



# Kenya Agricultural & Livestock Research Institute

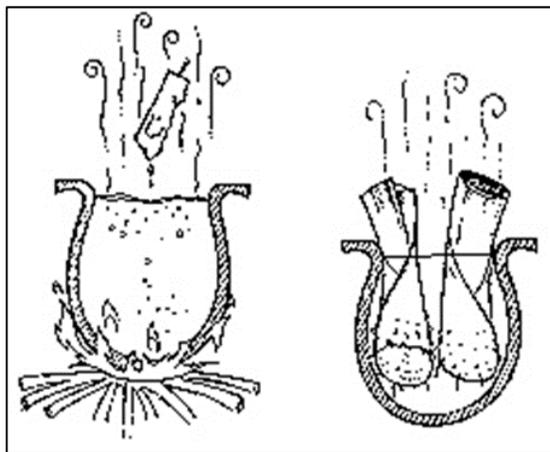
## Factsheet

### Panama wilt (Fusarium wilt) of banana in Kenya

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Panama wilt (Fusarium wilt) caused by a fungus *Fusarium oxysporum* f.sp. *cubense* (Foc) is an endemic disease on banana in Kenya. It was first observed in Kenya in 1952 in Malindi and Muranga on a cultivar suspected to be Bluggoe (ABB), locally known as Bokoboko. It was not until mid-1990s that farmers and agricultural extension officers from other regions complained of severe outbreaks of the disease. The new race (T4) reported in the FAO alert has not been observed in Kenya. The only races of Fusarium wilt confirmed in Kenya are races 1 and 2.

The pathogen has no natural distance dispersal mechanisms and spreads primarily through transference of diseased banana material. Planting material (suckers, rhizomes) either latently infected or carrying contaminated soil have been and remain important methods of long distance dispersals. Movement of diseased banana trash and contaminated soil by man and machine are also significant. Surface irrigation and flood water have also been shown to spread the pathogen. Other factors promoting dissemination include poor crop management and unreliable source of planting materials. Most farmers tend to use conventional banana suckers instead of micro-propagated (tissue cultured) planting material that are preferred. For conventionally propagated banana, although a fungicidal and hot water treatment is necessary most farmers skip this step.



**Figure 1:** Hot water treatment of banana suckers

In Kenya, Panama disease is mainly caused by a fungus *Fusarium oxysporum* f.sp. *Cubense* race1. The fungus survives in soil and on plant waste/debris and enters the roots through bruises and spreads to the whole plant through conductive tissue in the pseudo stem. Healthy looking banana suckers could be infected. Bananas affected by Panama wilt show yellowing of leaves starting with the oldest. Some

of the leaves droop, turn brown, dry and tear. In some cases, the outer leaf sheaths of the pseudo stem may split longitudinally near the soil level.

The affected plant will not develop sufficiently to produce a mature bunch and the disease can cause total crop loss (Figure 2a&b). Some recommended disease control methods include: planting resistant or tolerant varieties; plant quarantine i.e. stop movement of planting material from affected regions; cultural control i.e. have fields clean of leaves and other plant debris; crop rotation; and disinfect all farm equipment while working between banana stools.

Panama wilt has been reported in most regions where this crop is cultivated particular to ripening bananas. The disease can wipe out an entire banana crop of a susceptible variety. The major banana growing areas affected by this disease are Nyanza, western, central, eastern and coastal regions. Incidences of Fusarium wilt occur at a higher frequency in the central region of Kenya i.e. Muranga, Nyeri and Kiambu particularly on the Cavendish genotypes. In Meru South, this disease is a constraint on Cavendish types especially Apple banana varieties. The Cavendish bananas introduced in the 1990s are now widespread and many farmers have replaced the panama susceptible cultivar AAB '*Sukari Ndizi*' with the Cavendish cultivars. These latter cultivars are prominent in the market.



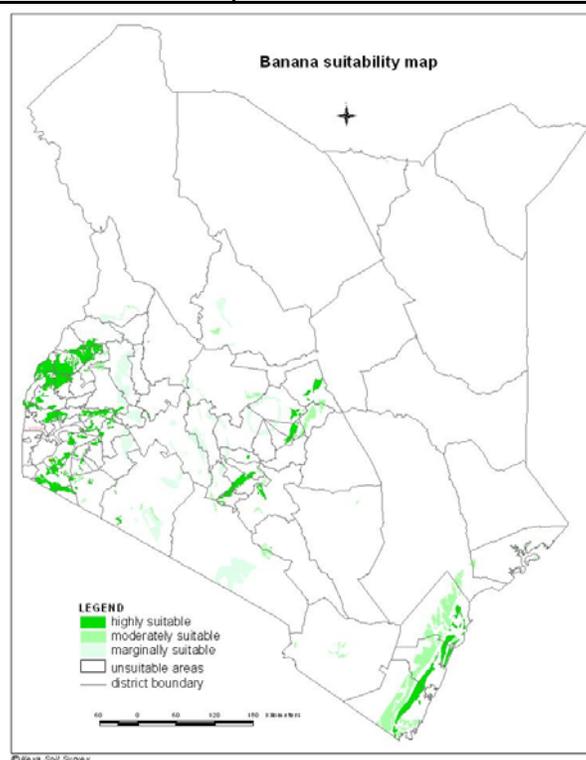
Figure 2a: Longitudinally split banana pseudo stem, a sign of panama disease



Figure 2b: Small mature bunch of panama affected banana plant

**Table 1:** Banana cultivars widely grown in Kenya

Genome group	Cultivar name	Region where commonly grown	Use
AAA	Dwarf Cavendish Valery Giant Cavendish Israel Kampala (Gros Michel)	Mostly Taveta, Coast Central and Eastern (80%), also in Western (30-40%) and Nyanza (10%)	Dessert Dessert Dessert
AA	<i>Muraru</i>	Mostly in Central and Eastern	Dessert
AAB	<i>Kisukari</i> <i>Kisii Ndizi</i>	Central, Western and Nyanza	Dessert
AAA-EA	<i>Ngombe</i> <i>Ekeganda</i> , <i>Egesabara</i>	Mostly (80%) Nyanza, also in Central, Eastern and Western (10- 20%)	Cooking



**Figure 3:** Banana suitability map in Kenya; **Source:** Kenya Soil Survey

The small fruited dessert bananas (hereafter referred to as “Apple”) found in East Africa are diverse, although many times referred to by same names. Within the AAB “Apple” dessert bananas there are four distinct taxa recognized including Prata/Pome, Mysore (also represented by Pisang Ceylan, *Sukari* red or *Wangae* red), Silk and “*Sukari Ndizi*” (Onyango, 2008). Fusarium wilt race 1 is a constraint to banana production and has diminished the cultivation of “Apple” bananas known locally as “*Sukari Ndizi*”, and other banana varieties such as Gross Michele (“*Bogoya*”, “*Bogobogo*” (*Kahinja*) and Silk (represented by *Manjano*, *Ungoye* sweet and *Mboki Musikari* in Kenya).



**Figure 4:** Apple banana varieties

**Table 2:** Banana yield (tons/ha/yr), fruit length (cm) and bunch weight (kg) recorded in Kisii

Apple bananas	Yield	Bunch weight	Fruit length
"Sukari Ndizi"	9	8	14
Prata	16	17	22
Silk	8	8	17
Mysore	13	14	16
GT	14	14	16

For over a decade KALRO has introduced 165 banana genotypes to evaluate production - yield, resistance to pests and diseases and utilization under various eco-zones. In areas of high disease pressure, tetraploid hybrids - the FHIA types are recommended because they have high tolerance to Fusarium wilt and are also very high yielding (can produce up to 400 fingers with fruit bunches weighing up to 140 kg). Other varieties that are promoted by KALRO include Goldfinger, GT (Geraldine Tucker), Cavendish types such as Valerie, Giant and Dwarf Cavendish are tolerant to this disease and have good utilization attributes. GT is a recently introduced banana variety. East African highland bananas (cooking types) are resistant to both races including *Ngombe*, *Nsu Ngombe*, Uganda Green and Diploid (AA) *Muraru*. It is reported that Cavendish banana genotypes are resistant to Fusarium wilt races 1, 2 and 3. Some farmers plant the Gros Michel (Kampala) for its market preference. Resistant Apple varieties include GT, Prata – Manyatta, Soth, Exera, Kifutu and Mysore. Cavendish types including Williams, Chinese Cavendish, giant Cavendish, Valerie, Dwarf Cavendish, Lacatan, Poyo, Israel, Grand Nain and Paz are all resistant to race 1 but succumb to race 4. *Sukari ndizi* (*Kisukari*) and Gros Michel/Kampala/Bogoya) are highly susceptible to both races.

Resistant dessert banana varieties that can be grown in panama hot spot areas	
Tetraploid hybrid - AAAA	FHIA 17
Cavendish varieties	Giant Cavendish, Valery, Chinese Cavendish, Paz, Williams, Grand Nain, Lacatan
Tetraploid hybrid - AAAB	Gold Finger (FHIA 1)
Tetraploid hybrid "Apple" – AAAB	GT
Medium height Bogoya AAA	
Exera	

**Table 3: Control of Panama disease**

<b>Quarantine</b>	<ul style="list-style-type: none"><li>- Prevent Panama disease from establishment in new areas as a priority</li><li>- Movement of diseased planting material and use of infected implements is prohibited</li></ul>
<b>Crop hygiene</b>	<ul style="list-style-type: none"><li>- Areas where Fusarium wilt occurs, general crop hygiene can help reduce disease incidence and prolong economic life of the crop</li><li>- Use of healthy planting material in areas of sporadic occurrence. This can be done by starting with clean &gt;nuclear stock= produced from micro-propagation (tissue culture) ex-plants or rhizome buds (Bulked “clean” material on clean land should be inspected to confirm absence of disease before distribution)</li></ul>
<b>Cultural control</b>	<ul style="list-style-type: none"><li>- Where disease exists, the rate of spread can be reduced</li><li>- Good soil fertility - this ensures good feeding to the crop</li><li>- Soil treatment (expensive) fumigation</li><li>- Crop rotation</li><li>- Flood -fallowing - depth of 30cm for 4 months</li></ul>
<b>Plant resistance</b>	Resistant cultivars to the race present in Kenya e.g. Cavendish type for the race 1 resistance. The use of plant resistance is the most effective approach to management of Fusarium wilt and is the most economic and practical long-term option for small-scale farmers in Kenya

**Recommended action by FAO**

- Awareness raising at all levels and adoption of appropriate risk assessment, surveillance and early warning systems;
- Implementation of phyto-sanitary measures to prevent spread of the disease through agricultural practices, irrigation and drainage systems, transportation, vehicles, containers, tools or visitors;
- Preventive measures, including quarantines, the use of disease-free planting materials, movement of infected soil and planting materials into and out of farms, and disinfection of vehicles;
- Capacity building in National Plant Protection Organizations (NPPO) in planning, extension and research, including the use of rapid and accurate diagnostic tools;
- Training of technical officers, producers and farm workers on disease identification, prevention and management under field conditions, and appropriate instructions to visitors

Farmers can access KALRO website ([www.kalro.org](http://www.kalro.org)) for more information on the disease. KEPHIS is increasing surveillance along border points to stop introduction of diseased banana from neighbouring countries. Farmers should report any abnormal growth characteristics of their bananas to the nearest KALRO centre; take several clear photographs and email to KALRO or send samples of symptomatic plant parts to the diagnostic laboratory situated in Nairobi (KALRO-Kabete). Samples are analyzed at a cost.

Samples can also be taken to Plant Clinics (90) located in some parts of the county with concentrations in Central, Eastern and Western Kenya. These plant clinics are managed by County agriculture extension staff (Plant Doctors) that have undergone extensive training on disease diagnostics. The Plant Clinics are backstopped by KALRO, CABI and ICIPE. KALRO centres with Plant Clinics include KALRO-Kitale, KALRO-Embu, KALRO-Thika, KALRO-Katumani and KALRO-Njoro.

Farmers should know the source of their planting material, preferable using micro-propagated (TC - tissue culture) plants. Sourcing suckers from a neighbour can be devastating. They also need to practice good agricultural practices. Farmer sensitization, upscaling of micro-propagation (tissue culture) laboratories and establishment of farmer owned hardening nurseries would contribute to availability of “clean” planting material. Contact the nearest KALRO centre for advice on availability of clean planting material including tissue culture seedlings.

#### **Abbreviations Used**

- AAA – - Triploids of *Musa acuminata* colla- this found in East Africa region. used for ripening and cooking
- EA
- AAB - Triploid hybrids of *Musa acuminata* colla and *Musa balbisiana* colla (most are plantains or roasting type).
- AAB - Triploid hybrids of *Musa acuminata* colla and *Musa balbisiana* colla. (Mostly are dessert and beer type)
- ABB - Triploid hybrids of *Musa acuminata* colla and *Musa balbisiana* colla
- AAA - Triploids of *Musa acuminata* colla, not originally found in East Africa - Recent introductions e.g. Cavendish sub-group, Green Red/ Red sub-group and Gros Michel sub-group
- AAAA - Tetraploid hybrid of *Musa acuminata* colla
- AAAB - Tetraploid hybrid of *Musa acuminata* colla and *Musa balbisiana* colla

***Contributions from: Margaret Onyango (deceased)-KALRO Kisii; Jesca Mbaka-KALRO Thika; Ruth Amata-KALRO Kabete and Easton Njeru-KALRO Embu are highly acknowledged***