

QUARANTINE IMPORTANT DISEASES OF SORGHUM, PEARL MILLET, CHICKPEA, PIGEONPEA AND GROUNDNUT

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ABSTRACT

Quarantine important diseases of sorghum, pearl millet, chickpea, pigeonpea and groundnut are described. In case of sorghum no report appears to be available on the occurrence of mildew, bacterial leaf streak, bacterial leaf blight and bacterial leaf spot in India. Downy mildew, head smut and sugarcane mosaic virus, though found in the country, have quarantine restrictions owing to the fear of their new races being introduced. Downy mildew and ergot, the two serious diseases of pearl millet, are present in India but the entry of seed from the areas where these diseases occur is restricted. Bean yellow mosaic virus of chickpea has not been recorded in India; cucumber mosaic virus, pea leaf roll virus, blight, wilt and alfalfa mosaic virus are present in the country but import of seed from countries where these diseases occur is restricted under quarantine rules. In the case of pigeonpea, anthracnose, bacterial leaf spot and stem canker, sterility mosaic virus and yellow mosaic virus do occur in the country but they too have quarantine restrictions. The exotic diseases of groundnut — scab, Texas root rot, rosette virus, peanut stunt virus, peanut mottle virus and peanut marginal chlorosis virus — and already occurring rust and bacterial wilt, have quarantine importance.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) serves as a world centre for the improvement of sorghum, pearl millet, pigeonpea, chickpea and groundnut. The Memorandum of Agreement with the Government of India authorizes the Institute unrestricted import of seeds and genetic materials from any part of the world, consistent with the appropriate plant quarantine regulations. ICRISAT fully respects and abides by the quarantine rules of Government of India. Being an international institute the plant quarantine responsibility of ICRISAT is much heavier because of the (a) greater number of seed exchanges involved; (b) higher degree of responsibility expected, lest any inadvertent negligence in international shipment of seed should result in import or export of any pest or disease and thus endanger agriculture of the country concerned and (c) greater speed required in seed movement to ensure timely planting by the cooperators.

It is comparatively easy to control the insects in the imported seed materials at the quarantine stations, but the diseases pose a difficult problem. In this paper an attempt is made to provide some information on the quarantine important diseases of sorghum, pearl millet, chickpea, pigeonpea and groundnut.

SORGHUM

A. DISEASES NOT REPORTED FROM INDIA

1. MILO DISEASE — *Periconia circinata* (Mangin) Sacc.

Distribution : Sorghum growing regions of USA, particularly Texas, Kansas, Oklahoma, New Mexico, Nebraska, Arizona and California (Tarr, 1962).

Symptoms : The leaves of the disease affected plants tend to droop and become slightly rolled with the older ones turning yellow and drying out from the tips and margins when roots are attacked. Infected seedlings may show characteristic water soaked reddish discolouration of the cortex and vascular tissues.

Mode of Transmission : Soil-borne, but is also carried on the seed (Tarr, 1962).

Economic Importance : In Texas the trials extending over 10 years indicated that grain losses up to 50 to 60% may result where susceptible sorghum is sown in milo disease-infested soil.

2. BACTERIAL LEAF STREAK — *Xanthomonas holcicola* (Elliot) Starr and Burkh.

Distribution : USA, Australia, South Africa and Argentina.

Symptoms : The first symptoms are narrow, water-soaked translucent leaf streaks 2 to 3 mm wide and 2 to 15 mm long, which soon turn red and become opaque. Later, these may broaden into somewhat irregularly oval spots with tan centres and narrow red margins.

Mode of Transmission : Common occurrence of this disease suggests that either it is carried with the seed or is soil-transmitted.

Economic Importance : Under favourable climatic conditions its development and spread can cause considerable leaf injury thereby reducing forage value and grain yield. According to Nirula (1979) seed samples of sorghum for import into India must be collected from fields where this disease does not occur.

3. BACTERIAL LEAF BLIGHT — *Pseudomonas andropogoni* (E. F. Smith) Stapp.

Distribution : USA, Argentina, Formosa, China, Australia and Nigeria.

Symptoms : When young, the lesions are narrow (only a few mm wide). These become wider later and extend into long interveinal streaks which may extend up to 40 cm. Abundant droplets of bacterial exudates are produced from the stripes.

Mode of Transmission : This bacteria is thought to be transmitted by seed. But so far there is no experimental evidence to confirm it. (Elliott *et al.*, 1929).

Economic Importance : In warm wet weather it causes necrosis of large areas of leaf tissues, thus reducing the forage value and grain yield. Entry of sorghum seeds from areas where this disease is prevalent, is prohibited in India. (Nirula, 1979).

4. BACTERIAL LEAF SPOT — *Pseudomonas syringae* Van Hall

Distribution : USA, Europe, Australia, New Zealand, South Africa, and Tunisia.

Symptoms ; The leaf lesions are at first dark green and water soaked in appearance. These soon become reddish and finally dry to light coloured in the centres with narrow reddish borders.

Mode of Transmission : Bacterial leaf spot is spread by wind, rain and possibly by insects.

Economic Importance : Bacterial leaf spot is sometimes wide spread on sorghum and sudan grass in USA, but rarely causes serious crop losses.

B. DISEASES ALREADY PRESENT IN INDIA BUT HAVING QUARANTINE RESTRICTION :

Some diseases are present in India, but their entry along with seed is restricted as they are likely to bring in new races (e. g. downy mildew of pearl millet) which can cause devastating epiphytotic.

1. DOWNY MILDEW — *Sclerospora sorghi* (Kulk).

Distribution : India, Pakistan, Egypt, Kenya, Uganda, South Africa, Tanzania East Africa, Nigeria, Rhodesia, the Sudan, Botswana and zaine.

Symptoms : The leaves of the infected plants become narrow, pale yellow, and under suitable climatic conditions, are covered with a fine white bloom especially on the lower surfaces as sporulation occurs. White streaks often become red purple on the upper surfaces.

Mode of Transmission : The source of primary infection is believed to be soilborne oospores, which germinate and initiate systemic infection which later produce large number of conidia on leaf surface. The conidia spread by wind and other agencies and become the source of secondary infection (Rangaswamy, 1975)

Economic Importance : In South Africa, a severe outbreak was reported in January 1956 with 100% infection in some sorghum fields.

2. HEAD SMUT — *Sphacelotheca reiliana* (Kuhn) Clinton.

Distribution : Europe, North and South America, Mexico, Africa, Asia, Australia, New Zealand, West Indies, and China.

Symptoms ; The first signs of infection appear at heading time when the young head

within the enclosing boot is seen to be completely replaced by a large whitish gall, which may be sometimes partial.

Mode of Transmission : The infection is from the spores, present in the soil and according to Ramakrishnan (1963) only young plants are susceptible.

Economic Importance : Incidence of head smut is often sporadic in small areas. The disease incidence may be 50% or more in some infected fields. In Texas some fields showed up to 60% infection.

3. SUGARCANE MOSAIC VIRUS.

Distribution : North and South America, Turkey, West Indies, Egypt, Uganda, Ma'agasy, South Africa, Sierre Leone, Zaire, Nyasaland, the Philippines, Indonesia, China, Japan, Malaya, Indochina, Australia, Hawaii and India.

Symptoms : Pale green elongated blotches appear in the dark green background tissue of the infected leaf. Typically the blotches are irregularly oval or oblong, elongated, parallel to the mid rib, and not delimited by veins resembling mosaic pattern.

Mode of Transmission : *Aphis maidis* is the principal insect vector for this virus.

Economic Importance : Sorghum is generally not seriously affected in the field except when cultivated in the vicinity of infected sugarcane crop.

PEARL MILLET

DISEASES ALREADY PRESENT IN INDIA BUT HAVING QUARANTINE RESTRICTIONS

1. DOWNY MILDEW — *Sclerospora graminicola* (Sacc) Schroet

Distribution : China, Fiji, France, Germany, Holland, Hungary, India, Israel, Italy, Japan, Malawi, Mozambique, Nigeria, Rhodesia, Romania, USSR Senegal, Spain, Tanzania, Upper Volta and USA.

Physiological specialization : Uppal and Desai (1932) reported failure to infect pearl millet with oosporic inoculum from *Setaria* or *Panicum* and vice versa. Tasugi (1934) reported that *S. graminicola* from *Setaria italica* could not infect *S. viridis* and vice versa. Bhat (1973) found that hybrid HB3 was highly resistant at Mysore (Sout India) but it was susceptible at many other locations. One of the reasons for this could be the existence of several ecological and physiological races.

Symptoms : The infected leaves loose their green colour and the ears turn wholly or partially into a green head of small twisted leaf-like structures.

Mode of Transmission : Oospores sticking to the surface of the healthy grain and those fallen in the soil during harvesting and threshing operations may cause infection of seedlings.

Economic Importance : Mitter and Tandon (1930) observed heavy infection of downy mildew (45% of plants) in the neighbourhood of Allahabad. Uppal and Kamat (1928) obtained 60% infection by soil inoculation with oospores. According to quarantine regulations, seeds for import into India should be collected only from those plants which are free from downy mildew (Nirula, 1979).

2 ERGOT — *Claviceps microcephala* (Waller) Tul :

Distribution : India; Ghana Gambia, Senegal and Tanzania in Africa.

Symptoms : Small droplets of a light honey-coloured, dew-like substance exudes from infected spikelets. A few to many such spikelets may be found in a group, which darken with age and small greyish or dark brown sclerotia are formed.

Mode of Transmission : Sclerotia get mixed with *Bajra* grains besides falling in the field during threshing and harvesting operations and spread infections.

Economic Importance : In India, the pathogen caused very severe damage to pearl millet in recent years. The extent of damage was so heavy in some fields that the entire crop had to be burnt in order to prevent further damage and spread.

CHICKPEA

DISEASES NOT REPORTED FROM INDIA

1. BEAN YELLOW MOSAIC VIRUS

Distribution : Iran and USA.

Symptoms : General yellowing of foliage, shortening of internodes often an increased stiffness and twisting of the terminal growth and brown internal vascular discoloration of the stem are noted. Discoloration is confined largely to the phloem.

Mode of Transmission : The main aphid vectors are *Aphis craccivora*, *Acyrtosiphon pisum* and *A. sesbaniae*.

Economic Importance : In Iran 5 to 13% of natural infection due to this virus was recorded (Kaiser and Danesh, 1971).

DISEASES ALREADY PRESENT IN INDIA BUT HAVING QUARANTINE RESTRICTIONS

1. CUCUMBER MOSAIC VIRUS

Distribution : Colombia, Iran, USSR and India.

Symptoms : This virus produces wilt symptoms in the affected plant in addition to the stunting, leaf deformation and dwarfing.

Mode of Transmission : It is transmissible by more than 60 spp of aphids notably *Aphis gossypii* and *Myzus persicae*. Seed transmission is probably not common.

Economic Importance : Yield loss upto 99.7% during prebloom and up to 87.2% during full bloom was reported from Iran (Kaiser and Danesh, 1971).

2. PEA LEAF ROLL VIRUS

Distribution : Iran, New Zealand and India.

Symptoms : Plants infected by pea leaf roll virus are usually severely stunted especially if infection occurred in the early stages. Often a proliferation of the axillary buds, twisting, thickening and rolling of the leaves are developed sometimes after infection.

Mode of Transmission : *Aphis gossypii*, *A. fabae* and *A. craccivora* are the important vectors for the transmission of this virus.

Economic Importance : Seed yields of all food legumes were reduced at pre bloom by 81 to 100% and by 19 to 94% at full bloom. Mortality of plant infected by PLRV at prebloom usually exceeded 50% for most food legumes studied (Kaiser, 1972).

3. BLIGHT - *Ascochyta rabiei* (Pass) Labr.

Distribution : Algeria, Morocco, Tanzania, India, Iran, Israel, Pakistan, Greece, Italy, Portugal, Rumania, Spain and USSR(Ukraine).

Races : Two new isolates of blight pathogen, 'Bajaura HP' and 'Gurudaspur Punjab' were obtained in addition to the existing isolates 'IARI' and 'Lahaul'. These two new isolates were found to be highly pathogenic.

Symptoms : The disease symptoms appear first on the leaves as water soaked lesions which later develop into roundish spots with brown margin and yellowish grey centre. When the infection takes place on the stem, linear spots with irregular margin develop which later girdle the stem causing the shoot to wilt.

Mode of Transmission : The primary inoculum is spread through fungal spores and hyphae, which are carried along with the seed.

Economic Importance : In Azerbaijan USSR, *Ascochyta rabiei* caused up to 100% loss. In India the leaf blight caused considerable damage. In Spain this pathogen is the most important one on chickpea causing up to 50% loss in yield, Quarantine regulations prohibit the entry of seed from plants infected by this disease (Nirula, 1979).

4. WILT - *Fusarium oxysporum* F. sp. *ciceri* (Padwick) Snyd and Hans.

Distribution : India, Burma, Pakistan, Australia, Ethiopia and USA.

Symptoms : The first symptom of the disease in the field is drooping of plants followed by sudden death. The leaves may also turn yellow and drop off prematurely. Transverse sections of the basal stem or the roots reveal masses of fungal hyphae in the vascular bundles and discolouration of the vascular cells.

Mode of Transmission : After the harvest of the crop, the fungus survives on the host roots for several years. It may produce chlamydospores, which are resting spores which can withstand adverse soil conditions and then become active when the next crop is sown (Rangaswami, 1975).

Economic Importance : Mortality of chickpea plants due to this disease varied from 1.9 to 7% under natural conditions at Agricultural Research Station, Badnapur (Shaikh 1974). Mortality of chickpea plants was 95% in acidic soil with high soil moisture and without organic matter while it was low in another combination with acidic soil (Chauhan, 1965)

5. ALFALFA MOSAIC VIRUS

Distribution : India, Iran and USA.

Symptoms : The first visible symptom of mosaic in the field is twisting of the terminal bud followed by necrosis and the initiation of secondary branches. Mild mottling on leaves and premature drying are the other symptoms caused by this virus.

Mode of Transmission : Alfalfa mosaic virus is transmitted by atleast 13 species of aphids (Kennedy *et al.*, 1962). This virus is not transmitted through seed in chickpea.

Economic Importance : In an experiment conducted in Iran with alfalfa mosaic virus, 99.4% reduction in yield and 65.3% plant mortality were recorded from the plot inoculated in prebloom stage. Plant mortality did not occur in the plot when the plants were inoculated in full bloom but the yield was decreased up to 86.5% (Kaiser and Danesh, 1971).

PIGEONPEA

DISEASES ALREADY PRESENT IN INDIA BUT HAVING QUARANTINE IMPORTANCE

1. ANTHRACNOSE - *Colletotrichum cajani* Rangel
Colletotrichum capsici Somani *et al.*

Distribution : Puerto Rico, USA and has recently been reported in some parts of India. (Maharashtra) by Somani *et al.* (1975).

Symptoms : Numerous brownish grey, oblong and slightly sunken cankerous spots are found about 10 cm above ground level on the main stem. Besides, main stem branches are also found affected. On the local varieties drying and death of the branches from tips downwards is noticed. Corky localized longitudinal splitting of bark is observed on the main stems. Minute black acervuli are noticed on these sunken areas.

Mode of Transmission : The fungus is carried along with the seed and causes primary infection of the seedlings. Secondary spread may be due to air-borne conidia.

Economic Importance : New varieties PL 8796 and Kaki were found severely affected at Akola during 1973 (Somani, *et al.*, 1975).

2. BACTERIAL LEAF SPOT AND STEM CANKER - *Xanthomonas cajani* Kulkarni *et al.*

Distribution : India and Sudan.

Symptoms : The spots as they develop become quadrilateral (1mm) and are surrounded by a hallow on the upper surface of the leaves. Spots which are light brown initially become dark brown later and are raised on the upper surface as a result of drying of bacterial exudation. On the main side of branches the pathogens produce dark brown cankers which, when numerous and close, cause peeling of the bark.

Mode of Transmission : Reported to be carried through infected leaf debris.

Economic Importance : The disease is believed to cause some damage to pigeonpea crop during hot and humid summer months.

3. STERILITY MOSAIC VIRUS

Distribution : Burma, Thailand and India.

Symptoms : The characteristic features are stunting, bushy and pale green appearance of plants, drastic reduction in leaf size and complete cessation of reproductive structures. The leaf lamina remains smooth. The diseased leaves are malformed, wrinkled and small.

Mode of Transmission ; Successful transmission can be achieved through graft, sap and through Eriophid mite.

Economic Importance : The surveys carried out in Uttar Pradesh India, revealed heavy incidence in some areas, and in some fields the yield loss was 100% (Nene, 1972).

4. YELLOW MOSAIC VIRUS

Distribution : India, Puerto Rico and Sri Lanka.

Symptoms : The disease first appears in the form of yellow diffused spots scattered on leaf lamina not limited by veins and veinlets. Such leaflets show broad yellow patches alternating with green patches. In advanced stage necrotic areas with bleached appearance can be found in small patches. The entire lamina turns bright yellow in the later stages.

Mode of Transmission : The virus is transmitted by white fly (*Bemisia tabaci*).

Economic Importance : The surveys carried out in Uttar Pradesh, India, showed 22 districts with 26 to 50% infection, 3 districts with 51 to 95% infection and in 1 district with 1 to 5% infection (Nene, 1972).

GROUNDNUT

DISEASES NOT REPORTED FROM INDIA

1. SCAB - *Sphaceloma arachidis* Bitan Court and Jenkins

Distribution : Brazil and Argentina.

Symptoms : The lesions appear on almost all the aerial parts of the affected plant. Lesions on the leaves are small, round or irregular, isolated or confluent, depressed in the centre and raised on the edges. The lesions have a dark margin on the upper surface and a brown margin on the lower surface. Lesions on the stems and petioles are oval and raised, and contain greyish olive conidiophore and black acervuli.

Mode of Transmission : This disease is not seed borne, and may be spread through soil.

Economic Importance : This disease has been posing serious quarantine problems in the import of seed from Brazil and Argentina to other groundnut growing continents. The Government of India forbids the entry of groundnut seed from areas where this disease occurs. (Nirula 1979)

2. TEXAS ROOT ROT - *Phymatotrichum omnivorum* (Shear) Duggar

Distribution : Southern groundnut growing areas of USA.

Symptoms : White mats of fungus are formed on the soil surface above infected roots under moist soil conditions. These become tan coloured as sporulation occurs. The rhizomorphs also bear tan sclerotia of the size of pinheads which darken and become warty with age. Infected plants wilt and die rapidly.

Mode of Transmission : This pathogen has a wide host range and can persist in soil for long periods.

Economic Importance : Severe losses were reported from the crop grown in heavier soils of southern USA.

3. ROSETTE VIRUS

Distribution : Kenya, Uganda, Somalia, Tanzania, Zambia, Zaire Rhodesia, Malawi, South Africa, Senegal, Upper Volta, Gambia USSR Indonesia, Philippines, Nigeria, Angola, Mozambique. Reports from countries other than in Africa, have not been fully substantiated.

Two strains of the 'Rosette' virus have been reported.

Symptoms :

Chlorotic Rosette : Youngest leaflets show faint mottling accompanied by slight veinal necrosis, subsequent leaves may be completely chlorotic showing mosaic pattern.

Green Rosette ; Dark green foliage mottle on a light green background and a marked reduction in leaflet size are the common symptoms of this disease. Infected plants are dark green and have a stunted bunched appearance.

Mode of Transmission ; Both types of groundnut rosette are transmitted by *Aphis craccivora*.

Economic Importance : This disease is endemic in many African countries in semi arid tropics. In 1975 in Nigeria, the disease caused up to 50% reduction in yields.

4. PEANUT STUNT VIRUS

Distribution : USA and Japan.

Symptoms ; The most typical symptom is a severe dwarfing of the foliage. Leaflets and petioles are reduced in size and the leaves are frequently curled upwards or malformed. Affected plants are usually chlorotic and paler.

Mode of Transmission : Seed transmission to the extent of 0.1% or less is known (Troutman *et al.*, 1967). Several species of aphids are the vectors for transmission of this virus.

Economic Importance ; Reduction in yield and quality was recorded from the affected

crop According to quarantine regulations, the parent crop should be inspected during its active growth period for the viruses (Nirula, 1979).

5. PEANUT MOTTLE VIRUS

Distribution : USA, Australia, Philippines, Africa, Malaysia, South Africa, Japan and Europe. Recently few reports were made on the occurrence of this disease in India also (Reddy *et al.*, 1978).

Symptoms : Chlorotic and necrotic rings on groundnut foliage are caused by this virus. General chlorosis and mottling of the whole plant is also common. Seed discolouration was observed in the seed collected from the affected plants.

Mode of Transmission : The seed transmission is at the rate of 1 to 8% in groundnut. *Aphis craccivora* and other aphid species transmit the disease.

Economic Importance : An average of 20% reduction in yield was recorded in the peanut mottle virus affected groundnut plots. The Government of India restricts the import of seed material from plants infected by this disease. (Nirula, 1979).

6. PEANUT MARGINAL CHLOROSIS VIRUS

Distribution : Papua New Guinea.

Symptoms : The leaves of the diseased plants show yellowing of the leaf margins and crinkling. The affected plants are usually smaller than the normal plants.

Mode of Transmission : This virus is transmitted through seed, and also can be transmitted by grafting.

Economic Importance : The yield of the affected plants is reduced to half of that from healthy plants. The entry of the seed into India from areas where this disease is present in groundnut is prohibited. (Nirula, 1979).

7. SMOOTH-HEADED LESION NEMATODE - *Pratylenchus brachyurus* (Godfrey, 1929) Filip & Stek 1941.

Distribution : Australia and USA.

Symptoms : Enzymes produced by the nematode hydrolyse storage compounds in the plant to toxic products causing lesions. Once the lesions appear, fungi and bacteria attack the dead tissue. Heavily attacked plants have small root systems and the vines are stunted and chlorotic.

Mode of Transmission : These nematodes can survive as larvae or adults for up to 28 months within dry shelled tissues in storage and thus the shells continue to be an important nematode reservoir and means of spread up to 100%.

Economic Importance : Serious losses in groundnut due to this nematode were reported from Australia and USA. It causes losses in yield up to about 20% when it occurs in relatively high populations. The quarantine regulations do not permit the entry of groundnut seed along with their shells (Nirula, 1979).

DISEASES ALREADY PRESENT IN INDIA, BUT HAVING QUARANTINE RESTRICTIONS

1. RUST — *Puccinia arachidis* Speg.

Distribution : Africa, Asia, Australia, Polynesia North America, Central America, West Indies and South America. In India, it was recorded for the first time in 1969 by Chahal and Chohan (1971).

Symptoms : Red brown uredospores are produced within 48 hours of the first appearance of the disease and spread rapidly by wind, etc, under favourable conditions resulting in defoliation and death of growing crop. The leaf tissues around the infected sites die and dry out in irregular patches, and eventually the leaflets may curl and drop off.

Mode of Transmission : This pathogen is spread by wind. The leafhoppers containing rust pustules will transmit this from one area to another.

Economic Importance : Losses are heavy especially if the crop is infected in a wet growing season. At several places 100% infections by this disease was reported (Subrahmanyam *et al.*, 1979).

2. BACTERIAL WILT OR SLIME DISEASE — *Pseudomonas solanacearum* E. F. Smith.

Distribution : East Indies, South Africa and USA. In India this pathogen is known to attack tobacco, potato, brinjal and some other solanaceous crops.

Symptoms : Infected plants appear generally unhealthy, chlorotic and wilted under water stress. Dark brown discolouration is evident in xylem tissues. If this stem is cut across at soil level a grey slimy liquid can be pressed out of the bundles.

Mode of Transmission : The pathogen survives in soil and spreads in water around soil particles.

Economic Importance : Heavy losses were reported in groundnut crops grown in irrigated areas. Slime disease of peanuts, the first recorded important disease was observed

in East Indies in 1905 with atleast 25% loss. (Garren and Wilson, 1951)

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