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Research Article

A Study on Genetics of Red Rot Resistance in Sugarcane

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Abstract

Out of 7 crosses with one or both the parents resistant to red rot, five crosses produced predominantly resistant progenies ranging from 61.64% in Co 7201 x 96-195 to 83.72% in Co 86002 x 96-38. In two crosses with one of the parents resistant there was a higher proportion (77.61 to 91.67%) of susceptible progenies. The cross Co 7201 x 96-104 (MR x MR) produced maximum proportion (80.0 %) of resistant seedlings. In the crosses with Co 86002 (S) as female parent and three other moderately resistant male parents, the proportion of resistant progenies was higher compared to susceptible ones. In the cross involving female parent as MR and male as MS (Co 7201 x 96-195) the proportion of resistant seedlings was 61.64% and susceptible 38.36%.The parents 96-38, 96-195, 95-108 (F_1 of improved *S.officinarum x S.spontaneum)* produced more resistant progenies.The parent Co 7201 was identified as a good general combiner and found to transmit resistance to majority of its progenies.

Key Words: *S.spontaneum*, red rot, resistance, progenies

Introduction

Among biotic stresses, certain diseases like red rot, smut, RSD, GSD, YLS are some of the important diseases causing moderate to heavy loss in cane productivity. Red rot is the most important disease of concern causing heavy loss to farmer throughout the country except certain pockets. Among the control measures for red rot, resistant varieties play very crucial role besides other management practices. Development of resistant varieties of sugarcane through breeding needs the knowledge on the genetic basis of resistance to red rot. Hence, the present study was taken up with the objective of finding the genetic basis of resistance to red rot in sugarcane.

Material and Methods

Five hundred and eighty six clonal progenies from 9 crosses viz., Co 7201 x 96-104 (70),Co 7201 x 96-195 (73), Co 86002 x 96-38 (86), Co 86002 x 95-155(30),Co 86002 x 96-155 (27),Co 88028 x 95-104 (67),Co 94005 x 96-550 (24),Co 86002 x 96-195 (102), Co 88032 x 95-108 (107) were utilized for the study. The crosses were made during Oct- Nov, 2000 flowering season and seedlings were raised during 2001. The unselected clonal population was planted at Coimbatore during 2004 and tested for red rot reaction using CCT method (Mohanraj *et al*., 1997) against mixed inoculum of red rot fungus during 2004. The clones were rated as R, MR, MS, S and HS based on the standard procedure (0-9 scale)

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Results and Discussion

The clonal progenies screened against red rot varied from 24 in the cross Co 94005 x 96-550 to 107 in Co 88032 x 95-108. The crosses were grouped into those involving parents with moderately resistant (MR) x moderately (MR) resistant, MR x MS (moderately susceptible), susceptible (S) x Resistant (R) or MR and S x S or MS (moderately susceptible) reaction. The cross Co 7201 x 96-104 (MR x MR) produced maximum proportion (80.0 %) ie. 56 out of 70 progenies of resistant seedlings (Table 1). Only 20%of the seedlings (11 MS, 3S and 0 HS) were cateogorized as susceptible. In the cross involving female parent as MR and male as MS (Co 7201 x 96-195) out of 73 progenies, 2 were R and 43 were MR

making 45 or 61.64% resistant and 38.36% susceptible which included 10 MS, 14 S and 4 HS. This indicated that the resistant parents imparted resistance to their progenies.

The third category comprised of five crosses in which female was susceptible and male MR or R. In the three crosses with Co 86002 (S) as female parent and three other moderate resistant male parents,the proportion of resistant progenies was higher compared to susceptible ones. In the cross Co 86002 x 96-38, there were two resistant and 70 moderately resistant progenies out of a total of 86 progenies. Among the remaining progenies, 9 were moderately susceptible, 3 susceptible and two were highly susceptible. In the cross Co 86002 x 95-155 there were 2 R and 18 MR out of 30 progenies and in Co 86002 x 96-155, there were 19 MR out of 27 progenies making the proportion of resistant progenies 66.67% in the former and 70.37% in the later cross. In the two crosses Co 88028 x 95-104 and Co 94005 x 96-550, the number of susceptible progenies was high compared to resistant progenies. In Co 88028 x 95-104, 52 out of 67 progenies and in Co 94005 x 96-550, 22 out of 24 progenies were found to be susceptible making 77.60% and 91.67% of progenies susceptible respectively. In all the five crosses, the derivatives of *S.spontaneum* were used as male parents which were either MR or R.
In the last category in which both the parents were susceptible, the number of resistant progenies was higher in the cross Co 86002 x 96-195 (67.65) while in Co 88032 x 95-108 the number of susceptible progenies was higher (59.81%). The latter cross showed one progeny with 'R'. Large number of resistant progenies found in the cross involving both susceptible parents indicated the role of interaction of genes from both parents. Development of resistant progenies from crosses involving susceptible parents from the study indicated the possibilities of exploiting additive gene interaction effect to produce resistant progenies.

Out of 7 crosses with one or both the parents resistant, five crosses produced predominantly resistant progenies ranging from 61.64% in Co 7201 x 96-195 to 83.72% in Co 86002 x 96-38. In two crosses with one of the parents resistant there was a higher proportion (77.61 to 91.67%) of susceptible progenies. The results from the progeny populations suggest that the utilization of resistant sources in crossing would increase the frequency of red rot resistance in the population.

The study showed that even when both susceptible parents were used, large number of progenies with resistance to red rot can be obtained. But possibility of getting more resistant progenies is higher by using at least one resistant parent. In general it was observed that progenies from crosses involving resistant parents tend to be more towards resistant or moderately resistant reaction. The parents 96-38, 96-195, 95-108 with 50 % genes of *S.spontaneum* produced more resistant progenies as expected. The parent Co 7201 also can be used as a good general combiner as it was found to transmit resistance to the extent of 60.0%.

Both additive and dominance variances were equally important and heritability (in narrow sense) was 0.51 for red rot resistance in sugarcane. High value (0.97) of heritability (in broad sense) indicated the negligible influence of environment on red rot disease development in sugarcane (Bakshi ram and Sahi, 2005). Different segregating ratios (1:3, 3:1 and 1:5) were reported (Chaudhary , *et al*., 1986) for resistance to susceptible clones. He also stated that few genes with additive effect governed the disease. R – HS & (MS&S) were found to be proportionate to number of loci having dominant or recessive alleles. In our present study also (2:1, 1:1.5, 4:1 and 1:5, 11:1) ratio for resistant to susceptible genotypes in response to red rot was observed. The segregation of resistant and susceptible progenies could not be fit into any specific pattern for making prediction due to high heterozygous nature of parents and also due to meiotic pecularities in the crop.

Generally, the source of resistance to red rot is contributed by *S.spontaneum* clones and it is the segregation of whole chromosomes from S.*spontaneum* rather than specific genes which is reflected in the segregation of resistant and susceptible progenies. The segregation pattern of red rot inheritance varied with the crosses and was assumed to be governed by single gene and by two genes as observed in our study. This may be attributed to the elimination of dominant or recessive *S.spontaneum* genes which imparts resistance or susceptibility in sugarcane.

S. spontaneum hybrids were identified as potential sources of resistance to red rot. (Natarajan *et al*., 2001) emphasized the importance of horizontal and vertical resistance in sugarcane red rot and stressed upon the introduction of new variability of

S.spontaneum to attain stable resistance. In our study, all the male parents used were F_1 hybrids from *S.officinarum* and *S.spontaneum*. The results from the present study suggest that the utilization of identified resistance sources as donors in crossing would increase the frequency of red rot resistance in the progeny population for making effective selection and production of red rot resistant varieties in sugarcane.

Inferences

The study implies that:

I. The frequency of resistant progenies was higher when one of the parents was resistant to red rot.

II. High proportion of resistant progenies were obtained (40–68%) in cross combinations involving susceptible parents which might be due to interaction of additive genes.

III. The genetic segregation appears to be controlled by more than one gene which is most probably from *S.spontaneum*. Hence segregation is due to both gene segregation and chromosome segregation, because *S.spontaneum* chromosomes generally are univalents and elimination of chromosomes is very common. Thus in both female and male parents, the source of resistance is probably *S.spontaneum*.

The paucity of resistance in the current breeding population indicates the need to identify new sources of resistance.The introduction of new *S.spontaneum* clones will thus increase the probability of producing varieties with stable resistance.The results indicate that level of red rot resistance in the population can be increased by careful choice of parent clones and cross-based selection. The genetic stocks developed from this study can be exploited for developing red rot stable resistant clones.

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Table1. Segregation for red rot (CCT)

		Cross/Cateogory	R	MR	MS	S	HS	Total	Monogenic ratio
I		**MR x MR**							(R:S)
	1.	Co 7201 x 96-104	1	55	11	3	0	70	4 :1
		MR x MS							
	2.	Co 7201 x 96-195	2	43	10	14	4	73	2:1
II		**S x R or MR**							
	3.	Co 86002 x 96-38	2	70	9	3	2	86	3:1
	4.	Co 86002 x 95-155	2	18	3	6	1	30	2:1
	5.	Co 86002 x 96-155	0	19	3	5	0	27	2:1
	6.	Co 88028 x 95-104	0	15	17	32	3	67	1:3
	7.	Co 94005 x 96-550	0	2	3	16	3	24	1.11
III		**S x MS or S**							
	8.	Co 86002 x 96-195	0	69	19	9	5	102	2:1
	9.	Co 88032 x 95-108	1	42	25	34	5	107	1:1.5