



# Phytoplasma diseases of cassava

## *Various phytoplasma*



Photo: Paul van Mele, Agro-Insight

*Cassava showing bunches of leaves, typical of witches' broom symptoms, in Thailand.*



Photo: Paul van Mele, Agro-Insight

*Brown vascular tissues are seen on witches' broom infected plants in Thailand when the stems are cut.*

**SUMMARY:** Several severe diseases of cassava are associated with a number of different bacteria-like phytoplasmas in South America, the Caribbean, Asia, Africa, and the South Pacific. In some, shoots are bunched with small yellow leaves; in others, symptoms are seen only on roots at harvest. Management of these diseases is difficult: methods of spread are unknown and commercial growers and smallholders lack access to clean planting material. Careful selection of cuttings is recommended and also early removal of plants if disease symptoms occur.

## KEY SIGNS

In recent years, a number of diseases have emerged that are caused by phytoplasmas. Often phytoplasma infections cause normally dormant shoots to grow, producing small, yellow leaves. These symptoms are called a witches' broom. However, not all the phytoplasma diseases of cassava produce symptoms like that. The phytoplasma diseases of cassava found so far are listed below.

In South America, frogskin of cassava has been reported. It is unusual in that there are few above ground symptoms of disease, apart from slight swellings of lower stems, and curling and yellow/green patterns on the leaves of some varieties. However, the roots are thin, woody, with thick outer layers, and deep cracks. Sometimes the cracks will form a ring around the root.

In Thailand, cassava witches' broom disease was first reported in 2008. It spread rapidly and is now widely distributed across the region. Affected plants show bunches of shoots with short internodes, small yellowish leaves at the top of the plants, brown vascular tissues (the tubes that carry nutrients and water) and poor storage root development.

In Brazil, a cassava disease associated with a phytoplasma has been known since the 1940s. Losses of 70% are reported on stunted plants with yellow distorted leaves and abnormal multiple shoots.

In Uganda, plants have recently been found with phytoplasma that have yellowish leaves and are slightly stunted. The weed sticky mallow (*Malvaviscus arborus*) was also found to be infected with the same phytoplasma.

## MANAGEMENT

**Prevention** – what to do before signs are seen

*Cultural approaches:* The recent appearance of these diseases in different parts of the world suggests that they are new and, as such, must be monitored carefully. They reinforce the need for care when moving plants internationally. Unrestricted movement could spread phytoplasmas and other diseases. Transfers should only be made as pathogen-tested plants growing as sterile tissue cultures following the FAO/IBPGR (1991) *Technical Guidelines for the Safe*

### *Movement of Cassava Germplasm.*

A priority in the management of these diseases is the use of clean planting material; however, there are few if any such schemes in African countries. Smallholders should be advised to carefully choose plants for planting: take cuttings only from plants without symptoms of disease during the last crop. This is the most important and probably the only effective method of managing these diseases, if sources of certified or approved cuttings are not available.

Additionally, do not plant new plots of cassava next to those that have the disease.

**Control** – what to do after signs are seen

*Cultural approaches:* During the crop growth, remove any plants with symptoms of phytoplasma as soon as they are seen: look out for witches' broom symptoms, as well as stunted plants with abnormal yellow leaves.

Collect and burn plants that show symptoms of disease.

## CAUSE

Phytoplasmas are bacteria-like organisms that can only exist inside the phloem (part of the vascular system) of plants. They are mainly spread by insects. Unlike bacteria, they do not have rigid cell walls and so vary in shape. Phytoplasmas often cause diseases of economic importance.

Molecular analyses of the four phytoplasmas that cause disease in cassava have shown that they belong to different taxonomic groups and, therefore, are the cause of different diseases. Apart from these four, there are also reports of phytoplasma diseases of cassava in Cuba and the Wallis and Futuna Islands in the South Pacific. Methods of spread are unknown for any of them, except for movement in stem cuttings used for planting.

## IMPACT

Cassava is the third most important crop in the tropics after rice and maize in terms of calories produced. Phytoplasma diseases of cassava are a threat to its production as an export crop (mainly Southeast Asia), and as food and income for smallholders. As such, phytoplasma diseases are a potential threat to food security for millions of people. In Vietnam, for instance, the impact occurs in three ways: (i) there is direct yield loss (in some parts of the country, 60,000 ha were affected in 2010, with overall yield and starch losses of 30%); (ii) processors need to buy more cassava roots to make up for the shortfall in starch content, and (iii) farmers, who are paid on starch content, are paid less. In the other regions affected by phytoplasma diseases the impact is just as serious. In parts of Colombia and Brazil, for instance, epidemics of phytoplasma disease have resulted in yield losses of 70-90%.

## DISTRIBUTION

Cassava witches' broom spreads in Southeast Asia (Cambodia, China, Indonesia, Laos, the Philippines, Thailand and Vietnam). Frogskin is known from Colombia, Brazil, Venezuela, Peru, Costa Rica and Panama. Other diseases, as yet not well defined, occur in Brazil, Costa Rica, Cuba, Panama, Peru, the South Pacific and Venezuela.

## FURTHER READING

Alvarez E, Pardo JM, Fernando MJ, Assunta B, Thanh ND, Hoat TX (2014) Detection and identification of 'Candidatus Phytoplasma asteris'-related phytoplasmas associated with a witches' broom disease of cassava in Vietnam. *Phytopathogenic Mollicutes* 3(2): 77-81. (<http://www.indianjournals.com/ijor.aspx?target=ijor:mollicutes&volume=3&issue=2&article=003>)

Arocha Y, Echodu R, Talengera D, Muhangi J, Rockefeller E, Asher O, Nakacwa R, Serugga R, Gumisiriza G, Tripathi J, Kabuye D, Otipa M, Vutseme K, Lukanda M, Boa E (2009) Occurrence of 'Candidatus Phytoplasma aurantifolia' (16SrIII group) in cassava and four other species in Uganda. *Plant Pathology* 58(2): 390.

Cassava diseases in Africa: A major threat to food security. (<http://www.fao.org/docrep/012/i1460e/i1460e.pdf>).

Flores D, Haas IC, Canale MC, Bedendo IP (2013) Molecular identification of a 16SrIII-B phytoplasma associated with cassava witches' broom disease. *European Journal of Plant Pathology*. Published online. (<http://www.scribd.com/doc/228796504/1-Molecular-Identification-of-a-16SrIII-B-Phytoplasma>).

Frison EA, Feliu E (eds) (1991) *FAO/IBPGR Technical guidelines for the safe movement of cassava germplasm*. Food and Agriculture Organization of the United Nations, Rome/International Board for Plant Genetic Resources, Rome. (<http://ecoport.org/Resources/Refs/IPGRI/cassava.pdf>).

Oliveira SAS, Abreu EFM, Araújo TS, Oliveira EJ, Andrade EC, Garcia JMP, Álvarez E (2014) First report of a 16SrIII-L phytoplasma associated with frogskin disease in cassava (*Manihot esculenta* Crantz) in Brazil. *Plant Disease* 98(1): 153-154.

*Phytoplasma aurantifolia*. CABI Crop Protection Compendium. (<http://www.cabi.org.ezproxy.library.uq.edu.au/cpc/datasheetreport?dsid=54518>).

Witches' broom – a curse on cassava. (<http://www.new-ag.info/en/focus/focusItem.php?a=3184>).