
Study of Ecological Relationship of *Colletotrichum falcatum* with Other Fungi in Sugarcane Stalks

A. BISWAS* AND N. SAMAJPATI

Sugarcane Research Station, Bethuadahari, 741126, India and
Mycology Laboratory, Department of Botany, University of Calcutta,
Calcutta 700 019, India.

In the study of ecological relationship of *C. falcatum* with other fungi in sugarcane stalks it was observed that *F. moniliforme* was comparatively slower in growth than *C. falcatum*, the red rot fungus. However, *F. moniliforme* became activated in the presence of *C. falcatum*, the reverse, i. e. *F. moniliforme* apparently did not play any conspicuous role in accentuating the activity of *C. falcatum* in cane stalks. The progress of the two fungi within inoculated stalks was determined by actual isolations. It was also observed that *F. moniliforme* could be present in an internode showing no symptoms of the disease.

Key words : Ecological relationship, *Colletotrichum falcatum*, *Fusarium moniliforme*

INTRODUCTION

In the course of work on red rot, it was observed that canes showing typical symptoms of red rot, collected from various experimental plots of the Sugarcane Research Station, Bethuadahari, Nadia and its adjoining cane fields, yields *Colletotrichum falcatum* (the red rot pathogen) as well as *Fusarium moniliforme* (the wilt pathogen) on culture media. This association was particularly found to be very common in all the collections made from heavily infected plots in the cultivars e.g., Co. 419, Co. 527, Co. 961, Co. 975, Co. 997, Co. 1132, Co. 6311, Co. 6315 etc. It was thus apparent that the two fungi could thrive in the same sugarcane stalk.

This is the part of a Ph.D. thesis under the guidance of the second author, submitted by the first author to the Calcutta University.

*Present address : Zonal Adaptive Research Station, Kakdwip-743347, India.

The reasons for this co-existence are not fully known. An attempt was, therefore, made during three consecutive crop seasons (1981-1982 to 1983-1984) at the Sugarcane Research Station, to determine the ecological relationship of *Colletotrichum falcatum* and *Fusarium moniliforme* in sugarcane stalks under conditions at Bethuadahari.

MATERIALS AND METHODS

Twenty apparently healthy seven-months-old standing cane stalks of five selected sugarcane cultivars viz., Co. J. 64, Co. 961, Co. 1132, Co. 6311 and Co. 6415 were inoculated by Standard Plug Method (Chona, 1954) separately with 15 days old pure cultures of (i) *C. falcatum* (Isolate WB-2) (ii) *F. moniliforme* (Isolate W-3) and (iii) mixed culture of *C. falcatum* and *F. moniliforme* respectively in the second fortnight of September every year. Equal quantities of the inoculum were used in each case. Similarly equal amount of inoculum of both the fungi was mixed in the mixed culture. Suitable checks, inoculated with sterile water, were maintained in each case. After four months of inoculation, the canes were split open longitudinally and the linear spread of infection as determined from visual symptoms was recorded.

To determine the spread of each of the two fungi in cane stalks inoculated with *C. falcatum* and *F. moniliforme* singly or in combination, isolations were made from all internodes from the one above inoculated internode to the apex including both discoloured (affected) and apparently unaffected ones. Canes with the dried off tops were not taken for such isolations. As it was very inconvenient to handle such a huge number of samples, only two tissue samples were drawn from each internode and transferred aseptically to OMA medium. Only three stalks for each cultivar were examined in this way. The number of internodes varied in different cultivars depending upon the extent of spread of lesions in cane stalks.

RESULTS AND DISCUSSION

Reaction of five sugarcane cultivars inoculated with *C. falcatum* and *F. moniliforme* singly and in combination and the fungi reisolated from internodes are presented in Table I.

Data in Table I indicated that the per cent length of infection in cane stalks inoculated with the mixed cultures was almost the same as with *C. falcatum* singly in all the cultivars. The presence of *F. moniliforme* did not appear to have any effect on the pathogenic activity of *C. falcatum*. Data also showed that the per cent length of infection was much less in the case of *F. moniliforme* than in either of the other two cases. However, when *C. falcatum* and *F. moniliforme*

Table 1 : Reaction of five sugarcane cultivars inoculated with *C. falcatum* and *F. moniliforme* singly and in combination**

Cultivars	Fungi inoculated	% length of Cane showing red rot	Number of inter-nodes discoloured	Fungi reisolated	Furthest internode from which reisolated
Co. J. 64	<i>C. falcatum</i>	35.5	7	<i>C. falcatum</i>	7
	<i>F. moniliforme</i>	25.4	2	<i>F. moniliforme</i>	3
	<i>C. falcatum</i> + <i>F. moniliforme</i>	40.1	8	<i>C. falcatum</i> <i>F. moniliforme</i>	8 10
Co. 961	<i>C. falcatum</i>	46.2	8	<i>C. falcatum</i>	8
	<i>F. moniliforme</i>	11.7	2	<i>F. moniliforme</i>	3
	<i>C. falcatum</i> + <i>F. moniliforme</i>	38.1	7	<i>C. falcatum</i> <i>F. moniliforme</i>	7 10
Co. 1132	<i>C. falcatum</i>	54.3	7	<i>C. falcatum</i>	7
	<i>F. moniliforme</i>	33.8	3	<i>F. moniliforme</i>	4
	<i>C. falcatum</i> + <i>F. moniliforme</i>	60.5	8	<i>C. falcatum</i> <i>F. moniliforme</i>	8 10
Co. 6311	<i>C. falcatum</i>	29.0	5	<i>C. falcatum</i>	5
	<i>F. moniliforme</i>	18.5	2	<i>F. moniliforme</i>	4
	<i>C. falcatum</i> + <i>F. moniliforme</i>	32.5	5	<i>C. falcatum</i> <i>F. moniliforme</i>	5 9
Co. 6315	<i>C. falcatum</i>	85.5	10	<i>C. falcatum</i>	10
	<i>F. moniliforme</i>	27.0	2	<i>F. moniliforme</i>	3
	<i>C. falcatum</i> + <i>F. moniliforme</i>	83.4	10	<i>C. falcatum</i> <i>F. moniliforme</i>	10 13

** Average of 3 years (1981-82 to 1983-84)

were inoculated as mixed culture, the affected internodes turned purple red with concomittant development of white spots elongated at right angles to the long axis of the stalks. In such cases, it was extremely difficult to locate strands invaded by *C. falcatum* or *F. moniliforme*.

Data on spread of *C. falcatum* in sugarcane stalks inoculated with only *C. falcatum* as determined by actual isolations are given in Tables 1 and 2.

Data in Tables 1 and 2 revealed that inoculation with singly resulted in a visible lesion in the inoculated internode and also in the 5-10 internodes immediately above it. The fungus could be reisolated only from the internodes showing visible symptoms. Apparently healthy internodes above last (top most) internode showing discolouration yielded no *C. falcatum*.

Table 2 : Spread of *C. falcatum* in sugarcane stalks inoculated with only *C. falcatum*.

Cultivars	Serial number of internode from base to top*	Discolouration of tissues in internode	Total number of tissue samples drawn for isolations from internodes	Number of tissue samples yielding <i>C. falcatum</i>
Co. J. 64	1	+	12	12
	2	+	12	12
	3	+	10	10
	4	+	9	9
	5	+	7	7
	6	+	8	8
	7	+	11	11
	8	—	10	0
Co. 961	1	+	14	14
	2	+	10	10
	3	+	8	8
	4	+	7	7
	5	+	8	8
	6	+	5	5
	7	+	4	4
	8	+	4	4
	9	—	8	0
Co. 1132	1	+	25	25
	2	+	20	20
	3	+	18	18
	4	+	15	15
	5	+	12	12
	6	+	8	8
	7	+	12	12
	8	—	12	0
Co. 6311	1	+	16	16
	2	+	18	18
	3	+	12	12
	4	+	10	10
	5	+	8	8
	6	—	11	0

Co. 6315	1	+	22	22
	2	+	20	20
	3	+	18	18
	4	+	17	17
	5	+	20	20
	6	+	15	15
	7	+	12	12
	8	+	8	8
	9	+	10	10
	10	+	7	7
	11	—	8	0

* Inoculated internode taken as 0

+ Discolouration present

— No discolouration

** Average of three years (1981-82 to 1983-84)

Spread of *F. moniliforme* in sugarcane stalks inoculated with only *F. moniliforme* as determined by actual isolations are presented in Tables 1 and 3.

Table 3 : Spread of *F. moniliforme* in sugarcane stalks inoculated with only *F. moniliforme***

Cultivars	Serial Number of internode from base to top*	Discolouration of tissues in internode	Total number of tissue samples drawn for isolations from internodes	Number of tissue samples yielding <i>F. moniliforme</i>
Co. J. 64	1	+	7	7
	2	+	4	4
	3	—	8	2
	4	—	7	0
Co. 961	1	+	10	10
	2	+	8	8
	3	—	7	3
	4	—	6	0
Co. 1132	1	+	12	12
	2	+	14	14
	3	+	10	10
	4	—	8	2
	5	—	8	0
Co. 6311	1	+	14	14
	2	+	8	8
	3	—	7	5

	4	—	4	1
	5	—	10	0
Co. 6315	1	+	12	12
	2	+	5	5
	3	—	6	2
	4	—	8	0

* Inoculated internode taken as 0

+ Discolouration present

— No discolouration

** Average of three years (1981-82 to 1983-84)

Data in Tables 1 and 3 indicated that inoculation with *F. moniliforme* alone resulted in a visible lesion in the inoculated internode and also in the 2-3 internodes only immediately above it. The fungus could be reisolated from the internodes showing visible symptoms and also from 1-2 apparently healthy internodes above last (top most) internode showing discolouration.

Spread of *C. falcatum* and *F. moniliforme* in sugarcane stalks inoculated with mixed cultures as determined by actual isolations are presented in Tables 1 and 4.

Data in Tables 1 and 4 revealed that in stalks inoculated simultaneously with the mixed cultures of *C. falcatum* and *F. moniliforme* visible lesions are encountered in the inoculated internode and also in the 5-10 internodes immediately above it which was almost the same as with *C. falcatum* singly. *C. falcatum* could be reisolated only from the visibly affected internodes whereas *F. moniliforme* from all the visible affected internodes as well as the apparently healthy internodes 2-4 above the top most internode showing discolouration. The range of spread of *F. moniliforme* in the tissues without accompanying visible lesion was found to have increased in cases of simultaneous inoculation with *C. falcatum*.

It has been observed by various workers that in epidemic areas, *C. falcatum* is often found in association with the wilt fungus (Butler and Khan, 1913; Hartin-Leake, 1944; Bourne, 1953; Khanna and Rafay, 1953; Abbott and Mughes, 1961; Srinivasan, 1964).

The present study confirms the reports of early workers from India and abroad. Results of present studies show that within a sugarcane stalk the number of internodes traversed by *C. falcatum* is higher than *F. moniliforme*, when these two fungi are inoculated separately. In cases of mixed inocula, however, *F. moniliforme* traverses a larger number of internodes than *C. falcatum*. Whereas *F. moniliforme* becomes activated in the presence of *C. falcatum* the reverse, i.e.,

Table 4 : Spread of *C. falcatum* and *F. moniliforme* in sugarcane stalks inoculated with mixed cultures**

Cultivars	Serial number of internode from base to top*	Discolouration of tissue in internode	Total number of tissue samples drawn for isolations from internode	% (of total) samples yielding <i>C. falcatum</i>	% (of total) samples yielding <i>F. moniliforme</i>
Co. J. 64	1	+	25	60.0	40.0
	2	+	25	64.0	36.0
	3	+	20	45.0	55.0
	4	+	16	37.5	62.5
	5	+	10	30.0	70.0
	6	+	11	45.4	54.5
	7	+	4	50.0	50.0
	8	+	4	50.0	50.0
	9	—	10	0.0	100.0
	10	—	10	0.0	100.0
	11	—	12	0.0	0.0
Co. 961	1	+	15	53.3	46.6
	2	+	18	55.5	44.4
	3	+	10	60.0	40.0
	4	+	8	62.5	37.5
	5	+	3	66.6	33.3
	6	+	6	50.0	50.0
	7	+	4	50.0	50.0
	8	—	8	0.0	100.0
	9	—	10	0.0	100.0
	10	—	10	0.0	0.0
	11	—	12	0.0	0.0
Co. 1132	1	+	26	61.5	38.4
	2	+	28	60.7	39.2
	3	+	18	66.6	33.3
	4	+	12	58.3	41.6
	5	+	10	60.0	40.0
	6	+	8	62.5	37.5
	7	+	6	50.0	50.0
	8	+	4	50.0	50.0
	9	—	6	0.0	100.0
	10	—	10	0.0	100.0
	11	—	10	0.0	0.0
	1	+	6	33.3	66.6
	2	+	7	57.1	42.8
	3	+	3	66.6	33.3
	4	+	4	50.0	50.0

Co. 6311	5	+	4	50.0	50.0
	6	—	10	0.0	100.0
	7	—	8	0.0	100.0
	8	—	10	0.0	100.0
	9	—	10	0.0	100.0
	10	—	10	0.0	0.0
Co. 6315	1	+	26	65.3	34.6
	2	+	20	75.0	25.0
	3	+	12	58.3	41.6
	4	+	10	60.0	40.0
	5	+	8	50.0	50.0
	6	+	5	60.0	40.0
	7	+	5	60.0	40.0
	8	+	5	40.0	60.0
	9	+	3	33.3	66.6
	10	+	2	50.0	50.0
	11	—	8	0.0	100.0
	12	—	10	0.0	100.0
	13	—	10	0.0	100.0
	14	—	10	0.0	0.0

* Inoculated internode taken as 0

+ Discolouration present

— No discolouration

** Average of three years (1981-82 to 1983-84)

F. moniliforme apparently do not play any conspicuous role in accentuating the activity of *C. falcatum* in cane stalks, which is in accordance with Singh and Singh (1975). On the other hand, this observation is at variance with that of Khanna and Rafay (1953) who considered that the *Fusarium* considerably increased the damage caused by red rot.

The present study clearly indicated that some ecological relationship exists between the two fungi in sugarcane stalks which is confirmed by the development and pathogenicity of *F. moniliforme* which seems to be added by the food base offered by the host tissue killed by *C. falcatum* infection. It is also likely that red rot injury in any part of cane lowers the resistance or tolerance power of other parts to infection by *F. moniliforme* and this may be the reason of the two fungi are often found together in cane stalks.

ACKNOWLEDGEMENT

Grateful thanks are due to the Director of Agriculture, West Bengal to permit the first author to carry out research works at the Sugarcane Research Station, Bethuadahari.

The first author is indebted to Dr. S. B. Chattopadhyay, Ex-Vice Chancellor of Bidhan Chandra Krishi Viswavidyalaya for critically going through the manuscript and making many valuable comments and suggestions. Thanks are also due to the Mycologist, West Bengal, Agronomist and Asstt. Sugarcane Specialist of Sugarcane Research Station, Bethuadahari for providing necessary facilities.

REFERENCES

- Abbott, E. V. and Hughes, C. G. (1961). Red rot, In, *Sugarcane diseases of the world* Vol. I. Edited by Martin *et al.*, Elsevier Publishing Company, Amsterdam, pp. 263-282.
- Bourne, B. A. (1953). Studies on Sugarcane red rot in the Florida Everglades. *Proc. Int. Soc. Sug. Cane Technol.*, 8, 915-924.
- Butler, E. J. and Khan, A. H. (1913). Some new sugarcane diseases Part I. Wilt. *Mem. Dept. Agri. India Bot. Ser.*, 6 : 180-190.
- Chona, B. L. (1954). Studies on the diseases of Sugarcane in India IV. Relative resistance of Sugarcane varieties to red rot. *Ind. Jour. Agric. Sc.*, 24 : 301-315.
- Khanna, K. L. and Rafay, S. A. (1953). Annual report of the scheme for the investigation and control of wilt diseases of sugarcane for the year ending 31st May, 1953. Central Sugarcane Research Station, Pusa, Bihar, India, 14 pp.
- Martin-Leake, H. (1944). Red rot of sugarcane. *Intern. Sug. Jour.*, 46 : 7-8.
- Singh, K., Budhraj, T. R., and Singh, M. B. (1965). The development and pathogenicity of *Cephalosporium sacchari* Butler as affected by *Physalospora tucumanensis* Speg. in Sugarcane stalks. *Proc. Intern. Soc. Sugarcane Technology*, 12 : 1120-1124.

(Accepted for publication 24th August 1990)