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STUDIES INTO CAUSES OF CHLOROSIS IN *TABERNAEMONTANA DIVARICATA* (LINN.) R. BR.

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Three categories of plants (severely chlorotic, moderately chlorotic and normal) were analysed to determine the micronutrient (s) causing chlorosis in *Tabernaemontana divaricata*. Leaves of each type of plant were analysed for copper, manganese, zinc, iron, potassium, sodium, total protein, total carbohydrates and chlorophyll. The data show the copper, manganese, iron, and total chlorophyll levels to be the highest in normal while lowest in severely chlorotic leaves. Potassium, sodium and total proteins were higher in severely chlorotic leaves. Total carbohydrates did not show any appreciable difference while zinc content appeared to be the lowest in moderately chlorotic and highest in normal leaves. The visual symptoms show iron chlorosis but chemical analysis show that other elements (Cu, Mn and Zn), besides iron, may be contributing to the development of visual deficiency symptoms in the plants under observation.

INTRODUCTION

Importance of micronutrients for plant growth is well recognized. Zinc, for instance, is needed for the formation of auxins which are growth promoting substances in plants. It is also a necessary component of several enzyme systems which regulate various metabolic activities within plants. Similarly, copper has some function in the formation of chlorophyll and iron acts as a catalyst in the production of chlorophyll. Manganese catalyses not only various reactions of carbohydrate breakdown and organic acid metabolism but also a number of conversions involved in the nitrogen and phosphorus metabolism. Deficiencies of micronutrients result in abnormalities in plants, low yield of crops, and in many cases in crop failure. This experiment was carried out to detect the deficiencies of micronutrient (s) and their effects on metabolites of physiological interest.

MATERIALS AND METHODS

Three categories of *Tabernaemontana divaricata* plants were selected having visual differences, i.e. severely chlorotic, medium chlorotic and normal

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green. Randomly selected leaves of each class were taken and washed with dil. HCl and then with distilled water to decontaminate them. After drying leaves in sunlight, they were wrapped in filter papers and were oven dried to a constant weight at 70°C. Oven dried leaves were ground avoiding all possible contamination. Then, these samples were digested in conc. H_2SO_4 and 72% $HClO_4$. Na & K were determined by flame photometer while Fe, Mn, Cu and Zn were detected by atomic absorbtion spectrophotometer. Protein was estimated by micro-kjeldhal method. Fresh leaves of each type were selected randomly and midribs were removed and chlorophyll was extracted in 80% acetone. The chlorophyll contents were determined with the help of a spectrophotometer (Witham *et al.* 1971).

RESULTS AND DISCUSSION

Relevant data pertaining to iron, manganese, copper, zinc, sodium, potassium, protein, total sugars and chlorophyll are given in Table 1.

It is evident from the given Table that three different plants show a decreasing trend in the quantity of iron from green to chlorotic plants. It indicates that formation of chlorophyll is quite dependent upon iron. Similar results were obtained by Brown (1956) and Locke and Eck (1965).

Results for manganese show that its quantity decreased with the advent and progress of chlorosis, showing that synthesis of chlorophyll was associated with an adequate supply of Mn. The present findings are in accord with those of Tiechler-Zallen (1969) and Bidwell (1974).

Data pertaining to zinc and copper contents of leaves show that amount of zinc and copper was slightly less in severely chlorotic leaves than that for normal green leaves. It was concluded that zinc and copper were related with the production of chlorophyll in an undetermined way. More or less similar results were obtained by Gilbert (1948) and Viets and Frank (1967).

Results for sodium and potassium show a negative relationship between these elements and chlorophyll.

The total protein content of each category of plants showed an increase in the direction of green to chlorotic plants. This increasing trend in total protein contents, during chlorosis, is one of the symptoms of copper deficiency as reported by Gilbert (1951).

There was not much difference of total sugar contents in the three types of leaves under study.

Table 1 : ***Mineral elements, chlorophyll, reducing sugars and protein contents of leaves of Tabernaemontana divaricata.***

Degree of Chlorosis	Fe	Mn (ug g^{-1} plant tissue)	Cu	Zn	K (mg $100g^{-1}$)	Na	Chlorophyll (mg g^{-1}) a	b	Total	a/b	Reducing sugar (%)	Total protein (%)
Severe	234.62	27.12	12.03	33.09	4.24	0.6509	0.1850	0.1214	0.3100	1.52	11.35	4.39
Medium	283.37	42.26	20.84	31.60	3.71	0.4559	0.6224	0.3931	1.1800	1.58	12.02	3.56
Normal	314.70	47.62	23.39	39.43	3.08	0.2140	1.0514	0.9270	1.9700	1.13	11.39	2.53

The contents of total chlorophyll and the fractions (chlorophyll a and b) as shown in Table 1 reveal a marked decrease within increase in the severity of chlorosis. A similar decreasing pattern in the contents of chlorophyll a and b was observed in normal, medium and severely chlorotic plants. Identical were the findings of Eltinge (1941), Simons *et al.* (1963) and Jacobson (1945).

The plant analysis data indicate that the chlorotic symptoms were probably due to the deficiency of iron and manganese in the chlorotic plants. Copper and zinc levels were almost identical in all the three categories of plants. This imbalance in mineral nutrients resulted in upsetting the levels of important metabolites. The quantities of chlorophyll a, chlorophyll b and total chlorophyll were drastically reduced. The ratio of chlorophyll a to chlorophyll b indicates that under nutrient deficiency the latter is much more labile as compared to the former. Total protein increased in chlorotic plants but sugars did not show any dissimilarity in all the plant categories under observation.

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