

INVESTIGATION ON WILT OF JUTE *CORCHORUS*
CAPSULARIS L. & *CORCHORUS OLITORIUS* L.:
DISEASE SYNDROME AND INCITANTS

By

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A survey on the distribution of Hooghly wilt and root rot of jute was undertaken in different jute growing tracts of West Bengal, wilt being more prevalent in some areas whereas root rot in others both in Gangetic & Vindhyan alluvium soils.

Organisms constantly isolated from the affected plants were *Pseudomonas solanacearum*, *Macrophomina phaseolina*, *Fusarium solani*, *Melioidogyne incognita* and *Melioidogyne arenaria*. Inoculation studies showed that the organisms isolated except *Fusarium solani* were capable of inciting disease on jute plants.

Wilt was evident in July and characterised by yellowing and gradual shedding of leaves and sudden death of plants. Rotting of roots was not very conspicuous. In root rots, copious rotting of roots was more prominent, though the symptoms in many cases were indistinguishable from wilt.

INTRODUCTION

Since 1950, a wilt disease commonly known as "Hooghly wilt" has been observed on jute (*Corchorus olitorius* L.) in West Bengal. The disease now appears to be the next in importance to stem rot incited by *Macrophomina phaseolina* (Tassi) Goid. (Kundu *et al*, 1959).

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Initially the disease was attributed to a group of pathogens in association, namely *M. phaseolina*, one unidentified bacterium and one *Fusarium* sp. (Annual Report, J. A. R. I., 1951-52 & 1953-54). Later it was indicated that a species of *Pseudomonas*, *Fusarium solani* (Mart) App. & Wr. emend Synd. and Hans. and *Ozonium* sp. together with *M. phaseolina* might be involved (Annual Report, J. A. R. I., 1955-56). Ghosh and Mukherjee (1967) reported presence of *M. phaseolina*, *Rhizoctonia solani* Kuhn and *F. solani* and two species of bacteria one being tentatively identified as *Pseudomonas solanacearum* in freshly wilted jute plants. Pathogenicity test revealed that except *M. phaseolina* and *R. solani*, others could not incite any symptom of disease in jute. Recently Sharma and Mukherjee (1970) reported jute to be one of the hosts of *Pseudomonas solanacearum* E. F. Smith.

Apart from typical wilt, another disease which may be more typically termed as root rot has been observed, though symptoms of the disease are often not clearly distinguishable from wilt, but differences in disease syndrome and aetiology can be noted.

Considering the importance of the disease in the jute growing tracts of West Bengal and the lack of precise knowledge on its etiology and disease syndrome the present investigation was undertaken. An account of the distribution, disease development, symptoms, besides incitants of the disease, has been given in the present paper.

MATERIALS AND METHODS

To determine distribution and prevalence of the diseases of wilt and root rot, a survey was undertaken in important jute growing areas of West Bengal, when the crop attained the age of 6 to 8 weeks. The plants were examined diagonally across the fields. Infection was recorded through random counts.

Samples of diseased plants collected from the fields were examined in the laboratory for presence of pathogens. Isolation of the organisms was made after surface sterilization with 0.1% mercuric chloride solution on Potato Dex-

trose Agar for fungi, and Nutrient Agar and Tetrazolium chloride medium (Kelman, 1954)-for bacteria. Nematodes were isolated and examined following the methods of Goodey (1963). Typical isolates of nematode and bacteria were sent to Indian Agricultural Research Institute, New Delhi and Common Wealth Mycological Institute, London, respectively for Identification.

Experiments relating to infection studies were undertaken in the green house with twenty-seven days old plants of olitorius jute (var JRO 620) grown in sterilized soil in pots (40 cm diameter).

For pathogenicity tests, finely powdered garden soil (pH 6.5) was used. The soil was sterilized with 2% formalin in the usual way after application of farmyard manure. Ammonium sulphate and calcium superphosphate, besides farmyard manure, were used to supplement nitrogen and phosphorus at the rate of 40 Kgs. and 30 Kgs. per hectare respectively.

For bacterial inoculation, colonies of only fluidal type were used. The inoculum was prepared from four days old culture. Inoculations were usually made by pouring 300 ml. of standard bacterial suspension in sterile water containing approximately 8×10^6 bacterial cells/ml. around the roots. Besides root and stem inoculations, following Winstead and Kelman (1952), spraying of bacterial suspension on the leaves was done with the help of an atomizer.

Inoculum of fungus was prepared by growing organisms on Sand-Maize medium for 7 days in 250 ml. flasks. 100 gms. of such culture was incorporated in each pot containing sterilized soil.

Inoculum of nematodes was prepared following the method of Goodey (1963). Inoculation was done by pouring 50 ml. of nematode larvae snspension containing approximately 150 larvae/ml, around the roots,

RESULTS AND DISCUSSION

Distribution of the disease : Observations on the samples of diseased jute plants collected from the different areas surveyed, indicated presence of two

distinct diseases namely, bacterial wilt and root rot in different parts of West Bengal (Table-1). Bacterial wilt was observed to be confined primarily in the districts of Hooghly, Howrah, Burdwan and Midnapore, whereas root rot in the districts of 24-Parganas, Nadia & Malda, they were however also noted in the districts Howrah, Hooghly and Burdwan.

The percentage of infection of bacterial wilt ranged between 0.1 and 29.0 and that of root rot between 1.0 and 30.0. Infection was not uniformly present in all the fields.

Symptomology : Symptoms of bacterial wilt caused by *Pseudomonas solanacearum* were usually evident in July when the plants attained the peak of vegetative growth. The first noticeable symptom of the disease was epinasty of the leaves which was later followed by the temporary drooping during the day, with recovery at night simulating the conditions of temporary wilting, even though abundant moisture was present in soil (Plate I, Fig. A.) The affected plants presented pale green appearance in contrast to shiny dark green colour of the healthy plants. With the progress of the disease, leaves turned yellow and the plants appeared to be stunted in growth.

Gradual defoliation started from the base upward, ultimately the stem was left with just a few leaves at the top (Plate I, Fig. B). Occasionally the crown became flaccid and drooped. After two to three days the remaining leaves also shed off and the defoliated stem turned light brown and finally wilted. Rarely, the stalks of the diseased plants were noticed to remain standing with the dead leaves (Plate I, Fig. C)

Affected plants showed tendency to develop adventitious roots in the basal region in early stages of infection. Root system of the diseased plants in the initial stages of infection did not appear to be much affected (Plate I, Fig. D) In later stages, the roots of wilted plants were found to undergo decomposition to a limited extent. Rotting with sliminess was noticed in some cases.

When sections of the affected stem at an early stage of the disease or of the root, were examined, discolouration of xylem was not noticed. Section of stem or of root when placed in water on a clean glass slide, the water became turbid

within five to ten minutes due to oozing of bacteria, which was found to be profuse during active development of disease (Plate I, Fig. H) Infected plants exhibited bacterial ooze at room temperature even upto a period of three to four months.

Symptoms which normally characterise wilt due to *Pseudomonas solanacearum* on majority of the hosts namely stunting, yellowing and wilting (Kelman, 1953) were also evident on jute. Moreover the wilt affected jute plants showed gradual defoliation.

Symptoms of both stem rot and bacterial wilt were often observed on the same plant. In plants affected with both *M. phaseolina* & *P. solanacearum*, root rot, collar rot and stem rot were evident. Most characteristic was the development of light brown to deep brown lesions at the base of the stem. Usually these lesions appeared soon after defoliation of stem and extended along the stem and covered the entire area both longitudinally and radially. The stem became shrivelled and turned deep brown to blackish brown. These lesions of *M. phaseolina* spread more rapidly in plants already affected with *P. solanacearum*.

Root system of the affected plants became brown to black and showed extensive rotting. When the roots of diseased plants were removed carefully it was observed that except the tap root and a few secondary roots, all other roots showed decay (Plate I Fig. E). Pycnidia were found to be abundant at the stem (Plate I, Fig. F)

Wood of both stem and root on being cut open showed light brown discoloration at later stage (Plate I, Fig. G)

Bacterial wilt was often found to be associated with nematode infestation. Above ground symptoms incited by bacteria and nematode were found to be more or less similar. Conspicuous stunting however suggested simultaneous infection of these two organisms. Stunting was more pronounced in the younger plants which presented a dull and slightly mottled appearance. Defoliation was more prominent in these cases. Presence of nematodes could only be observed after uprooting the plants when the knots or galls were noticed on roots

Typical root rot, however, is different from wilt. Symptoms of root rot have been described by Ghosh & Mukherjee (1967). Mixed symptoms of bacterial wilt and root rot were indistinguishable in the field particularly in advance stages of the disease.

Combined infection of *M. phaseolina* and *Meloidogyne incognita* was found to cause severe root rot (Plate I, Fig. I & J) and symptoms were similar to that noticed in typical wilt. Such affected plants were found to be characterised by dull appearance in the initial stage, followed by yellowing of leaves which began to be shed gradually. Defoliated stems became shrivelled and completely withered. Minute brown erumpent pycnidia were found on the stem.

Isolations studies : Isolations were made from the samples collected from seventeen different localities covering five districts. Isolates most frequently obtained from the samples were ; *P. solanacearum*, *Macrophomina phaseolina*, *Fusarium solani*, *Meloidogyne incognita* (Kofoed & White) Chitwood. *Meloidogyne arenaria* (Neal) Chitwood could be obtained only from one locality.

Isolations from the roots often yielded more than one organism. *F. solani* was predominant in isolated from roots infected with root rot. It was consistently isolated from plants either dead or in the advanced stage of the disease.

Isolations from roots of affected jute plants often yielded a number of bacteria, but the same from the stem consistently yielded *Pseudomonas solanacearum*.

Infection studies : Among the different pathogens used for inoculation, *F. solani* failed to infect jute plants (Table-2) even when the plants inoculated with the fungus were maintained upto two months in the green house. All other pathogens could infect jute.

Plants inoculated with spraying of bacterial suspension of *P. solanacearum* on uninjured leaves did not show any symptoms of wilting. However, embossed spots were observed on the leaves, which sometimes coalesced and formed a cankerous growth. Occasionally such lesions turned brown. Blackening of vein or development of spots was not observed. Rapid development of wilting was observed in plants inoculated with stem-puncture technique. Disease develop-

Table 1 Occurrence of Bacterial wilt & root rot in different localities of West Bengal

Localities	Districts	Preceding crop	Jute species	No. of plants examined	Plants infected with Bacterial wilt	No. of plants infected with Root rot.
Chinsurah	Hooghly	Potato	<i>C. oltorius</i>	49	5(10.2)*	9.(0)*
Arambagh	Hooghly	Cauli flower and Cabbage	"	55	7(12.7)	3.(5.4)
Tarakeshwar	Hooghly	Potato	"	60	16(26.6)	0.(0)
Singur	Hooghly	Potato	"	50	10(20.0)	6(12.0)
Jangipara	Hooghly	Potato	"	70	1(1.4)	0.(0)
Burdwan	Burdwan	Wheat	"	63	2(3.1)	5(7.8)
Saktighar	Burdwan	Potato	"	51	7(13.7)	0(0)
Udayanarayanpur	Howrah	Potato	"	68	1(1.4)	1(1.4)
Ulubaria	Howrah	Potato	"	50	2(4.0)	0(0)
Sonarpur	24-Parganas	Brinjal	"	59	0(0)	1(1.7)
Tehatta	Nadia	Lentil mixed with mustard.	"	65	0(0)	2(3.07)
Krishnagar	Nadia	Wheat	"	67	0(0)	9(13.4)
Karimpur	Nadia	—	"	50	0(0)	15(30.0)
Malda	Malda	Wheat	"	54	0(0)	2(3.7)
Radhakantapur	Midnapore	Potato	"	71	21(29.0)	0(0)
Memari	Burdwan	Potato	<i>C. capsularis</i>	53	1(1.9)	0(0)
Deganga	Nadia	—	"	60	0(0)	2(3.7)

*—The figures in parenthesis indicate the percentage of plants infected.

ment was slow in plants that were inoculated without root injury and mortality upto 90% was recorded after 45 days of inoculation.

Table 2. *Plants showing infection 20 days after inoculation*

SL. No.	Organisms	Method of inoculation	Percentage infection
1.	<i>P. solanacearum</i>	Spray	100
2.	<i>P. solanacearum</i>	Stem puncture	100
3.	<i>P. solanacearum</i>	Root (with injury)	100
4.	<i>P. solanacearum</i>	Root (without injury)	30
5.	<i>M. phaseolina</i>	Root (without injury)	100
6.	<i>M. incognita</i>	Root (without injury)	100
7.	<i>M. arenaria</i>	Root (without injury)	100
8.	<i>F. solani</i>	Root (without injury)	0.0
9.	Check	Root (with injury)	0.0

Isolation from the disease plants followed by inoculation studies, confirmed suggestions of earlier workers (Annual Report, J. A. R. I. 1951-52, 1953-54 and 1955-56) that a number of organisms causing more or less simultaneous infection were responsible for inciting the disease. These organisms were conclusively found to be *Macrophomina phaseolina*, *Pseudomonas solanacearum*, *Meliodegyne incognita*. *Fusarium solani* though observed to be present was not found to play any role in the disease syndrome, as it failed to produce any infection under artificial conditions. Ghosh and Mukherjee (1962) reported no doubt that *P. solanacearum* might be involved in this particular wilt disease, but their observations were tentative and suggestive to some extent, not conclusive. Considering the criteria of true host of *Pseudomonas solanacearum* (Kelman, 1953), the first record of the organism on *Corchorus* sp. (*C. acutangula* L.) dates back to 1924 (Plam & Jochems, 1924). Recently it has been reported on cultivated jute (Sharma and Mukherjee, 1970). It may be mentioned that these three organisms namely *M. phaseolina*, *P. solanacearum*, *M. incognita* are individually

capable of causing infections on jute and producing symptoms of stem rot, vascular wilt and root knot respectively no doubt, but their presence on the same host plants and combined role in the disease syndrome need to be investigated.

The disease has so far been confined to the alluvial tracts on both Gangetic and Vindhya alluvium. Jute is grown following rice, wheat, mustard, potato etc. Jute-potato rotation is fairly common in many areas where the wilt is reported to be present. Potato is known to be a good host for both *Macrophomina phaseolina* and *Pseudomonas solanacearum*. *Meloidogyne incognita* has been observed in many fields of vegetables which often find place in Jute-potato rotation system as a catch or relay crop. Severity of the disease has been found to vary from place to place. Disease is found in the monsoon months when question of moisture stress does not arise. On the other hand, prevalence of high humidity and attendant soil moisture may help in the development of the disease. It may be reasonably assumed that the severity of the disease is due to cumulative effect of a number of factors host, pathogen and environment.

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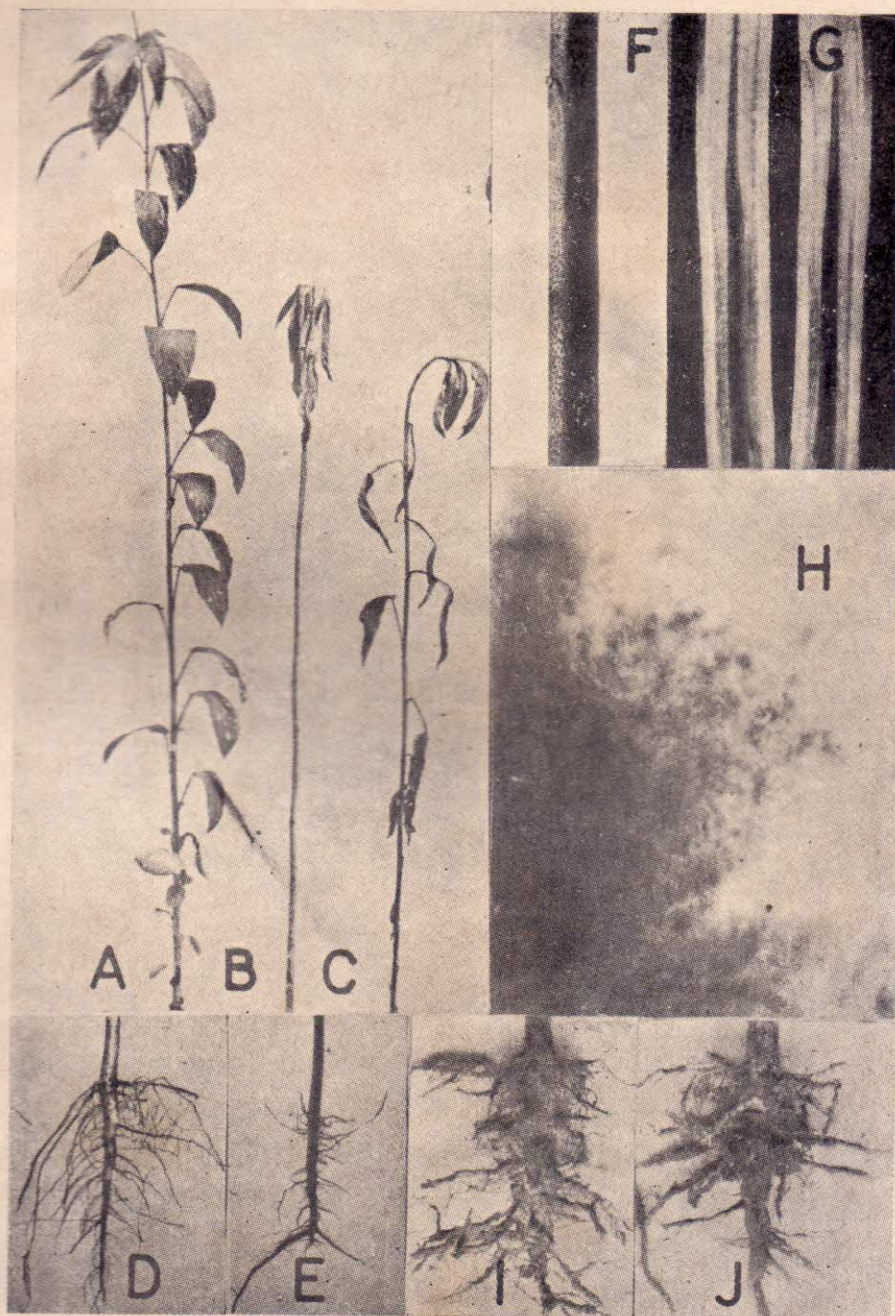
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EXPLANATION OF PLATE

Fig. 1. Jute plants showing symptoms of bacterial wilt and root rot of jute.

- A) Healthy plant
- B & C) Plants showing wilt symptoms caused by *Pseudomonas solanacearum*.
- D) Root system of bacterial wilt affected plant at the early stage.
- E) Advanced stage of symptom showing decay of roots due to simultaneous infection of *P. solanacearum* & *M. phaseoli*.
- F) Pycnidia of *M. phaseoli* on the stem of bacterial wilt affected plant.
- G) Split stem of plant affected with collar rot & bacterial wilt.
- H) Transvers section of stem placed in water showing bacterial ooze.
- I & J) Root system showing symptoms of *M. incognita* and *M. phaseoli* infection at different stage.



On Jute disease

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