

PECTIC AND CELLULOLYTIC ENZYMES
ASSOCIATED WITH *GLOEOSPORIUM*
ROT OF PAPAYA

PAPAYA (*Carica papaya* L.) fruit rot caused by *Gloeosporium papayae* P. Henn. was examined, to find out the involvement of pectic and cellulolytic enzymes in the disease.

Extracts of healthy and infected tissue were prepared by homogenising 100 g of the tissue in 100 ml of distilled water. Homogenised tissue extract was centrifuged for 5 minutes at 3000 r.p.m. Clear liquid thus obtained was used as enzyme extract for enzyme analysis. Pathogen was also grown in natural papaya pulp medium, to determine secretion of these enzymes. Water extract of the above, after removing fungal growth was used as the source of enzyme.

and cellulase are viscosity reducing enzymes and were determined by viscometric procedure (Van Etten *et al.*, 1967)¹. PME was determined by continuous titration method (Kertesz, 1951)². Boiled enzyme extracts were taken as control which did not show any enzyme activity.

Results have been presented in Table I. Out of the various enzymes studied, extracts of just ripe healthy papaya tissue, indicated the activity of PME and PG. PME was not secreted by the pathogen in papaya pulp medium, but its activity was detected in the extracts of infected tissue. It may therefore be concluded that PME associated with infected tissue is of host origin, and that its release has been accelerated by some host-pathogen interaction. Source of PG appears to be host as well as pathogen, because it has been detected in healthy tissue extract,

TABLE I

Pectic and cellulolytic enzymes associated with healthy and infected papaya fruit, and secreted in papaya pulp medium by the pathogen

	D. ys of incubation	Enzyme Activity*					
		PG	PMG	PME	PGTE	PMTE	Cellulase
Healthy	7	5.2	..	0.033	..	..	..
Fruit	12	11.5	..	0.044	..	..	..
Infected	7	71.4	47.9	0.077	10.4	17	27.3
Fruit	12	43.4	17.9	0.102	22.5	37.7	36
Papaya	4	49	53	..	10.3	6	..
Pulp	7	18.6	16.2	..	25.6	22	8.1
Medium	9	13.9	9.0	..	32.3	34	11.8
	12	..	..	..	21.0	17.7	4.5

* Enzyme activity of PG, PMG, PGTE, PMTE and Cellulase, expressed as the % loss in the viscosity of enzyme-substrate reaction mixture after 90 min reaction time. Activity of PME expressed as the amount of 0.22 N NaOH in ml., absorbed/ml enzyme-substrate reaction mixture during 120 min. reaction time. Total volume of the reaction mixture for PME was 35 ml; 5 ml enzyme extract, 30 ml 1.2% pectin in water. Values of enzyme activity are the mean of three separate observations for each.

The following enzymes were detected during the studies. Polygalacturonase (PG), Polymethylgalacturonase (PMG), Pectinmethyl-trans-eliminase (PMTE), Polygalacturonate-trans-eliminase (PGTE), Pectin Methylsterase (PME) and Cellulase. The substrate for PG and PGTE was sodium polypectate; for PMG, PMTE and PME, pectin; and for cellulase, carboxy methylcellulose. Reaction pH for glycosidases was 4.6; for transeliminases 8; and for cellulase 5. PG, PMG, PGTE, PMTE,

as well as in culture medium. Other enzymes associated with infected tissue (PMG, PGTE, PMTE and Cellulase) appear to be of pathogen origin. These enzymes are secreted by the pathogen in culture medium, and they were not detected in the extracts of healthy tissue.

Plant tissues contain pectic material in middle lamella, as well as impregnated in the cellulose skeleton of the cell walls. While cellulose skeleton of the cell is degraded by the cellulase, pectic

material of the cell wall is degraded by pectic enzymes. This is necessary for the spread of the pathogen in host tissue. Soft rot symptoms like maceration of tissue, water oozing and concavity in the infected area are the results of the action of enzymes on host tissue. These enzymes thus work for the initial parasitic stage of the pathogen, and subsequently for the saprophytic stage that follows, by making the degraded material available to the pathogen.

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VARIABILITY IN *XANTHOMONAS VESICATORIA* (DOIDGE) DOWSON FROM TOMATO, CHILLI AND DATURA

PATHOGENIC variability in *Xanthomonas vesicatoria* was reported early in 1941 by Burkholder and Li¹. Since then many workers have attempted to study the variability in this bacterium with varying results; (Dye *et al.*³, 1964; Cook and Stall², 1969). Studies were conducted with eight isolates, three from tomato, four from chilli and one from datura. Morphologically all the isolates from tomato and chilli were alike in characters such as motility gram-reaction and flagellation. They behaved alike in most of the biochemical and physiological properties such as hydrolysis of starch, sodium hippurate, etc. In the utilisation of carbon compounds (sugars) and production of acid, the chilli isolates, gave delayed and mild acid reaction in cellobiose galactose dextrin and melibiose, whereas lactose and mannitol were utilised only by the tomato isolates. In disc-gel electrophoretic comparison of the soluble protein patterns, 12 bands were common in all, tomato and chilli isolates exhibited identical patterns, having 16 bands compared to 22 in datura.

Bacteriophages, isolated from chilli and datura were very specific to their homologous bacterial isolates. The chilli phage did not attack 20 other xanthomonads and 2 pseudomonads tested but the datura phage typed *X. sesami* and *X. corcori*. In pathogenicity trials and cross inoculation experiments, it has been observed that the tomato isolate is not virulent on chilli, the chilli isolate readily infects both chilli and tomato, the tomato and chilli isolates could infect datura while the datura isolate could not infect chilli or tomato.

Based on the evidence obtained in the studies on physiological characters, protein, bacteriophage sensitivity and pathogenicity of tomato, chilli and datura isolates of *X. vesicatoria*, it is considered that they represent three different strains of the pathogen and that the tomato and datura strains might have evolved from the chilli strain. Further, the original host of the pathogen might have been chilli as evident by its ability to infect both tomato and datura. Moreover, the disease was recorded for the first time on chilli (Gardener and Kendrick⁴, 1921). The tomato isolate was less specialised in that it could infect datura whereas the datura isolate was more specialised and could not infect tomato or chilli.

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A NOTE ON MONADELPHY IN SOME LAMIACEAE (LABIATAE)

EPIPETALOUS free stamens are reported in all the genera of Lamiaceae by Hooker (1885), Mukherjee (1940), Rendle (1959), Hutchinson (1959), Lawrence (1965) and Mitra (1965) except in *Coleus* where they are epipetalous and monadelphous. During a comparative floral anatomical studies on some taxa of Indian Lamiaceae, the author observed some interesting morphological features of the androecium which are recorded here.

It is observed in the present investigation that in *Anisochilus polystachyus* (Figs. 16-18) and *A. carnosus* (Figs. 13-15) the filaments of the stamens fuse at their base to form an incomplete tube. It extends to a height of 100-150 μ after the stamens get separated from the corolla tube. A similar condition has also been noticed in *Geniosporum prostratum* (Figs. 10-12) but the tube is