TRANSLOCATION OF Fe^{59} IN SUGARCANE PLANTS GROWN UNDER HIGH LIME SOILS

S. C. SRIVASTAVA AND D. K. TANDON

Indian Institute of Sugarcane Research, Lucknow

ABSTRACT

The translocation of Fe^{59} in sugarcane plants growing under high lime soils was studied. In different tissues the total iron content of chlorotic plant was found to be high while the manganese content was low in comparison to healthy plant growing under similar conditions. The relative percentage distribution of Fe^{59}, applied to root, in different tissues was more in the actively growing tissues of chlorotic plant than the healthy one. Similar trend was observed in upper internodes. However, in other tissues the percentage distribution was relatively low.

INTRODUCTION

It is a well known fact that the iron is an immobile element in the plant. During its uptake from the soil, either the iron is unavailable to the plants or the plants are unable to utilize the absorbed iron. Deficiency of iron of the former type is not very common in Indian soils. In the latter, immobilization of absorbed iron in plants may be attributed to some soil conditions like presence of high lime, high bicarbonate content, etc. The precipitation of iron in plants due to high lime is termed as lime induced chlorosis. In this type of chlorosis there is no restriction of iron uptake by the plants from the soil, but it is the precipitation or inactivation of iron inside the plant (McGeorge & Breazeaie, 1956; Granick, 1958). Thus, iron is not translocated to the actively growing tissues to be metabolized and gets accumulated in or near the internodes (Saughelli, 1969). This limits the utilization of iron in shallow, black soils for sugarcane cultivation. The paper describes the pattern of iron translocation in sugarcane on high lime soils.

MATERIAL AND METHODS

The studies were conducted in sugarcane under high lime conditions at Jaora (M.P.). Nine months old chlorotic and healthy plants having two canes each were selected. The pH of the rhizosphere soil was observed by saturated paste extract. The estimation of $CaCO_3$ was done by Collins' Calcimeter. The Fe^{59} was applied to the roots of the intact plants in the following way to check the fixation of Fe^{59} in soil.

Three to four active roots of the mother shoot cane were washed and dipped in petridishes containing about 22 μc Fe^{59}/g iron. The plants were harvested after 144 hr contact with radioactive iron and the samples were drawn from the mother-shoot as crown leaves, 3 to 6 leaves, 3 to 6 leaf-sheaths and the whole stem which was divided into three equal portions and designated as upper, middle and lower stem. All the analyses were done in oven dry tissues. The iron was setimated by O-phenanthroline method and Mn by periodate method as described by Jackson (1958). The Fe^{59} activity was counted in a Gamma-ray spectrometer.

RESULTS AND DISCUSSION

The pH and $CaCO_3$ content of the rhizosphere soil of chlorotic and healthy clump is given in Table 1. It shows that there is not a wide difference in pH. The chlorosis may occur due to the contact of active roots to the $CaCO_3$ present in the soil, since the total percentage of $CaCO_3$ present is high in the rhizosphere soil of chlorotic canes.

Table 1—pH and $\%CaCO_3$ content of rhizosphere soil of healthy and chlorotic plants

Tissue	Rhizosphere soil	
	pH	$\%CaCO_3$
Healthy	7.8-8.4	9.2-13.8
Chlorotic	8.2-8.8	12.1-15.5

As reported by SRIVASTAVA, AGARWAL AND JAFRI (1966), the sugarcane plants grown under high lime conditions became chlorotic and contained high iron and low manganese when compared to the healthy ones grown under the same conditions, thus affecting the iron manganese ratio to a high extent (Table 2). Therefore, in high lime soils the unavailability of iron is not there, but the iron becomes inactive inside the plant and limits the chlorophyll formation.

Table 2—Mineral content in different tissues of healthy and chlorotic plants (oven dry tissue)

Tissue	µg Fe/g tissue		µg Mn/g tissue		Fe/Mn	
	Healthy	Chlorotic	Healthy	Chlorotic	Healthy	Chlorotic
Crown	93.34	133.34	18.33	10.83	5.1	12.3
Leaves 3 to 6 ..	120.00	146.67	27.50	9.17	4.4	26.0
Sheaths 3 to 6	40.00	53.34	16.46	7.21	2.4	7.3
Upper stem	86.67	66.67	17.81	16.85	4.9	4.0
Middle stem	40.00	60.00	16.43	18.76	2.4	3.2
Lower stem	60.00	66.67	14.52	14.94	4.1	4.6

The percentage distribution of Fe^{59} on different tissues of healthy and chlorotic sugarcane plants shows that iron moves freely to all tissues (Table 3). The high iron percentage in chlorotic plant is found in crown leaves and upper stem while in other tissues it is low in comparison to the healthy ones. The specific activity in different tissues of healthy plant is high as compared to chlorotic plant except in upper stem. The low specific activity in different tissues in chlorotic plant reveals that it may be due to the higher content of iron present in respective tissues.

Our results show that during absorption from the roots the iron first moves towards the actively growing tissues as was reported by BROWN, YAMAGUCHI AND LEAL-DIAZ (1965) showing that the plants growing under high lime conditions take up iron which gets pre-

Table 3—Distribution of Fe^{59} in different tissues of healthy and chlorotic sugarcane plants

Tissue	% Fe^{59} distribution		Specific Activity $\times 10^{-4}$	
	Healthy	Chlorotic	Healthy	Chlorotic
Crown	23.7	24.9	27.6	17.2
Leaves 3 to 6 ..	24.8	22.3	22.5	14.0
Sheaths 3 to 6 ..	25.1	24.7	68.5	42.7
Upper stem	10.3	13.8	12.9	19.0
Middle stem	8.4	8.3	22.7	16.4
Lower stem	7.7	5.9	14.0	10.1

cipitated in the respective tissues having preferential accumulation in sheaths and thus rendering it unavailable for normal functioning.

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