Asian Journal of Chemistry Vol. 16, Nos. 3–4 (2004), 1897–1900

FT-IR Spectroscopic Studies for the Detection of Amino Acids in Sugarcane Status Infected with Red-rot

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An attempt has been made to investigate the status of amino acid content in resistant and red-rot disease infected sugarcane crop using FT-IR spectral study. From the present study it has been shown that FT-IR can be used for the detection of amino acids to a high degree of success and their status in both diseased and resistant varieties.

Key Words: Sugarcane, Red-rot, FT-IR, Amino acids.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is affected by many diseases of which red-rot is considered to be the most important one. Many researchers[1–4] have reported that the sugarcane infected with this disease is associated with changes in amino acids content. A number of reports[5–7] regarding qualitative and quantitative assessment of amino acids in sugarcanes are available in literature, but very little attention has been paid to determine the amino acid composition of sugarcane through spectroscopic studies. Not much work has been done to identify the presence of amino acids and their compositions using infrared spectroscopy. Hence the present study has been undertaken.

EXPERIMENTAL

In the present study, 12 varieties of sugarcane (Co 86249, CoG 93076. Co 86032, CoC 99061, CoSi 95071, Co 85019 (resistant) and CoC 671, CoC 90063. CoC 98061, Me 707, CoV 92102, Co 6304 (red-rot infected)) crop at the age of eight months were collected from different fields in the sugarcane growing area of EID Parry (India) Limited, Nellikuppam, Cuddalore District, Tamil Nadu, India. Samples were collected field-wise by adopting standard procedure. Sugarcane plant samples of both resistant sugarcane, resistant leaves and red-rot disease infected sugarcane, red-rot disease infected leaves were oven dried at 110°C, ground to fine powder and the IR spectra were recorded using the KBr pellet technique employing a Perkin-Elmer FT-IR spectrometer in the range of 4000–

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400 cm^{-1}. 1 mg of sample was mixed with 20 mg of potassium bromide (1 : 20) and pressed into uniform pellets of uniform thickness with a diameter of 13 mm.

RESULTS AND DISCUSSION

From the IR spectra of all the samples, absorption bands occur at 3452, 2927. 2352, 1635, 1253 and 1053 cm^{-1}. The tentative assignments are shown in Table-1. All the bands can be assigned to the presence of various amino acids, polysaccharides and chlorophyll groups. The amount of variation may be expressed in terms of the variation of extinction coefficient "K".

The extinction coefficients are calculated for prominent absorption bands at 1635 and 1053 cm^{-1} belonging to amino groups using the relation K = DA/M, where D is optical density, A is area of cross-section and M is mass of the sample in mg. The details of observations and results are given in Tables 2–5. The ratio between leaves and sugarcanes of both resistant and red-rot disease infected sugarcane of frequency 1635 and 1053 cm^{-1} is found.

From Tables 2 and 4 we observe that the ratio between leaves and cane of resistant variety sugarcane of frequency 1635 cm^{-1} is found to be increasing, but the red-rot disease infected sugarcane of frequency 1635 cm^{-1} shows that the ratio between leaves and sugarcane is found to be decreasing. A similar trend is observed corresponding to frequencies 1053 cm^{-1}. It is evident from the results presented in Tables 2–5 that the ratio between leaves and sugarcane of resistant variety of sugarcane is found to have an increasing trend compared to red-rot disease infected sugarcane crop. The trend was the same at both the frequencies 1635 and 1053 cm^{-1}. From the results, we conclude that the amino acid content increases in red-rot disease infected sugarcane crop and decreases in resistant variety sugarcane crop, which is in consonance with results obtained in earlier studies.

TABLE-1
INFRARED ABSORPTION FREQUENCIES (cm^{-1})
AND THEIR ASSIGNMENTS

Frequency (cm^{-1})	Assignments
3452 vs, br	Bonded OH stretch/NH stretch
2925 sw	CH stretching
2356 m	NH_3^+ stretching
1635 s	C=O stretch /amino acids
1250 m	C—O stretching
1053 s	CO stretching

s: Strong, vs: Very strong, br: Broad, m: Medium.

TABLE-2
EXTINCTION COEFFICIENT (K) OF PROMINENT ABSORPTION BAND 1635 cm^{-1} AND RATIO BETWEEN LEAVES AND CANE OF RESISTANT VARIETY OF SUGARCANE

Variety	Resistant sugarcane Ex. coeff. (cm^2/mg)	Resistant leaves Ex. coeff. (cm^2/mg)	Leaves/ Sugarane
Co 86249	0.0400	0.0708	17.70
CoG 93076	0.0076	0.0650	8.55
Co 86032	0.0100	0.0488	4.88
CoC 99061	0.0118	0.0553	4.68
CoSi 95071	0.0164	0.0309	1.88
Co 85019	0.0509	0.0868	1.70

TABLE-3
EXTINCTION COEFFICIENT (K) OF PROMINENT ABSORPTION BAND 1635 cm^{-1} AND RATIO BETWEEN LEAVES AND CANE OF RED-ROT DISEASE INFECTED SUGARCANE

Variety	Red-rot sugarcane Ex. coeff (cm^2/mg)	Red-rot leaves Ex. coeff (cm^2/mg)	Leaves/ Sugarcane
CoC 671	0.0786	0.0670	0.85
CoC 90063	0.1110	0.0878	0.79
CoC 98061	0.2258	0.0533	0.23
MC 707	0.1121	0.0854	0.76
CoV 92102	0.0812	0.0467	0.57
Co 6304	0.0993	0.0798	0.80

TABLE-4
EXTINCTION COEFFICIENT (K) OF PROMINENT ABSORPTION BAND 1053 cm^{-1} AND RATIO BETWEEN LEAVES AND SUGARCANE OF RESISTANT VARIETY OF SUGARCANE

Variety	Resistant sugarcane Ex. coeff. (cm^2/mg)	Resistant leaves Ex. coeff. (cm^2/mg)	Leaves/ Sugarcane
Co 86249	0.0195	0.2295	11.77
CoG 93076	0.0862	0.2290	2.65
Co 86032	0.1340	0.4959	3.70
CoC 99061	0.1523	0.2336	1.53
CoSi 95071	0.1345	0.4160	3.09
Co 85019	0.2064	0.3776	1.82

TABLE-5
EXTINCTION COEFFICIENT (K) OF PROMINENT ABSORPTION BAND 1053 cm^{-1} AND RATIO BETWEEN LEAVES AND SUGARCANE OF RED-ROT DISEASE INFECTED SUGARCANE

Variety	Red-rot sugarcane Ex. coeff. (cm^2/mg)	Red-rot leaves Ex. coeff. (cm^2/mg)	Leaves/ Sugarcane
CoC 671	0.2573	0.1899	0.73
CoC 90063	0.5020	0.3308	0.65
CoC 98061	0.2064	0.1854	0.89
MC 707	0.3040	0.3330	1.09
CoV 92102	0.3081	0.1387	0.45
Co 6304	0.3165	0.2321	0.73

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(*Received*: 7 April 2004; *Accepted*: 10 June 2004) AJC-3461