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Trace Element Analysis of Red-rot Disease Incidence in Sugarcane by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)

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An attempt has been made to detect and estimate some important macro and micro elements present in both resistant and red-rot disease infected sugarcane of different varieties using inductively coupled plasma atomic emission spectrometry. This analysis reveals the presence of trace elements like B, Na, Mg, K, Ca, Cr, Mn, Fe, Co, Ni, Cu and Zn. A possible correlation between the status of trace elements and the diseased condition of sugarcane has been attempted.

Key Words: Sugarcane, Red-rot disease, Trace elements, ICP-AES.

Sugarcane plant suffers from many diseases such as red-rot, smut, wilt, mosaic, etc. In India red-rot is the first among the serious diseases of sugarcane crops[1,2]. Red-rot disease of sugarcane has become a disease of major importance in most of the sugarcane growing states of India. Due to the effect of red-rot disease the mineral nutrient status has not been adequately reported[3–6]. Work on the micro-element nutrition of sugarcane under Indian conditions is very limited. There is a direct correlation in plant nutrition between the concentration of a nutrient available to sugarcane and the amount of that nutrient subsequently accumulated by the plant. This study was undertaken to characterize the absorption of macro and micro nutrients by sugarcane and the effect of red-rot disease.

Twelve varieties of sugarcane (Co 86249, CoG 93076, Co 86032, CoC 99061, CoSi 95071, Co 85019 (resistant), CoC 671, CoC 90063, CoC 98061, Mc 707, CoV 92102 and Co 6304 (red-rot infected)) crops at the age of eight months were collected from different fields of sugarcane growing in area of EID Parry (India) Limited, Nellikuppam, Cuddalore District, Tamil Nadu, India. Samples were collected field-wise by adopting standard procedure[7,8]. The sugarcane samples of both resistant and red-rot disease infected sugarcane were oven dried at 120°C for 4 h and ground to fine powder. The oven-dried samples were digested by triacid digestion method[9].

The details of observations and results are given in Tables 1 and 2. The tables show the concentrations of Mg, Fe, Mn, Cu, Zn, Co, B, Ni, Cr, Na, K and Ca in the resistant and red-rot disease infected sugarcane. It has been reported that the above nutrients play a major role in the sugarcane variety infected with pathotypes of red-rot pathogen[10]. Each micronutrient plays a specific biochemical role and if present in insufficient quantity, the growth and hence the yield attributes may

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be seriously reduced. The effect of pathotypes of red-rot pathogen showed imbalance of nutrient status in sugarcane. In this study, in the red-rot disease infected sugarcane the concentration of Mg, Zn and Cu is low while Na, Ca and Fe are high compared to resistant variety sugarcane.

TABLE-1
CONCENTRATION OF RESISTANT VARIETY SUGARCANE (ppm)

Elements	Co 86249	CoSi 95071	CoG 93076	Co 85019	Co 86032	CoC 99061
Calcium	9.000	11.000	10.000	5.000	4.000	6.000
Potassium	94.000	52.000	38.000	42.000	44.000	92.000
Sodium	14.000	17.000	12.000	17.000	16.000	11.000
Magnesium	31.200	20.900	26.600	28.500	29.300	34.000
Zinc	0.682	0.218	0.255	0.550	0.307	0.438
Nickel	0.087	0.022	0.024	0.022	0.028	0.045
Cobalt	0.112	0.018	0.038	0.070	0.085	BDL
Iron	9.500	4.460	3.420	7.340	8.300	4.330
Boron	0.318	0.307	0.461	0.563	0.263	0.336
Chromium	0.177	0.020	0.030	0.023	0.050	0.085
Manganese	0.536	0.225	0.287	0.288	0.324	0.343
Copper	0.198	0.129	0.058	0.150	0.058	0.248

TABLE-2
CONCENTRATION OF RED-ROT DISEASE INFECTED SUGARCANE (ppm)

Elements	CoC 671	CoC 90063	Co 6304	Mc 707	CoV 92102	CoC 98061
Calcium	14.000	19.000	12.000	14.000	15.000	16.000
Potassium	34.000	27.000	68.000	30.000	48.000	78.000
Sodium	20.000	32.000	21.000	25.000	29.000	22.000
Magnesium	18.900	17.000	14.600	13.500	13.500	17.500
Zinc	0.203	0.111	0.213	0.213	0.205	0.208
Nickel	0.027	0.020	0.020	0.016	0.027	0.016
Cobalt	0.091	0.054	0.127	0.031	0.107	0.077
Iron	26.000	10.080	21.600	15.610	19.160	14.170
Boron	0.186	0.101	0.260	0.322	0.101	0.222
Chromium	0.149	0.053	0.041	0.053	0.040	0.043
Manganese	0.577	0.403	0.403	0.309	0.274	0.147
Copper	0.027	0.025	0.048	0.040	0.057	0.020

BDL—Below detectable limit

The reason for changes in mineral status of red-rot disease infected cane was discussed. The low concentration of Mg was recorded due to the greater concentration of calcium[11]. Magnesium acts as cofactor in sugar synthesis when it is available in greater amount in the metabolic environment[12]. Zinc plays an

important role in auxin synthesis[13]. A reduction in Zn content in red-rot disease infected sugarcane was observed over resistant variety, which may be possible due to its utilization by the pathotypes of red-rot pathogen as a substrate. These results are in close conformity with the observations of Kumar *et al.*[14] Copper provides metabolic control over auxin synthesis and is involved in protein metabolism. The deficiency of copper in red-rot disease infected cane thus favours the establishment of pathogen and disease development thereby impairing sucrose synthesis. Sodium was considered to be a non-essential element for plants. Conflicting reports are available regarding the effect of disease on sodium content in sugarcane. Our results as well as Dhumal *et al.*[15] indicate that infection causes an increase in sodium content in sugarcane crops. An increasing calcium content noted in the present study may be increase in iron content in the infected cane[16]. This condition may favour rapid causing reduction in sucrose and increasing amino acids. The increased iron content in diseased cane may favour growth and result in higher content of amino acids and lowered sucrose content. From the above results we conclude that the variation of Mg, Zn, Cu, Na, Ca and Fe plays a vital role in sugarcane plant due to the effect of red-rot disease.

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