Incidence of bacterial wilt disease in West Bengal, India

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ABSTRACT

Bacterial wilt caused by *Ralstonia solanacearum* is widespread in West Bengal (India). Surveys were conducted throughout West Bengal during 2004-2007 and incidence of some economically important crop plants namely; brinjal, tomato, potato, chilli, marigold, ginger, banana, elephant foot yam, Jute, tobacco, water melon, bottle gourd, large cardamom, hasnohana, bougainvillea and twelve wild plants namely; *Amaranthus spinosus* L., *Amaranthus viridis* L., *Croton sparsiflorus* Mor., *Pennisetum purpurium* Schum., *Malachra capitata* L., *Cestrum diurnum* L., *Datura metel* L., *Solanum indicum* L., *Solanum sisymbriifolium* Lam., *Physalis minima* L., *Melochia corchorifolia* L. and *Costus speciosus* (J. Koenig) Sm. were recorded from diverse location of West Bengal with medium to high disease intensity. During survey, bacterial wilt disease was confirmed by ooze test in the field and biochemical tests in the laboratory in every case. A sharp relationship was observed between disease intensity and different meteorological factors during the experimental period. Crop plants transplanted during summer months were found infected more with this disease than those transplanted in the relatively cooler part of the year. In most of the cases, wilting process of wild plants started from the month of March (Av. Tmax. 32°C and Tmin. 20°C) when temperature gradually rises. The maximum wilt intensity was recorded during August-September (Av. Tmax. 30°C and Tmin. 26°C) and death of such plants ceased at the end of October (Av. Tmax. 29°C and Tmin. 19°C) or first week of November (Av. Tmax. 29°C and Tmin. 19°C). The active inoculums from wild hosts during August-September could easily be transported to nearby crop fields by rain and irrigation water run-off.

Key word: Bacterial wilt, host range, *Ralstonia solanacearum*, seasonal incidence.

INTRODUCTION

Bacterial wilt incited by *Ralstonia solanacearum* is a devastating disease distributed all over the world including tropical, subtropical and temperate regions (Hayward, 1991). This disease attacks over 450 plant species (Daughtrey et al., 1995). Several researchers reported the occurrence of this devastating disease from India as well as West Bengal (Das and Chattopadhyay, 1955; Mukherjee and Chattopadhyay, 1955; Chattopadhyay and Mukherjee, 1968; Sharma and Mukherjee, 1970; Chaudhuri and Khatua, 1982; Chatterjeeet et al., 1997 Samaddar et al., 1998, Mondal, 2003; Mondal el al., 2004b). The target control measure has been limited due to its broad distribution, vascular nature, wide host range, great variability and ability to survive in soil and water (Haywads, 1991). Wide host range of the pathogen also increased the survival potential of the pathogen. The survival of the pathogen in wild hosts may be one of the reasons for the devastating nature of the disease. During last three decade, situation in agriculture has been changed to a great extent. This change is obviously related to climate change as well as crop diversification, higher cropping intensity, varietal replacement, manuring, intensive fertilizers and pesticides use in...
the dynamic agricultural system. To understand the disease scenario in West Bengal in these perspective present studies were undertaken.

MATERIALS AND METHODS

During 2004-2007, surveys were carried out in different parts of West Bengal employing multistage stratified random sampling. Incidence of both crop and wild plants were recorded. Percentage disease incidence was calculated during cropping season involving all the plants in a particular affected field. While, incidence of the disease on wild hosts in and around the crop fields, ridges of the field, road side, barren lands, fallow lands and in and around the fruit orchard and vegetable field were recorded in every month to be acquainted with the year round incidence of bacterial wilt disease. Bacterial nature of the disease was authenticated by ooze test, isolation in modified selective medium (Chatterjee, 1996), through morphological and biochemical studies and cross inoculation study by stem injection and root inoculation method (Kelman, 1953; Kelman, 1954; Hayward, 1964; Palleroni, 1984, Mondal et al., 2012). Different weather variables were collected to correlate with the disease incidence.

RESULTS

Incidence of bacterial wilt was recorded from diverse location of West Bengal with medium to high disease intensity. Fifteen cultivated plants namely; brinjal, tomato, potato, chilli, marigold, ginger, banana, elephant foot yam, jute, tobacco, water melon, bottle gourd, large cardamom, hasnuhana, bougainvillea, and twelve wild plants from seven different families namely; Amaranthus spinosus L. (Amaranthaceae), Amaranthus viridis L. (Amaranthaceae), Croton sparsiflorus Mor. (Euphorbiaceae), Pennisetum purpureum Schum. (Graminae), Malachra capitata L. (Malvaceae), Cestrum diurnum L. (Solanaceae), Datura metel L. (Solanaceae), Solanum indicum L. (Solanaceae), Solanum sisymbriifolium Lam. (Solanaceae), Physalis minima L. (Solanaceae), Melochia corchorifolia L. (Sterculiaceae) and Costus speciosus (J. Koenig) Sm. (Zingiberaceae) were recorded during the present investigation.

Brinjal (Solanum melongena L.) and tomato (Lycopersicon esculentum Mill.) transplanted during summer months were more liable to be infected with this disease than those transplanted in the relatively cooler part of the year. Wilting was generally observed in the reproductive stages of the crop growth. The maximum disease intensity was recorded during August – October in brinjal (Figure 1) and January – February in tomato (Figure 2). Bacterial wilt of potato (Solanum tuberosum L.) was observed in the early growth or during tuberization and continued up to crop maturity. The disease was recorded during November - February (Figure 3). Intensity of the disease nearly went up to 50% leading to heavy crop loss. Wilting was recorded during November - March in chilli (Capsicum annuum L.) (Figure 4). Both total and partial wilting was observed except potato where only total wilting recorded and found
comparatively less affected to this disease among all the infected cultivated solanaceous vegetables.

Marigold (Tagetes erecta L.) is grown in some pockets of West Bengal as a commercial ornamental crop. This crop suffers severely from bacterial wilt after rainy season particularly in pre-winter season (Figure 5) when the temperature is considerably high. Bacterial wilt of both cultivated and wild elephant foot yam (Amorphophallus campanulatus Blume; Syn.: A. paeonifolius (Dennst.) Nicolson) was observed from different places of West Bengal. The crop has been found infected during July - October (Figure 7). Ginger (Zingiber officinale Rosc.) is a commercial crop in hill region of Darjeeling district. Presently it is cultivated in the plains of West Bengal. The disease initiated from July and continued up to November with a pick of August – September in plain of West Bengal (Figure 6).

During survey, some other crops have also been found to be infected with this bacterium. These were, jute (Corchorus olitorius L.), triploid banana (Musa paradisiaca L.), tobacco (Nicotiana rustica L. and Nicotiana tabacum L.), watermelon (Citrullus lanatus (Thunb.) bottle gourd (Lagenaria siceraria (Molina) Standl.), large cardamom (Amomum subulatum Roxb.), hasnuhana (Cestrum nocturnum L.) and paper flower (Bougainvillea glabra Choisy).

Trend of infection Ralstonia solanacearum on Amaranthus spinosus, Amaranthus viridis, S. sisymbriifolium, Datura metel, Physalis minima and C. sparsiflorus were more or less similar and the bacterial pathogen survive in these hosts almost throughout the year that are presented in Figures 8, 9, 11, 13, 15 and 16 respectively. C. speciosus are grown...
respectively as ornamental plant and medicinal plants in some localities. *R. solanacearum* survive in *C. speciosus* (Figure 10) and *Cestrum diurnum* (Figure 12) throughout the season in latent or infectious form. But the weeds in which the *R. solanacearum* can survive during June to November are *Melochia corchorifolia, S. indicum, Malachra capitata* and *P. purpurium* (Figure 14, 17, 18 and 19 respectively).

At Chakdah, Nadia, farmers when started growing brinjal and elephant foot yam after destruction of mango orchard, more than 80% of brinjal and 40% of elephant foot yam showed wilting symptoms. After thorough investigation it was noted that there were so many weeds namely, *C. diurnum, A. spinosus, A. viridis, P. minima* and *C. speciosus* present in and around the field. *C. speciosus* was present in earlier mango orchard too.

On cross inoculation study by stem injection and root inoculation method (Kelman, 1953, Mondal et al., 2012), isolates of *R. solanacearum* from brinjal, tomato, potato, chilli, marigold and isolates of that from nine different wild plants, namely; *C. sparsiflorus, C. diurnum, S. indicum, S. sisymbriifolium, P. minima, D. metel, A. spinosus, A. viridis* and *M. corchorifolia* were found pathogenic on tomato and brinjal. Isolate from *C. diurnum* were highly virulent and developed symptoms rapidly on brinjal and tomato. But the isolates from ginger, elephant foot yam and *C. speciosus* showed host specificity. *R. solanacearum* isolates from ginger, elephant foot yam and *C. speciosus* were found pathogenic on ginger in artificial inoculation.

In most of the weeds wilting process started from the month of March (Av. Tmax. 32°C and Tmin. 20°C) when temperature gradually rises. The maximum wilt intensity
Figure 9. Year round survivality *R. solanacearum* on *A. viridis*.

Figure 10. Year round survivality *R. solanacearum* on *Costus speciosus*.

Figure 11. Year round survivality *R. solanacearum* on *Solanum sysimbriifolium*.

Figure 12. Year round survivality *R. solanacearum* on *Cestrum diurnum*. 
Figure 13. Year round survivality *R. solanacearum* on *Datura metel*.

Figure 14. Year round survivality *R. solanacearum* on *Melochia corchorifolia*.

Figure 15. Year round survivality *R. solanacearum* on *Physalis mini*ma.

Figure 16. Year round survivality *R. solanacearum* on *Croton spersiflorus*. 
was recorded during August-September (Av. Tmax. 30°C and Tmin. 26°C) and death of such plants ceased at the end of October (Av. Tmax.29°C and Tmin. 22°C) or first week of November (Av. Tmax. 29°C and Tmin. 19°C).

**DISCUSSION**

Incidence of the disease in wide variety of crops in addition to weeds and its occurrence throughout the year posed an alarming situation in West Bengal. Natural infection of such widely grown common wild plants helped to increased survival potential of the bacterium as well as for inoculum build up (Huang and Lakshman, 2010; Haywad, 1991). The active inoculum from weed hosts during August-September could easily be transported to nearby fields by rain water to the nearby vegetable fields. Wild plants thus appeared to play an important role in widespread occurrence of bacterial wilt of cultivated vegetable crops in West Bengal (Haywards, 1991). These hosts can also harbour the pathogen in off-season, and also served as collateral hosts of the pathogen. De-suckering helped in rapid spread of the disease in banana orchard. In potato and ginger, bacterial wilt pathogen introduced in the field mostly through seed tuber and rhizomes respectively (Mondal et al., 2004a). High incidence of bacterial wilt was noted earlier when susceptible crop was grown first time in a field (Kelman, 1953). In the present study brinjal and elephant foot yam
was severely infected when these crop were grown after clearing of mango plants from the orchards.

*R. solanacearum* isolated from majority of hosts infected tomato and brinjal indicating that the causal pathogen belongs to Race 1 (Buddenhagen et al., 1962). Race 2 of the pathogen infected triploid banana. *R. solanacearum* isolated from ginger, elephant foot yam and *C. spectosus* were found pathogenic on ginger in artificial inoculation and appeared to be Race 4 (Buddenhagen et al., 1962). Severity of this disease related with the prevailing temperature and soil moisture at the time of transplanting and sowing (Hayward, 1991).

**Conclusions**

The present study was an effort to find out the occurrence of the bacterial wilt disease round the year both in crop and wild hosts. Bacterial wilt is one of the key hindrances for vegetables production. Management of *Ralstonia solanacearum* has become difficult due to wide host range, vascular in nature and its occurrence throughout the year. Determination of races, weather variables for the disease development and year round survival of the bacterium will definitely help farmers for choosing next crop to avoid the disease. Intensive study and molecular diagnosis will be needed to supplement the further knowledge.

**REFERENCES**


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