64	20.01	24.65	22.76
Cu + Zn + Mo + Mn	22.31	21.24	21.30	21.61
Cu + Zn + Mo + Bo	17.75	11.57	12.23	13.85
Cu + Zn + Mo + Bo+Mn	12.39	14.45	15.22	14.02
C.D.	7.14	5.30	6.99	3.68

Table 2

Mean yield of paddy straw in grams/pot under different manurial treatments

Treatment	1964-65	1965-66	1966-67	Mean
Control	23.36	20.51	17.64	20.50
Mn	14.36	19.45	20.30	18.03
Bo	22.20	21.14	20.96	21.43
Bo + Mn	19.68	29.10	27.30	25.36
Mo	26.25	19.07	16.95	20.75
Mo + Mn	21.74	24.82	22.97	23.17
Mo + Bo	15.38	26.16	21.77	21.10
Mo + Bo + Mn	26.59	23.29	23.51	24.46
Zn	19.38	15.88	20.94	18.73
Zn + Mn	17.47	20.72	18.89	10.05
Zn + Bo	24.00	27.93	24.96	25.63
Zn + Bo + Mn	29.97	24.72	26.70	27.13
Zn + Mo	26.23	24.39	25.29	25.44
Zn + Mo + Mn	15.89	25.91	25.84	22.55
Zn + Mo + Bn	17.79	23.05	19.89	20.24
Zn + Mo + Bo + Mn	19.25	24.79	26.19	23.41
Cu	25.42	26.31	25.07	25.60
Cu + Mn	20.80	25.80	24.67	23.75
Cu + Bo	29.04	28.43	29.31	28.92
Cu + Bo + Mn	27.68	27.08	26.62	27.12
Cu + Mo	30.20	24.82	23.78	26.26
Cu + Mo + Mn	35.06	23.36	29.90	32.44
Cu + Mo + Bo	30.79	20.27	24.36	25.14
Cu + Mo + Bo + Mn	21.25	21.92	23.54	22.24
Cu + Zn	19.12	17.03	22.70	19.62
Cu + Zn + Ma	24.91	16.62	23.03	21.52
Cu + Zn + Bo	29.80	25.93	27.56	27.43
Cu + Zn + Bo + Mr,	39.C9	31.93	31.84	34.28
Cu + Zn + Mo	31.02	23.99	26.27	27.09
Cu + Zn + Mo + Mn	30.45	24.87	27.52	27.61
Cu + Zn + Mo + Bo	26.81	16.20	22.93	21.98
Cu + Zn + Mo + Bo+Mn	25.40	18.72	22.92	22.34
C. D.	9.26	5.99	4.97	3.94

This is in agreement with the findings of George and Sreedharan (1966), wherein a depression in yield was obtained by the combined application of these nutrients. Similar lack of response or negative response to combined application of micronutrients have been reported earlier by Kanwar (1964) and Gupta and Ram (1967). This may be due to the inhibitory or retarding effect of one nutrient over another as has been observed by Schweigart (1961) and Mariakulandai and Chami (1964).

Summary

A pot culture experiment was conducted to study the effect of the micronutrients Bo, Cu, Mo, Mn and Zn individually and in various combinations applied in conjunction with green manure and N. P. K. fertilizers, on paddy, in a red loam soil of Kerala at the Agricultural College & Research Institute, Veilayani, Kerala, India.

Application of Cu increased the grain and straw yield of paddy significantly. Bo and Mn significantly increased the straw yield. Mo and Zn either individually or in combination did not have any effect in increasing the grain and straw yield. The combined application of all these micronutrients did not influence the grain and straw production.

Acknowledgement

The authors are indebted to Prof. P. Kumara Pillai, Principal, Agricultural College and Research Institute, Veilayani, for the facilities provided and for the keen interest evinced in this work. The authors are also thankful to Prof. E. J. Thomas, Head of the Division of Statistics, for the help rendered in the statistical analysis of the experimental data.

References

Anonymous. 1960. Annual progress report of the scheme for investigation into the micronutrient status of the soils of Bombay State. 1959-1960.

Bodke, S. 1963. Mineral elements in plant nutrition and use of micronutrients. *Ferti. News* 8 (3): 27

Chatterjee, R. K. and Das, S. C. 1964. Comparative studies on the determination of available zinc in soils of varying mineralogical composition. *J. Indian Soc. Soil Sci.* ***12:*** 297-300

Dakhore, R. C., Naik, M. S. and Das, N. B. 1963. Effect of copper on the uptake of minerals by wheat plants in Delhi soils. *Indian J. agric. Sci.* 33: 219-25

Dastur, R. H. and Singh, K. 1953. A study of the effect of trace elements on growth and yield of American Cotton. *Indian Cott. Gr. Rev,* 7: 56-66

Datta, N. P. and Bains, S. S. 1959. Effect of soil application of fertilizer mixture (N. P. K.) alone and in conjunction with soil/or nutrients. *Indian J. Agron.* 4: 258-63

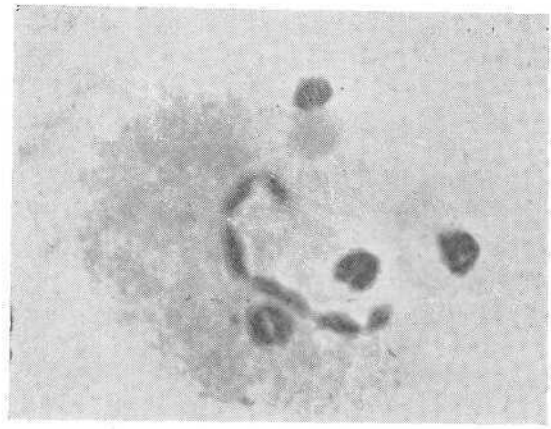

Fig. 5. Meiotic cell showing 4II + 1VI

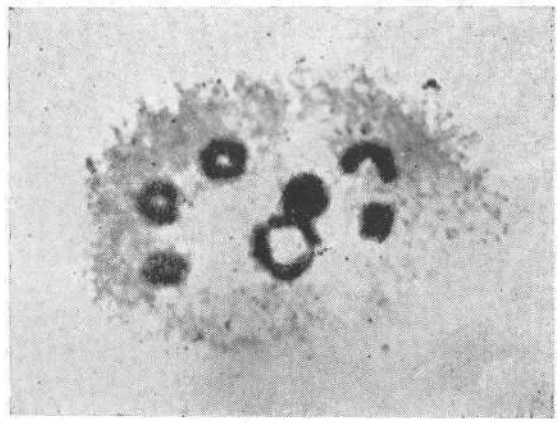

Fig. 6. Meiotic cell showing 5II + 1IV

Gautam, D. P., Ahuja, L. R. and Mukhopadhyay, D. 1964. Response of hybrid maize to micronutrient elements. *J. Indian Soc. Soil Sci.* 12: 411-21

George, C. M. and Sreedharan, C. 1966. Micronutrient studies on paddy in *Kayal* lands in Vellayani. *Agri. Res. J. Kerala.* 4 (2): 69-72

Gopala Rao, H. G. 1956. Effects of green manuring to red loamy soils freshly brought under swamp paddy cultivation with particular reference to availability of iron and manganese. *J. Indian Soc. Soil Sci.* 4: 225-31

Gupta, O. P. and Ram, L. 1967. Response of hybrid maize to micronutrients in Tarai soils of Uttar Pradesh. *Indian J. Agron.* 12: (4)

Joshi, N. V. and Joshi, S. G. 1952. Effect of copper sulphate on rice in Bombay State. Sci. *and Cult.* 18: 96

Kanwar, J. S., Randhawa, N. S. and Grewal, J. S. 1958, 1959, 1960, 1961, 1962. Annual progress reports of the scheme of distribution of micronutrients in the Punjab soils and their effects on the yield of crops for the years 1958, 1959, 1960, 1961, 1962

Kanwar, J. S. and Singh, S. S. 1961. Boron in normal and saline alkaline soils of the irrigated areas of the Punjab. *Soil Sci.* 92: 207

Kanwar, J. S. 1964. Research on trace elements in the Punjab present and future. *J. Indian Soc. Soil Sci 2:* 73

Kanwar, J. S. and Randhawa, N. S. 1967. *Micronutrient Research in Soil and Plants in India.* Indian Council of Agricultural Research, New Delhi: 75

Mahendra Singh and Pathak, A. N. 1968. Effect of soil reaction and manganese application on the growth and absorption of manganese by oat crop. *Indian J. Agric. Sci.* 38: (3): 486

Mandal, S. C , Ali, M. A. and Mukherjee, H. N. 1956 Boron requirement of some Bihar soils. *J. Indian Soc. Soil Sci.* 4: 79-86

Mariakulandai, A and Chami, A. 1964. Micronutrients and yields of rice. *Madras Agric. J. 54* (2): 63

Mulder, E. G. and Geretsen, F. C. 1952. Soil manganese in relation to plant growth. *Advance Agron.* 4: 221-77

Nair, C. G. K. and Mehta, B. V. 1959. Status of Zinc of Western India. *Soil. Sci.* 87: 155-9.

Rao, V. S. 1962. *Andhra Agric. J. 9:* 225

Scheigart, H. A. 1961. The role of trace elements in organisms. Paper read at the Annual Congress of the Nutrition Society of the Southern Africa, Johansburg 1960. *Potash Rev.* Derne, Switzerland, August 1961.

(*Accepted*: *16-10-1969)*