

## **MOLE RATS: Another Possible Mode of Spreading *Enset* Bacterial Wilt**

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Prepared by Dr. Robert Shank, Agriculturist, UNDP Emergencies Unit for Ethiopia

**Summary:** Farmers have reported mole rats as being an important constraint to *Enset* production. However, *Enset* bacterial wilt is often considered as the most serious cause of lost production. Extension agents have consistently instructed farmers to clean tools when working with *Enseti* plants or processing *Enset*. Recent indicators of extensive mole rat damage in 4 out of 5 bacterial wilt ‘hot spots’ led to more extensive investigation of the role of mole rats as a possible agent for dissemination of bacterial wilt on *Enset* plantations.

### **Brief update on Bacterial Wilt of *Enset***

Bacterial wilt disease is commonly found throughout the *Enset* growing area, being severe in several ‘hot spots’ for unknown reasons. There are no known sources of genetic resistance to *Enset* bacterial wilt so the disease is threatening the food security of the 10 million people who utilise *Enset* as a staple or co-staple food. High population and heavy dependence on low protein *Enset* and root crop foods already predispose this area to food and nutritional insecurity.

Possible known means of spreading the bacteria include unsanitary use of knives and tools when pruning, cultivating and harvesting *Enset*, as the bacteria could easily be spread from diseased plants to healthy plants through contaminated implements. Dereje<sup>1</sup> has demonstrated that as little as 1 millilitre of inoculum applied to the cut end of an *Enset* leaf could produce wilt symptom expression in the terminal leaf within 2 weeks. Infected plants deteriorate and collapse within 6-8 weeks producing copious amounts of bacterial mucus that becomes a source for spread to other plants by passive contact.

Therefore, extension agents have long advocated sanitary disposal of diseased plants and careful use of cultural knives and tools. It is recommended that knives be either flamed in a fire or laid in the sun for 2 days before touching another plant. However, farmers often prune entire plantations over a few day period without sterilizing their knives. Also, it is common to cut a leaf from several plants when needing a clean work space for processing *Enset*, when a sudden rain shower calls for an umbrella or when trying to pass through entangled leaves. In fact, Gizachew (IAR-Awassa, personal communication) has suggested spread may occur through the practice of harvesting, processing and sale of known diseased plants to unsuspecting customers who then infest their own tools in preparation of *Enset* foods. No published reports, however, show survival of the wilt bacteria in the acid condition of the fermentation process.

Most farmers are aware of their infected plants and many insist that they do avoid passive spread. Some were even smart enough to recognise that removal of diseased plants could, in itself, be a spreading mechanism by contact with healthy plants. Some farmers ‘wrap up’ a diseased plant

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<sup>1</sup> Dereje Ashagari. 1984. Studies on the bacterial wilt of *Enset* and prospects for its control. Ethiopian Agricultural Research Conference. April. Addis Ababa.

with its own leaves and allow it to dry up before removal, reducing the bulkyness of diseased plants. One farmer even wraps the diseased plants with cloth to avoid insects which could spread the bacteria by contact. Perhaps the best procedures have yet to be explored but could involve isolating plants as soon as diseased, followed by removal on a periodic basis and subsequent sterilisation of tools.

Consistent denial of unsanitary use of knives by some farmers and the presence of wilt infected plants where farmers do not even prune plants has led the author to suspect other means of spread. During the sampling of *Enset* plants for the assessment of production, 4 out of 5 'hot spots' with serious wilt loss were concurrently associated with the presence of mole rats. It was also noted that wilt infected plants were most numerous near the fence rows, property boundaries and pasture areas. Apart from isolated individually infected plants, it appeared that foci or centres of infection were developing at specific geographical spots on the farmstead near mole rat mounds. In addition, some farmers claimed that trimmed and pruned suckers planted into newly cultivated fields almost never become diseased until 2-3 years later during which they did not touch the plants with knives.

### **Background of the Mole Rat**

During a recent survey in Welayita<sup>2</sup>, farmers listed mole rats as being as destructive of *Enset* as bacterial wilt. Mole rats usually prefer and consume grass roots in open pastures with well drained soils but often thrive on weedy plant roots near fence rows and property boundaries, especially during the dry season. With land pressures reducing the pasture areas, extensive feeding by mole rats on root crops and *Enset* has become prevalent. Some farmers have experienced the heartbreak of seeing their entire plantation succumb one by one to mole rats. Plants often become yellow at the top, drying and dying from the extensive root cutting and subsequent water shortage. Feeding on 1-3 year old plants often results in complete loss of the root system and plants can be lifted out of the ground. Older and larger plants are often girdled and can remain alive but growth is retarded. Sometimes the "corm" (inside of the *Enset* plant) is tunneled in to the shoot meristem where the terminal leaf is cut off from its nutrient/water source.

Mole rats are solitary animals that develop their own extensive tunnel system. Individuals live alone and develop tunnels for feeding, for nesting and rearing offspring, for food storage and for sanitary disposal. The staff of the Awassa Plant Health Clinic recently mapped one tunnel system which consisted of 29 branches with a total length of 140 metres and covering 50 square metres. After a period of tunnel use, especially the sanitary tunnel, an area may be walled off and not used again.

The males do come out of their areas and visit the tunnel system of the females briefly during the mating season. Usually two, but as many as four offspring are produced twice a year and the juveniles leave the home of their mother to establish their own home. Mole rats usually space out their territory and only live a couple years but extensive crowding can denude large hillsides. Farmers complain that pasture production is reduced and animal numbers must be decreased in dry periods due to mole rats.

### **The potential role of mole rats in the spread of *Enset* Bacterial Wilt**

Except for the mole rat movement during the mating season, it is likely that mole rats are only responsible for localised spread of *Enset* bacterial wilt within a plantation or adjacent plantations. While mole rats prefer the warmth of open pastures, there appears to be extensive feeding in adjacent *Enset* plantations. Usually the presence of mole mounds indicates the location of the

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<sup>2</sup>Kefale Alemu and Stephen Sandford. 1991. *Enset* in North Omo Region. Farm Africa. Adis Ababa.

nesting site. But possibly due to the cool, damp condition of the *Enset* plantation, mole mounds may not be evident inside the plantation. Nevertheless, the network of tunnels could traverse several *Enset* plants. If one of these plants were infected with the bacteria, transmission to the other plants could occur.

In order to make a preliminary investigation, experts from Sholla Laboratory of the Crop Production and Protection Division of the Ministry of Agriculture and the Awassa Plant Health Clinic accompanied the author to several field sites on the border of Borena (Oromiya Region) and Gedio (Southern Nations Nationalities Peoples Regional State) which were known to have both *Enset* bacterial wilt and mole rats. The first two farmers had disposed of infected plants and tilled the area destroying the mole tunnels. The third farmer had not practiced any control measures for either pest.

A map of the *Enset* growing areas of these farmers shows the relationship between the two biotic pests (Figure 1). The presence of a leaning plant beside a diseased plant was the key indicator that mole rat feeding may be occurring beneath. When the two plants were uprooted, it was evident that feeding on the diseased plant had ceased recently and feeding had begun on the adjacent plant. In fact, the farmer and all persons in the exploration team believed that the second plant was disease free. When the plant was dissected, however, bacteria were evident in the corm, spreading to the shoot meristem, although symptoms were not yet evident on the apical leaf. The bacteria were clearly evident where the mole rat was feeding.

The mole rat tunnel from these two plants led in opposite directions, both undermining *Enset* plants not yet showing symptoms.

Leaving the tunnels exposed overnight, both were blocked with fresh soil by the next morning. The tunnels were reopened, traps were set in the tunnel and a single mole rat was caught by the second morning. Several of the diseased plants showed signs of feeding in the past but apparently the odour/taste of infected plants causes the mole rat to divert feeding to other plants. It is not known how many plants may be feeding sources at the same time.

Also, since *Enset* plants have extensive root systems, it is not known whether root infection occurs simply by the mole rat tunneling past, but it is possible that low levels of inoculum are transferred from plant to plant through passive contact with contaminated mole rat fur. Two types of feeding were noted on large plants, around the juncture of the stem/corm or up through the corm into the pseudostem. Either one would have exposed the body fur to contaminating bacteria. It is known that wilt bacteria do not survive long in soil but will live in the exuded mucus for some time, possibly long enough to be transferred to other roots along the tunnel.

Even if a farmer promptly destroyed infected plants, it is likely that mole rat feeding on other plants has already occurred, transferring the bacteria agent. Plants inoculated with 1 millilitre of bacterial suspension will show symptoms 10-14 days thereafter. The amount of inoculum transferred and the rate of disease development for that quantity transferred is not known. However, as long as mole rats are present, the farmer could always be several days behind the progress of the disease. One visited farmer exclaimed that his *Enset* feeds two families, one human and one bacterial, the first consuming 50 plants/year and the second 100. One place where a tunnel was exposed contained a handful of *Enset* corm pieces which were destined to be stored food. It is likely that this could be a source of recontamination even if a farmer promptly destroyed infected plants.

A proposal to control mole rats and dispose of wilt infected plants will be forwarded. Several areas with the occurrence of both pests will be tested to explore the effect of control of mole rats on the occurrence and severity of wilt. Control could be accomplished by either traps or chemicals so cost and effectiveness will be measured. However, the parameter of main interest

will be the effect of mole rat control on the spread of bacterial wilt regardless of the farmers sanitation practice. It is possible that sharing of work tools among households brings the bacteria to the plantation and infects individual or a few plants but that mole rat feeding, tunneling and contamination is responsible for mass infestation within a plantation or within adjacent plantations.

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**UN-EUE  
PO Box 5580,  
Addis Ababa, Ethiopia**

**Tel.: (251) (1) 51-10-28/29  
Fax: (251) (1) 51-12-92  
Email: [UNEUE@padis.gn.apc.org](mailto:UNEUE@padis.gn.apc.org)**