In isolating the bacteria, fresh leaves (one gram) were surface sterilised and extracted under aseptic conditions. The leaf extract serially diluted (1/10,000) was transferred to petridishes. Nine different media, *viz.*, nutrient agar, carrot extract agar, congo red agar and Jensen's Derxe's, Ashby's and Moore and Becking's N-free media were used for raising the cultures. Colonies appeared after 3 days of incubation at 37° C.

The bacteria were rod-shaped, motile with peritrichous flagella, gram-negative, non-capsulated, non-sporing, 2·0 to 2·3 μ in length and 0·52 to 1·23 μ in width. Colonies varied from white to yellow and were from 0·50 to 2·00 mm in diameter. Generally circular, convex, entire, glistening and translucent. Surface growth on agar stab-aerobic. Catalase negative, nitrate reduced, acid and gas from glucose, lactose, sucrose, mannitol, maltose, xylose and sorbitol. Only acid from glycerol and inositol. Citrate, gluconate but not malonate used as C-source. Gelatin liquefied in 15 days, starch hydrolysed, H_2S produced, indole and lysine –ve, V.P. –ve, M.R. +ve, arginine dihydrolase present.

Effect of temperature was studied on nutrient agar incubated at 5° to 55° C. Good growth at 35° to 39° C, fair at 20° and 40° C, no growth at 5° and 45° C, thermal death point at 50° to 55° C.

According to Bergey's Manual[2] these bacteria are *Enterobacter cloacae* (=*Aerobacter cloacae*).

The bacterium, *Enterobacter cloacae*, was reported to inhabit the outgrowths of stem of *Ipomoea cornea* and help the partner plant in nitrogen metabolism[1] and this may also be true with *Pedalium murex*. The same bacterium was also found to be a predominating coliform colonising the top, middle and bottom portions of the sugarcane plants[3].

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1. Balasundaram, V. R. and Sen, A., *Indian J. Microbiol.*, 1968, **8**, 33.
2. Buchnan, R. E. and Gibbons, N. E., *Bergey's Manual of Determinative Bacteriology*, 8th ed., The Williams and Wilkins Co., Baltimore, U.S.A., 1974.
3. Duncan, C. L. and Colmer, A. R., *Appl. Microbiol.*, 1964, **12**, 173.
4. Silver, W. S., Centifato, Y. M. and Nicholas, J. D., *Nature*, Lond., 1963, **199**, 336.

ROLE OF RELATIVE HUMIDITY AND NUTRIENTS ON SETA FORMATION IN *COLLETOTRICHUM PAPAYAE* P. HENN.

The genus *Colletotrichum* is distinguished from *Gloeosporium* only on the basis of presence of sterile structures, setae, in acervulus. But this basis is generally regarded as doubtful consideration. The observations of Saccas[5] and Schilling[6] suggest that such taxonomic difficulties can be solved by investigating the factors responsible for the production of such structures. The results of studies on some factors affecting the formation of setae in *Colletotrichum papayae*, the causal organism of anthracnose of *Carica papayae* L. are presented here both on the host and in pure culture

The petioles of 'papaya' were inoculated with *C. papayae* and kept at different levels (45, 60, 75, 90 and 100 ± 1%) of relative humidity (RH). Water evaporation from the vessels was prevented by means of wax seal. In pure culture, the studies were carried out at 28° C with pH 7·0 of the basal medium which were optimum for the growth of the fungus (Chahal, 1973). The cultures were incubated on three types of medium, *viz.*, Richard's agar, Richard's agar supplemented with yeast extract (5 g/l) and Richard's agar supplemented with Fe, Zn, Mn, Cu (0·02 ppm each) thiamine and inositol (100 ppm each) at different levels of RH.

Only on the petioles kept at 75 and 90% RH, abundant setae were formed in acervuli after 8 days. At 100% RH the acervuli formed were without setae. It seems, therefore, that the formation of setae occurs only in deficit RH of the atmosphere. *In vitro* on Richard's agar acervuli were not formed at 45% RH whereas lesser number of acervuli were formed at 55–100% RH and setae were not produced. On Richard's agar supplemented with yeast extract and Richard's agar supplemented with micronutrients (Fe, Zn, Mn, Cu, thiamine and inositol), acervuli were formed with numerous setae at 75–90% RH, whereas acervuli were completely absent at 45% RH. At 55 and 100% RH abundant aerial mycelium with acervuli on the surface of the agar were formed. Setae were completely absent. The cultures previously kept at 45, 55 and 100% RH and without setae were transferred into humidity chambers with 75% RH. After four days, instead of aerial mycelium, abundant acervuli with thick walled, dark, numerous setae with tapering ends were formed. Hence it is concluded that 75–90% RH and nutrients of the basal medium (yeast extract, Fe, Zn, Mn, Cu, thiamine and inositol) favour the formation of setae in *C. papayaes*.

The effect of RH and the nutrients on formation of setae is of some significance with regard to the distinction between the two genera *viz.*, *Colletotrichum* and

Gloeosporium. The validity of separation between these two genera merely on the basis of setae formation has been criticised already. Arx[1] regarded the genus *Gloeosporium* as being heterogeneous and transferred its species to forty-eight other genera including *Colletotrichum*. According to Arx[2] the genus *Colletotrichum* may not produce setae which may account for much of the apparent variability in setae formation. Three isolates of *C. atramentarium* (Berk. and Br.) Taub. and *C. linicola* Peth. and Laff. also showed the same response of RH as *C. papayae* (Frost, 1964). The effect of RH and the nutrients on the formation of seta may be of widespread occurrence in the genus *Colletotrichum*. Therefore, the investigations into the extent to which this effect of such factors on other species of this genus on formation of setae will be of much value.

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1. Arx, J. A., von, *Verb. Akad. Wet Amst. Ser.*, 1957, **2**, 51.
2. —, *Phytopath. Z.*, 1957, **29**, 413.
3. Chahal, S. S., *Ph.D. Thesis*, Pb. Univ., Chandigarh, 1973.
4. Frost, R. R., *Nature*, 1964, **201**, 730.
5. Saccas, A. M., *Rev. Appl. Mycol.*, 1960, **39**, 191.
6. Schilling, E., *Faserforschung*, 1922, **2**, 87.

CHANGES IN PHENOLICS AND SOLUBLE CARBOHYDRATES IN COWPEA VARIETIES INFECTED BY *XANTHOMONAS VIGNICOLA* BURK.

THE leaf spot and blight disease of Cowpea (*Vigna sinensis* Endl.) caused by *Xanthomonas vignicola* Burk, most often assumes epiphytotic proportions. Most of the high yielding cowpea varieties are highly susceptible to this pathogen. Cowpea cultivar, Co Pusa 4 is fairly resistant and CM 11 is highly susceptible while V 38 is moderately resistant to infection by *X. vignicola* (Padmanabhan *et al.*[13], 1977). This paper reports the changes in the phenolic compounds and soluble carbohydrates in Cowpea due to infection by *X. vignicola* and their bearing on the relative resistance of the host to the pathogen.

Materials and Methods

Seedlings of Co Pusa 4, CM 11 and V 38 were raised in pots (13 cm D × 11 cm H) at three plants per pot. Thirty days old seedlings were gently rubbed with a surface sterilized emery paper and spray inoculated with the bacterial suspension (10^7 cells/1 ml) of *X. vignicola*. Control plants received distilled water spray. To ensure maximum infection, the pots were kept under humid chamber for 48 hr. After 5 days, when the plants developed leaf spot symptoms, leaf samples (4 g) were extracted with 16 ml of boiling ethanol. The extract was used for the estimations of total phenols[2], *ortho*-dihydroxy phenols[8], reducing sugars[12] and non-reducing sugars[7].

Results and Discussion

The results presented in the Table revealed that the resistant variety Co Pusa 4 generally contained more total phenols in comparison with moderately resistant V 38 and susceptible CM 11. As a result of infection the levels of total phenols were increased in all the varieties. The resistant Co Pusa 4 showed the maximum increase as compared with the susceptible variety. Purushothaman[14] (1975) also indicated that the bacterial leaf blight (caused by *X oryzae*) affected tissue of TKM 6 rice variety also contained larger quantities of total phenols in comparison with the susceptible variety *viz.*, Co 13 and IR 8. Admittedly these relationships conform to the general view that plants resistant to disease, contain higher amounts of phenols[4,9].

Ortho-dihydroxy phenols (O.D.) are important in the disease resistance reactions[16,11,10]. The resistant variety Co Pusa 4 contained more O.D. phenols than V 38 and CM 11, the moderately resistant and susceptible varieties respectively.

Inoculation with *X. vignicola* increased the O.D. phenols in the three varieties. Maximum accumulation however, occurred in Co Pusa 4. Purushothaman[14] also indicated that the rice plants infected with *X. oryzae* accumulated more O.D. phenols. The O.D. phenols are easily oxidized leading to the formation of quinone compounds which are highly toxic to pathogens and their enzymes[11,10].

The resistant variety, Co Pusa 4 contained less soluble carbohydrates when compared to V 38 and CM 11, the susceptible ones. In the infected leaf tissue, there was further lowering of reducing and non-reducing sugars. Ranga Reddy and Sridhar[15] also reported that rice variety, IR 8 moderately resistant to *X. oryzae* contained generally less reducing and non-reducing sugars than the leaves of susceptible variety T(N)1.

More often than not, the sugar level in the healthy and inoculated plants is correlated with the resistance mechanism of host plants[6]. Higher amounts of soluble carbohydrates are reported to favour tissue susceptibility to *Xanthomonas* species[1]. In most of the host parasite interactions, the levels of total sugars decrease, following infection[7,3,15].