# MAIN VIRUS DISEASES OF PEANUTS IN INDIA AND INDONESIA

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## ABSTRACT

Bud necrosis caused by tomato spotted wilt virus is widespread and common in the semi-arid areas of India. The virus with membrane-bound isometric particles 70–90 nm in diameter, is transmitted by thrips, and has a very wide host range. Clump disease was observed on peanut grown in sandy soil in India. The causal virus consisted of straight tubular particles about 250 and 185 nm in length. The virus, named Indian peanut clump virus, resembled peanut clump virus reported from West Africa in symptomatology, particle morphology and soil-borne nature.

A disease characterized by mosaic mottling on the leaves of peanut is prevalent in the peanut-growing areas of Java and Sumatera islands. The virus is readily transmitted by sap-inoculation and by aphid in a non persistent manner. Virus particles consist of flexuous rods about 750 nm in length. The virus belongs to the potyvirus group and is serologically related to peanut chlorotic ring mottle virus and peanut stripe virus.

## Introduction

Numerous virus diseases have been recorded on peanuts cultivated in many countries. In India, several virus diseases were reported, and six causal viruses have been characterized and identified at ICRISAT. Those viruses are peanut mottle (Reddy *et al.*, 1978), tomato spotted wilt (Ghanekar *et al.*, 1979), peanut green mosaic (Sureenivasulu *et al.*, 1981), Indian peanut clump (Reddy *et al.*, 1983), cowpea mild mottle (Iizuka *et al.*, 1984) and peanut chlorotic leaf streak (Iizuka *et al.*, 1984) and peanut chlorotic leaf streak (Iizuka *et al.*, 1979; Reddy, unpublished data) viruses. In Indonesia, also several virus diseases of peanut have been recorded during the past 30 years, and recently, peanut mottle (Roechan *et al.*, 1978), peanut mosaic and peanut crinkle leaf (Iwaki, 1979) viruses were reported.

This report describes the characteristics of a strain of tomato spotted wilt and Indian peanut clump viruses occurring in India, and a virus causing peanut ring mottle which is widespread in Indonesia.

## Tomato spotted wilt virus (TSWV)

One of the most important virus diseases in India is "bud necrosis" caused by a strain of TSWV. The disease occurs in most of the peanut-growing areas, especially in the semi-arid regions where both the vector (thrips) and sources of the virus are abundant. The rate of disease incidence ranges from 5 to 80% in different parts of India (Ghanekar, 1980).

Symptoms caused by TSWV on peanuts consist of chlorotic rings and mottling on newly developed leaves, including necrosis of the tips, severe stunting, proliferation of axillary shoots with distorted leaves, and shrivelled kernels.

The virus is mechanically sap-transmissible, consistently transmitted by thrips (*Scirthothrips dorsalis* and *Frankliniella schultzei*), but not through seeds of peanut.

The host range of the virus is wide. Out of 33 plant species belonging to 8 families tested for their susceptibility to the virus, 30 plant species in 7 families were confirmed to be susceptible. *Glycine max, Vigna mungo, V. radiata, V. unguiculata* and *Lycopersicum esculentum* were found to

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be naturally infected with the virus. In addition, some common weeds in peanut fields were also infected with the virus.

The virus is unstable in crude sap. It has a thermal inactivation point at 40°C, and the longevity in vitro is approximately 5 hours at 25°C.

Electron microscope observations revealed the presence of spherical membrane-bound particles in thin sections of infected leaves. The particles, 70–90 nm in diameter, were located in the cytoplasm.

In serological tests, extracts from the infected peanut leaves reacted positively in haemagglutination tests with the antiserum to TSWV provided by the courtesy of Dr. Gooding.

Although it was not possible to select totally resistant genotypes within nearly 6,000 peanut accessions after exposure to natural infection, two cultivars consistently showed a lower incidence of the disease compared with the other. Wild *Arachis* species were screened under field conditions as well as by sap inoculation tests, and four of them showed resistance to the disease (Ghanekar, 1980). Recently, a commercial cultivar Robut 33-1 was found in field tests to exhibit a 50–90% lower incidence of the disease than a popular cultivar, due to the low infestation with thrips of the resistant cultivar (Amin, 1985).

## Indian peanut clump virus (IPCV)

Another economically important virus disease in India is "clump" caused by IPCV. The disease occurs in Punjab, Gujarat and Andhra Pradesh states mostly in sandy soil. Infected plants usually fail to produce pods, and losses of up to 60% have been recorded even in case of late infection (Ghanekar, 1980).

Infected plants are markedly stunted with small dark green leaves. The young leaves show mosaic symptoms with chlorotic rings.

The virus is transmitted by sap inoculation, but not by the aphid, *Aphis craccivora*. The virus is transmitted through soil, although no vectors have been identified yet, but not through seeds.

Thirty two plant species in 8 families were inoculated with the virus, and 17 species belonging to 3 families became infected. Systemic symptoms were observed on such plants as *Phaseolus vulgaris* (cv. Top Crop), *Cassia occidentalis, Nicotiana clevelandii*, etc., and local lesions on *Canavallia ensiformis, Chenopodium quinoa, Vigna unguiculata,* etc.

Thermal inactivation point of this virus is 60–65°C, and the virus remains active after 10 days of storage at room temperature (25–30°C).

Purified virus samples were observed under an electron microscope. The particles appeared as straight rods about 20 nm in diameter and about 250 and 185 nm in length.

Antiserum to the peanut clump virus (PCV) which was reported in West Africa (Thouvenel *et al.*, 1976), did not react with IPCV in microprecipitin and ELISA tests.

However, the virus resembles the West African PCV in the symptoms on peanuts, structure of the virus particles, and also soil-borne nature (Thouvenel *et al.*, 1976). The virus was named IPCV as it is serologically distinct from PCV from West Africa (Reddy *et al.*, 1983).

## Virus causing peanut chlorotic ring mottle

The disease caused by the virus is distributed in the Java and Sumatera islands of Indonesia. Leaves of infected peanut plants are usually light green and interspersed with dark green ring-like islands.

The virus is transmitted both by mechanical sap inoculation and by aphid (*Myzus persicae*) in a non persistent manner. Sixty-seven seeds collected from infected peanut plants were sown in sterilized soil, but no infected plants appeared.

The virus causes systemic symptoms on *Glycine max* (cvs. Toyosuzu, Harosoy, etc.), *Phaseolus vulgaris* (cv. Honkintoki), *Vigna angularis, V. unguiculata, Canavallia ensiformis,*

*Sesamum indicum* and *Nicotiana benthamiana*. The virus produces local lesions on *Chenopodium amaranticolor* and *C. quinoa*. No. infection occurs on *Pisum sativum, Glycine max* (cv. Norin No.2), *Phaseolus vulgaris* (cv. Top Crop), *Vicia faba, Nicotiana tabacum,* etc.

The particles of this virus consist of flexuous rods, about 750 nm in length. In thin sections of infected soybean leaf, cylindrical cytoplasmic inclusions were observed.

This virus formed a precipitin line in gel diffusion tests with both antisera to peanut chlorotic ring mottle and peanut stripe viruses provided by the courtesy of Dr. Iwaki and Dr. Demski, respectively. It also formed a faint precipitin line with antiserum to soybean mosaic virus, but did not react with antiserum to peanut mottle virus.

The virus was identified as a member of potyvirus based on aphid transmissibility, morphology of its particles, and the presence of cylindrical inclusions in infected cells. Peanut mottle virus (PMV), a member of potyvirus, has been reported from many countries and is distributed widely. On the other hand, PMV is different from the virus herein described in host range, symptomatology, and serology. Roechan *et al.*, (1978) described a strain of PMV from Indonesia, which resembles the virus herein described in host range and symptomatology. Recently, Fukumoto and Iwaki (1982) reported on a potyvirus which was named peanut chlorotic ring mottle virus (PCRMV) and was isolated from peanut in Thailand. PCRMV is also very similar to the Indonesian virus herein described in host range, symptomatology, and serology. The Indonesian virus reacted positively with the antiserum to peanut stripe virus (PStV) as reported by Demski *et al.*, (1984). PStV which originated from China resembles the Indonesian virus in host range, but symptoms on peanut are different. Moreover, PStV is transmitted through peanut seeds with as high a rate as 37.6%, while seed transmission has not been confirmed for the virus from Indonesia.

Although some characters of this virus differ from those of PStV, the virus is closely related to PStV as well as PCRMV. These viruses such as the Indonesian virus, PCRMV, and PStV, appear closely related serologically not only to each other, but also to blackeye cowpea mosaic, bean common mosaic, azuki bean mosaic, clover yellow vein and soybean mosaic viruses (Fukumoto and Iwaki, 1982; Demski *et al.*, 1984). The virus reported here may be similar to groundnut mosaic virus observed in Malaysia (Ting *et al.*, 1972) and groundnut mottle virus in the Philippines (Benigno and Favall-Hedayat, 1977). A virus which caused peanut mild mottle reported from China (Xu *et al.*, 1984) is closely related to PStV serologically (Demski *et al.*, 1984). These viruses, which are closely related to the Indonesian virus herein described (Table 1), are presumably widespread in the tropical and subtropical countries of Asia.

**Table 1 Comparison of selected host reactions between PMV and some other potyviruses reported from Asia**

| Plant species | PMV | A strain of PMV | PMMV | PStV | PCRMV | This virus |
|---|---|---|---|---|---|---|
| *Glycine max* | S | S | S | S | S | S |
| *Vigna unguiculata* | S | S | S | S | (S) | S |
| *Phaseolus vulgaris* (cv. Top Crop) | L | O | O | O | O | O |
| *Pisum sativum* | S | O | O | O | O | O |
| *Vicia faba* | S | O | O | O | (S) | O |
| *Chenopodium amaranticolor* | O | L | L | L | L | L |
| Reported from | Japan | Indonesia | China | China | Thailand | Indonesia |
| Reference | Inouye (1969) | Roechan (1978) | Xu (1983) | Demski (1984) | Iwaki, unpublished data | Iizuka |

Remarks: S; systemic symptoms, L; local lesions, O; no symptoms, ( ); symptomless infection.

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## Discussion

**Reddy, D.V.R.** (ICRISAT): Peanut mild mottle virus is related to peanut stripe virus but distinct from peanut mottle virus. Peanut stripe virus shows a high rate of seed transmission (37.6%) only under laboratory conditions whereas in the field the rate of transmission is only 4%. Do you consider that peanut chlorotic ring mottle virus is similar to peanut stripe virus?

**Answer:** Yes, I believe so although we have no evidence of seed transmission for peanut chlorotic ring mottle virus.

**Tantera, D.M.** (Indonesia): I would like to make general comments about the characterization of the viruses described by the various speakers. With regard to mungbean yellow mosaic virus reported by Dr. Honda, it appears that there is a need for standardizing methods of identification of the viruses. For example, the use of different buffers may affect inoculation techniques by sap. Seed transmission depends on the type of testing, including growth of seeds, counts of plants with infection in the next crop by applying ELISA or other serological methods. Also in the case of the host range, the symptoms may vary with the varieties or cultivars used depending on regional conditions. I would thus like to suggest that the use of RNA hybridization techniques may enable a better characterization of viruses such as peanut mottle, peanut chlorotic ring mottle and some of the other viruses described in the presentations.