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SERIOUS AND NEW DISEASES OF PULSE CROPS IN INDIA IN 1966[1]

F. J. Williams, J. S. Grewal, and K. S. Amin[2]

Summary

Several diseases caused considerable reduction in yield of pulse crops in India during the 1966 season. Cicer arietinum was severely damaged by the combined effects of wilt and drought in northern India. Sterility mosaic of Cajanus cajan was prevalent in eastern Uttar Pradesh. Yellow mosaic of mung caused severe damage to Phaseolus aureus and P. mungo in Punjab and Uttar Pradesh. Dolichos lablab and D. biflorus in central and southern India were damaged by yellow mosaic diseases. Rust and powdery mildew decreased yield of Pisum sativum in Uttar Pradesh. A new leaf crinkle symptom (probably caused by an unidentified virus), was seen on Phaseolus mungo and P. aureus at New Delhi and at Kanpur and Pant Nagar in Uttar Pradesh. A new yellows symptom (probably of virus origin), and a new wilt (caused by a fungus), were seen on Cajanus cajan at New Delhi.

INTRODUCTION

Yield of pulse crops (grain legumes, an important source of protein) in India are low, often less than 500 kg/ha (2, 3). Unsuccessful cultural practices, diseases, and insect damage contribute to the low yields. This paper reports some serious diseases and a few apparently new diseases seen by the authors from January 1966 to March 1967.

IMPORTANT DISEASES

Chickpea: Cicer arietinum L. (chickpea, Bengal gram, garbanzo) is planted on some 9.4 million hectares in India each year and the average yield is about 480 kg/ha (3). (For uniformity, nomenclature of cultivated plants is as listed by Maheshwari and Singh (6).) Chickpea grows throughout India, but is a major crop in the states of Uttar Pradesh, Punjab, Rajasthan and Madhya Pradesh (2).

Rainfall during December 1966 and January 1967 was subnormal throughout northern India. Then, as daily high temperatures increased during February and March, unirrigated chickpea plantings were subjected to severe moisture stress. Some plantings were a total loss. In many fields plants became chlorotic, and wilted and died before the fruit matured (Fig. 1). The primary roots, larger secondary roots, and lower stems usually had discolored xylem (Fig. 2). Wilting plants with the same root symptoms were seen in irrigated plantings, but the incidence was low.

Wilting plants were collected from irrigated and unirrigated fields in Punjab. Sections from primary roots and lower stems were soaked in 2.6% (v/v) sodium hypochlorite for 1 minute and small pieces of tissue placed on potato-dextrose agar in Petri dishes. Fusarium sp. was isolated from 55% and Operculella padwickii Kheswala from 45% of the plants from which a fungus was recovered.

Autoclaved soil was infested with cultures of either fungus and chickpea seed planted in the infested soil in pots. The pots were kept in the office because greenhouse facilities were unavailable. Several isolates of both fungi killed the seedlings. We had no facilities for inoculating older plants under controlled conditions so could not reproduce the disease symptoms seen in the field. The symptoms on the plants from which we isolated Fusarium sp. and Operculella padwickii were similar. Fusarium orthoceras Appel & Wr. var. ciceri Padwick is known to cause wilt of chickpea (6), and Operculella padwickii has been reported to have caused a foot rot of chickpea (5).

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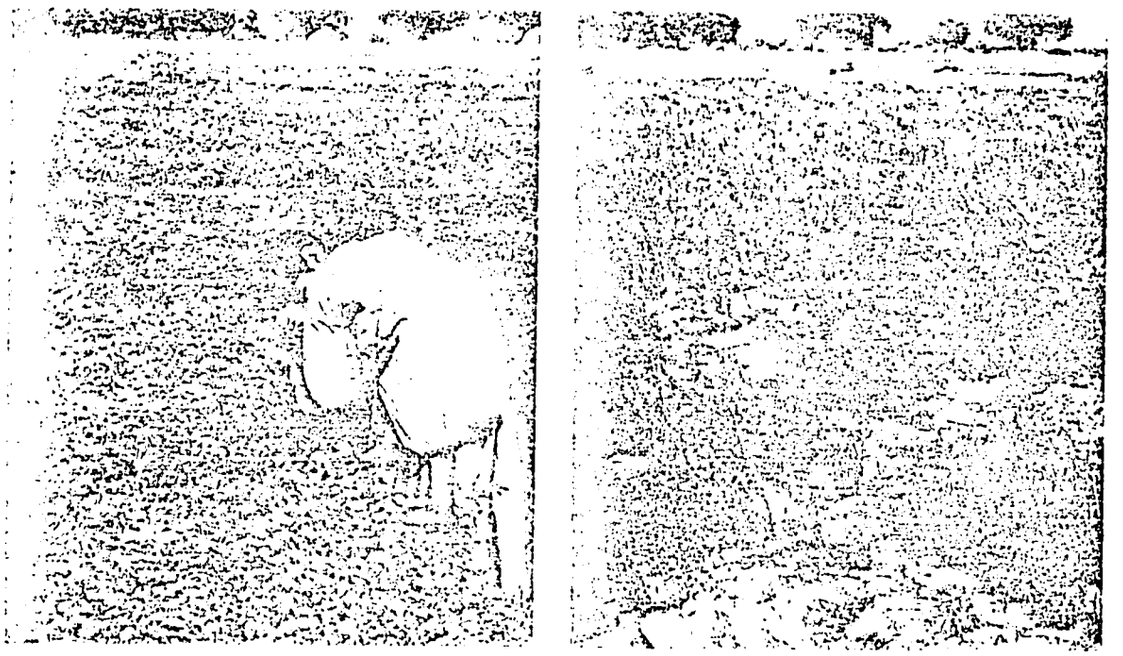

FIGURE 1. (Above) Irrigated (left) and unirrigated (right) adjacent fields of Cicer arietinum (planted from same seed lot on same day) showing many wilting and dead plants in unirrigated and a few wilting plants in irrigated field.

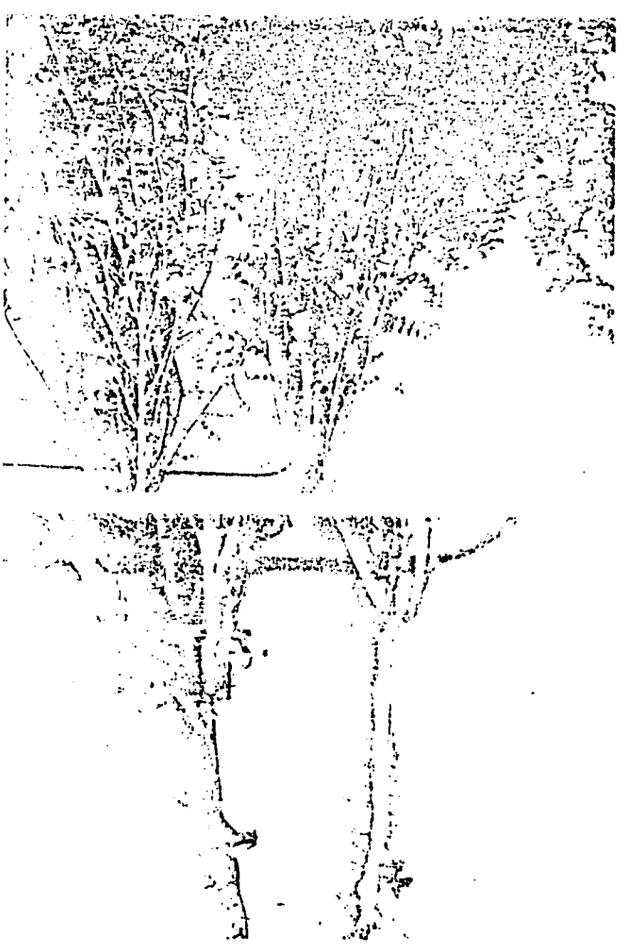

FIGURE 2. (Left) Top and root of wilted Cicer arietinum plant showing xylem discoloration. (Healthy plant on right)

Pigeon pea: Cajanus cajan (L.) Millsp. (pigeon pea, red gram, arhar) is planted on about 2.4 million hectares each year in India and the average yield in 1964 was 531 kg/ha (2).

Wilt of pigeon pea caused by Fusarium udum Butl. was prevalent and reduced yields in Uttar Pradesh. In some fields only scattered plants were affected, but often all the plants in a sector of the field were dead. Since plant populations in pigeon pea fields are usually less than the probable optimum, wilt reduces yield.

Sterility mosaic seriously reduced yields in eastern Uttar Pradesh. Symptoms include leaf mosaic, bushiness, and a reduction in flower formation. Capoor (1) established that a virus caused sterility mosaic of pigeon pea. Seth (10, 11) reported that the virus was transmitted by a mite (Aceria cajani Channabasavanna). Sterility mosaic was prevalent in our plantings of pigeon pea at New Delhi and at Coimbatore, Madras. It was reported as epiphytotic in Madras state in 1960 (4).

An outbreak of powdery mildew caused by Leveillula taurica (Lév.) Arn. resulted in severe defoliation of our pigeon pea breeding material at Coimbatore, Madras. All the 1100 cultures were susceptible.

Mung and urid beans: Phaseolus aureus Roxb. (green gram, mung) and P. mungo L. (black gram, urid) were damaged by yellow mosaic. Nariani (8) reported that the virus that causes yellow mosaic of mung is vectored by a whitefly (Bemisia tabaci). Yellow mosaic of mung was more serious on P. mungo than on P. aureus in our variety trials. Because of relative resistance, it produced a "checkerboard" pattern in our variety trials at New Delhi and at Kanpur and Pant Nagar, Uttar Pradesh (Figs. 3, 4). A field of P. mungo breeding material at Coimbatore, Madras, was nearly destroyed by rust caused by Uromyces appendiculatus (Pers.) Lk.

Pea: Pisum sativum L. is planted on about 1.3 million hectares in India each year and yields ab[illegible]20 kg/ha (3). Nearly half of the area planted is in Uttar Pradesh (2). In 1966 a variety tr[illegible] Pant Nagar, Uttar Pradesh, was damaged by rust caused by Uromyces fabae (Pers.) d By. ex Cke, and powdery mildew caused by Erysiphe polygoni DC. ex Mérat. Indigenous varieties were more resistant to both diseases, but yielded less than introduced varieties.

Dolichos spp: Dolichos lablab L. and D. biflorus are minor pulse crops in India. D. lablab was seen often affected by Dolichos lablab yellow mosaic virus. Symptoms consisted of light and dark-green patches on leaf blades, often restricted by veins. Later the affected areas become yellow. Powdery mildew caused by Leveillula taurica (Lév.) Arn. var. macrospora Upal, and a leaf spot caused by Cercospora dolichi Ell & Ev., also caused some damage to D. lablab. In nearly every field of maturing D. biflorus that we have seen, 40% or more of the plants had yellow mosaic symptoms. Nariani (8) reported D. biflorus susceptible to yellow mosaic of mung, and the symptoms we have seen are like those he described.

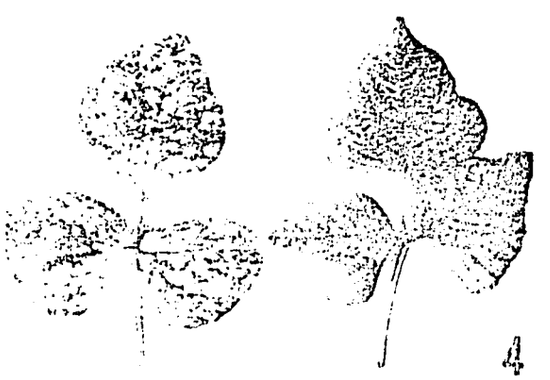

FIGURE 3. Relative susceptibility of varieties of Phaseolus mungo to yellow mosaic of mung.
FIGURE 4. Yellow mosaic of mung (left) and leaf crinkle symptom (right) on P. mungo.

SUSPECTED NEW DISEASES

A yellow mosaic disease symptom was observed on Cajanus cajan at New Delhi and in Uttar Pradesh and Andhra Pradesh (Fig. 6). The incidence was low. Symptoms consisted of bright yellow splotches on leaves, without leaf distortion. Occasionally symptoms were confined to a single branch, but often the entire plant was affected. The cause of this disease is being investigated.

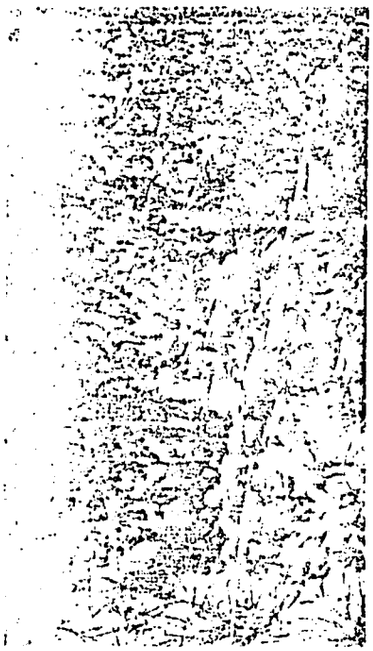

FIGURE 5. A -- Cajanus cajan plant showing wilt thought to be caused by a Phycomycete. B -- Stem canker on same plant.

A phycomycetous fungus was isolated from stem cankers of wilting Cajanus cajan plants from one New Delhi planting. Symptoms were a girdling stem canker near ground level with rapid wilting of affected plants (Fig. 5). The leaves did not become chlorotic before wilting. Plants were inoculated by slicing into the xylem, placing mycelium of the suspected pathogen into the cut and covering the cut with cellophane tape. The inoculated plants developed stem and petiole cankers at and above the point of inoculation and control plants remained healthy. The plants were killed by frost before the cankers had girdled the stems, but the fungus was recovered from cankers several inches above the point of inoculation. Newly wilted plants were seen over a period of about 3 weeks, then no more were found.

FIGURE 6. Yellows symptom on Cajanus cajan.

Symptoms on leaflets

Phaseolus mungo and P. aureus plants were observed with symptoms of an apparently new virus disease that caused stunting, leaf crinkling, and rugosity (Fig. 4). The plants did not die, but were severely stunted and produced few pods. Initial attempts to transmit a virus mechanically failed. The disease was more prevalent on P. mungo than on P. aureus. A few plants of P. mungo had both the leaf crinkle symptoms and symptoms of yellow mosaic of mung on the same leaves.

DISCUSSION

Several diseases caused serious reduction in yield of pulse crops in India during the crop year 1966. Considering crop acreage, the major diseases are wilt of Cicer arietinum, wilt and sterility mosaic of Cajanus cajan, and yellow mosaic of Phaseolus aureus and P. mungo. In each case, the most practical control measure is the development of resistant varieties. Some wilt resistant varieties of Cajanus cajan have been developed, but strains of the pathogen may exist, inasmuch as a variety that is resistant in one area is reportedly susceptible in another area. Results of our tests also indicate considerable variation in pathogenicity of Fusarium udum isolates.

Probably the pathogen complex and the relationship of water stress and soil temperature to effect of disease must be clarified before wilt-resistant varieties of Cicer arietinum can be developed.

Farmers and State agricultural workers have told us that sterility mosaic of Cajanus cajan is becoming more prevalent each year in northern India. Capoor (1) claimed sap and graft transmission, and Seth (10, 11) reported mite transmission of the virus. Narayanasamy and Ramakrishnan (7), however, were unable to verify either of these transmission claims, and on the basis of indirect evidence they suspected transmission by nematodes.

In replicated varietal tests, varieties B-1 and BR-2 of Phaseolus aureus were resistant to yellow mosaic of mung. Varieties T-65 and 1-1 of P. mungo had a low incidence of yellow mosaic of mung, but were especially susceptible to the new leaf crinkle disease. Crosses of the varieties with the lowest incidence of yellow mosaic and leaf crinkle disease have been made.

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