

## The Effect of Micro-Nutrients on the Growth and Yield of Paddy (TKM. 6) with and without Green Leaf Manure

by

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**Introduction:** In Madras State the rice crop is found to respond well with green manures and also with the application of major nutrient fertilizers. Recent studies on micronutrients in crop production have thrown conflicting results (Harrison *et al*, 1917; Joshi *et al*, 1952; Nagarajan *et al*, 1963; Lal *et al*, 1954; Narayanan *et al*, 1955; Raheja *et al*, 1959; Pillai, 1966) and in many cases no response to added micro-nutrient fertilizers was recorded (Datta *et al*, 1960). A study was therefore undertaken to assess the response of paddy TKM. 6 to micronutrient salts.

**Previous work:** For both the soils with high and low organic matter, 2.5 lb. per acre of copper resulted in either maximum or near maximum yields in wheat and no yield response was obtained from application of manganese, zinc and iron (Younts, 1964). The addition of copper to the soil (Joshi *et al*, 1952) without the addition of organic manure gave an increase of 33 per cent in the yield of rice over the control and the effect of the addition of copper sulphate along with manuring the soil with organic matter resulted in an increase of 77 per cent over that obtained by simple manuring with organic matter. They have also reported that zinc and copper are the limiting factors for crop production in the soil studied in Bombay.

Results from several studies in India (Raheja *et al*, 1959) indicate the possibilities of securing positive yield responses. Five pounds of zinc sulphate per acre increased the total crop yield by about 23 per cent in *ragi* (Gopala Rao, *et al*, 1950) and the application of five to 10 lb. per acre dose of zinc sulphate mixed with oil cakes to soils in Mysore also gave a positive response in *ragi* (Govindarajan, *et al*, 1951).

**Materials and Methods:** In order to study the growth and yield components of paddy variety TKM. 6 under controlled green house conditions this experiment was conducted in 1964—'65 under pot cultures with 10 replications per treatment. The micronutrients under trial were Copper, Manganese, and Zinc which were applied as sulphate salts each at 10 lb. per acre dose, both individually and also as a combination of all

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the three micronutrients. The micronutrients were applied with green leaf manure in one set, and the same micronutrients were tried without any green leaf manure in the other set. A control with green leaf manure and another without green leaf manure were also included. Soil from the Wetlands of Central Farm, was used in the experiment at the rate of 13 Kg. per pot. The calculated quantity of green leaf to supply 5,000 lb. per acre was incorporated in each pot for the treatments where green leaf was included. A basal dose of ammonium sulphate and superphosphate each at the rate of 100 lb. per acre was applied for all the treatments before planting. The micronutrient salts were also applied as per treatment before planting. Pot watering was done daily except during rains and special precautions were taken by irrigating the crop with only rain water. Periodical measurements of plant height and tiller counts besides the yield of grain and straw weight per plant were studied.

**Results and Discussion:** The plant height of paddy grown under pot-culture conditions where green leaf manure was not provided before applying micronutrients was less than in the treatments with green leaf manure. The control with green leaf manure recorded 84.7 cm, while the same without green leaf manure was 79.1 cm. in height (Table 1). The height measurements for the micronutrient treatment without green leaf manure gave values ranging from 76.6 cm. to 79.6 cm. whereas the range for similar treatments coupled with green leaf manure was from 84.7 to 91.9 which is 8.4 per cent over control.

TABLE 1

Final plant height at harvest stage and earhead number per plant (Paddy TKM. 6)

Treatments	Final plant height	Per cent on control	Mean earhead number per plant	Per cent on control
	Cm	%		%
1. Control (with green leaf manure)	84.7	100.0	7.5	100.0
2. CuSO <sub>4</sub> (10 lb) Green leaf manure	86.9	102.6	7.2	96.8
3. MnSO <sub>4</sub> (10 lb) Green leaf manure	86.6	102.2	9.5	126.2
4. ZnSO <sub>4</sub> (10 lb) Green leaf manure	91.9	108.4	8.9	119.2
5. CuSO <sub>4</sub> + MnSO <sub>4</sub> + ZnSO <sub>4</sub> (10 lb each) + Green leaf manure	85.7	101.2	9.5	126.2
6. Control (without Green leaf manure)	79.1	91.1	5.2	70.1
7. CuSO <sub>4</sub> (10 lb) (without Green leaf manure)	76.6	98.0	5.6	75.4
8. MnSO <sub>4</sub> (10 lb) without Green leaf manure	79.6	91.4	5.4	72.2
9. ZnSO <sub>4</sub> (10 lb) without Green leaf manure	76.9	85.4	4.1	58.8
10. CuSO <sub>4</sub> + MnSO <sub>4</sub> + ZnSO <sub>4</sub> (10 lb each) without green leaf manure	76.9	88.1	4.5	59.9

Statistically significant or not

No.

Yes (at 5% level)

CD = ± 2.0

S. E. 0.7

Conclusions: 3, 6, 4, 1, 2, 7, 8, 6, 10, 9

The number of earheads from individual seedlings planted gave statistically significant differences for the various micronutrient treatments either coupled with green leaf manure or not. An interesting feature in this study was that  $MnSO_4$  at 10 lb per acre dose with green leaf manure and the same in combination with  $CuSO_4$  and  $ZnSO_4$ , each at 10 lb per acre have given the same number of earheads *viz.*, 9.5 whereas the control with green leaf manure alone recorded on an average 7.5.

Similar to the findings in plant height, the average number of earheads per plant for the treatments without green leaf manure was statistically less than the treatments with green leaf manure, *eg.*, the control with green leaf manure recorded 7.5 whereas the same without green leaf manure was 5.2. The treatment combination of all the three micronutrients coupled with green leaf manure recorded the maximum mean earhead number per plant while the same micronutrient combination without green leaf manure recorded almost the minimum value of earhead production when compared to all the remaining treatments. Thus it is clear that the effect of trace elements either individually or combined together will be beneficial only if green leaf manure is also provided and the corollary is also true. When green leaf manure is not applied no treatment has recorded statistically significant differences over the control without green leaf manure whereas when green leaf manure is provided in the soil all the treatments except copper sulphate have given significantly higher earhead numbers than the control without green leaf manure.

The best treatment which gave the highest earhead production per plant has not given the maximum height which was noticed in the treatment zinc sulphate at 10 lb per acre with green leaf manure whereas the maximum earhead production was recorded in the treatment  $MnSO_4$  with green leaf manure and the same value was also recorded in the treatment  $MnSO_4$ ,  $ZnSO_4$  and  $CuSO_4$  each at 10 lb acre dose along with green leaf manure (Table 1).

In Table (2), the maximum grain yield per plant was noticed in the treatment zinc sulphate with green leaf manure and the maximum straw yield was produced in the treatment combination of micronutrients and green leaf manure. Similar to plant height and tiller counts the straw yield and grain yield per plant were also very much affected when green leaf manure was not included along with the micronutrient treatments.

Organic manure as a pre-requisite for increased application of chemical fertilizers (Pillai, 1964) in crop production forms the basis of this thought and the present investigation was carried out to nullify the adverse effect, if any, due to excessive added micronutrients, as the range of such nutrient requirements for crop growth is narrow (Wallace, 1951).

Soil application of trace elements to the paddy crop was found superior to foliar sprays in many cases (Nagarajan, S. S. *et al*, 1963; Narayanan, *et al*, 1955) and hence only soil dressings were studied in this particular experiment.

TABLE 2  
Grain and straw yield of TKM. 6 paddy

Treatments	Grain yield per plant (gm)		Straw yield per plant (gm)	
	Mean	Per cent on control	Mean	Per cent on control
1. Control (with green leaf manure)	7.1	100.0	8.7	100.0
2. CuSO <sub>4</sub> (10 lb) (with green leaf manure)	4.6	65.4	10.2	119.8
3. MnSO <sub>4</sub> (10 lb) (with green leaf manure)	7.5	104.7	9.6	110.7
4. ZnSO <sub>4</sub> (10 lb) (with green leaf manure)	10.0	140.2	11.6	110.7
5. ZnSO <sub>4</sub> + MnSO <sub>4</sub> + CuSO <sub>4</sub> (10 lb each) (with Green leaf manure)	7.5	105.6	12.3	141.2
6. Control (without Green leaf manure)	3.6	51.4	5.5	62.5
7. CuSO <sub>4</sub> (10 lb) (without Green leaf manure)	4.4	61.7	7.1	81.7
8. MnSO <sub>4</sub> (10 lb) (without Green leaf manure)	8.9	55.1	6.5	74.0
9. ZnSO <sub>4</sub> (10 lb) (without Green leaf manure)	3.3	46.7	6.3	72.5
10. CuSO <sub>4</sub> + MnSO <sub>4</sub> + ZnSO <sub>4</sub> (10 lb each) (with Green leaf manure)	1.6	23.4	5.0	57.3

Statistically Significant or not

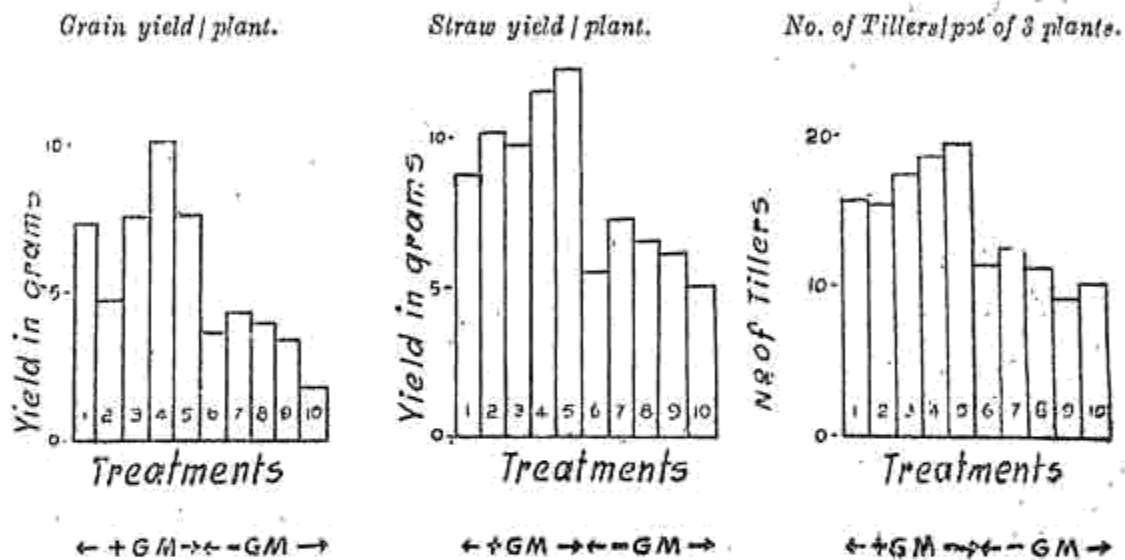
Yes  
(at 5% level)  
C. D. = ± 3.0  
S. E. = 0.7

Not Significant

The combination of the micronutrient salts CuSO<sub>4</sub>, MnSO<sub>4</sub> and ZnSO<sub>4</sub> without green leaf manure is definitely injurious to crop growth and development in paddy since this particular treatment has recorded the minimum grain yield of 1.6 gm per plant whereas the same treatment combination with green leaf manure has produced 7.5 gm per plant and the control with green manure alone has recorded on an average 7.1 gm per plant. The micronutrient treatments have given statistically significant differences in the grain yield per plant (Table 2) whereas the treatment effect on the straw yield per plant in general is not statistically significant.

Though the combination of copper, manganese and zinc salts each at 10 lb per acre coupled with green leaf manure has not brought in any increase in grain yield, it has resulted in increased straw production though statistically not significant and also the number of tillers per plant. However, the same treatment without the organic manure (green leaf) has neither given an increase in grain and straw yield nor in the production of tillers. The only advantage of the treatment combination of all the three micro-nutrients tried with green leaf manure is only in the green matter production in paddy.

Micronutrient Effect with and without Greenleaf Manure on Paddy T. K. M. 6.



The interesting finding is that there is a complementary effect of individual micronutrients and green leaf manure as a basal dose in increasing yield of both straw and grain in paddy and this effect is not substantially evident when the organic matter status in the soil goes down. Thus organic manure as a pre-requisite for increasing crop yields is not only applicable with regard to major nutrients (Pillai, 1964) but also with micronutrients. For confirmation of the findings, this pot culture experiment on the effect of micronutrients on paddy with and without green leaf manure as a basal manure is worth trying out under field conditions.

The application of the calculated quantity of green leaf manure per pot to supply 5000 lb per acre before planting the paddy seedlings, seems to have served as a stabilizer in adjusting the soil conditions and retaining moisture which might have also contributed to the encouraging performance of paddy TKM. 6. It is a well known fact that organic matter in the form of green leaf manure besides supplying all the trace elements required for crop production also supplies additional major nutrients. Thus when comparing the four treatments without green leaf manure against the similar treatments with presupplied green leaf manure, it is worth bearing in mind

the additional benefit normally expected due to the organic matter supplied. Our study mainly compares the effect of added micronutrients with and without green leaf on crop growth and development. The grain yield per plant for the treatments zinc and manganese with green leaf manure responded better than the copper treatment with green leaf manure. This finding is just the reverse of the reported results of Younts (1964) in wheat where 2.4 lb CuSO<sub>4</sub> produced either maximum or nearer maximum yield in soils with both high and low organic matter content. On the other hand, however, our findings for copper, manganese and zinc are in full agreement with Younts (1964) in the case of soils where green manure was withheld. The response of copper in such a soil as reported by Joshi and Joshi (1952) is also evident. The fact that the response of micronutrients in increasing crop yield depends on the organic matter status of the soil to a great extent has been established.

**Summary and Conclusions:** A green house study to assess the response of paddy, TKM. 6 to zinc sulphate, copper sulphate and manganese sulphate each at 10 lb acre dose individually and also as a combination of the three salts with and without green leaf manure in the soil, was conducted. The growth and yield characteristics per plant were studied and the following are the findings :

1. The final plant height just before harvest was found to be the maximum in the treatment zinc sulphate at 10 lb acre dose coupled with green leaf manuring and all the treatments where green leaf manure was included responded better than the similar treatments without green leaf manure.

2. The number of earheads produced from the productive tillers per plant was significantly superior in almost all the treatments where micronutrient salts were coupled with green leaf manure.

3. The mean number of tillers and grain and straw yield per plant have all recorded a good response to micronutrients each at 10 lb per acre, only when treated along with green leaf manure. Ten pounds of zinc sulphate per acre with green leaf manure gave the maximum response in grain yield and a combination of all the three salts with green leaf resulted in the maximum straw production. Zinc sulphate alone with green leaf manure, also gave the next best straw yield. Tiller production was similar to the straw yield for this treatment.

4. Summing up the findings it may be concluded that micronutrient application at 10 lb. per acre increases the crop yield of paddy and this response depends on the organic matter status of the soil.

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