

# FRESH NOTES

A TECHNICAL UPDATE PUBLISHED BY HORTGRO SCIENCE

## An update to the freshNOTES 197 of July 2022 on galls on apple nursery trees

### What has happened since the last freshNOTES?

- Prof Karen Theron visited various nurseries and a tissue culture facility to assess the extent of the problem and to try to identify its origins.
- Numerous samples were analysed by the Plant Disease Clinic at Stellenbosch University (SU) and by the ARC Infruitec-Nietvoorbij diagnostic service to identify the causative organism.
- The strategy to date has been to first identify the causal organism, which would then inform further actions.

### What is the extent of the problem?

- Mostly trees on G.778 and M9 are affected while galls have also, to a lesser extent, been observed on M7. The first two rootstocks might potentially be more sensitive to a pathogen or might have been infected at some or other point during their production.
- Many nurseries are affected but there are one or two exceptions.
- Galls have been found on trees planted over the last two seasons, but the incidence in the current season is much more severe.
- It is relevant to note that stone fruit and grapevine nurseries have seen a recent increase in crown gall infections.

### Could the laboratories identify the cause of the galls?

- The Plant Disease Clinic at SU and the ARC Infruitec-Nietvoorbij have both found it difficult to consistently identify pathogenic *Agrobacterium tumefaciens* from the apple galls despite numerous attempts and protocol optimisation. Some positive tests have been obtained but both laboratories cannot conclude that *A. tumefaciens* is the causative agent due to the rare association of the pathogen with crown galls.
- Published literature and overseas experts confirmed that it is very difficult to isolate pathogenic *A. tumefaciens* from apple galls.
- Using a carrot disk bioassay, the ARC was able to prove the involvement of a “pathogenic biological agent” in causing the galls.

# FRESH NOTES

A TECHNICAL UPDATE PUBLISHED BY HORTGRO SCIENCE

## What did Prof Theron find regarding the origin of the galls?

### *Pots versus open ground*

- Both trees in pots and in the open ground are affected.
- Where galls do occur, their incidence seems higher and symptoms are more severe in pots, but more specifically in cases where the root systems are restricted.
- Pots are not the cause of gall formation but may increase the severity of symptoms if used incorrectly.

### *Tissue culture (TC) vs non-TC.*

- The two rootstocks that are most affected do generally have a TC background at one or other stage of their production. However, a significant percentage of the affected rootstocks were derived from liners and so have had soil contact.
- At one nursery, M7 trees without a TC background also developed galls in the open ground while one nursery that exclusively uses TC rootstocks were not affected.
- Dr John Driver, international TC expert, indicated that it is highly unlikely that the TC process would give rise to gall formation. It is noted though that contamination can take place after the lab component when young plants are planted in medium and hardened off.
- At present, it is not possible to reach any conclusion on where contamination(s) of plants might have occurred.

### *Callus vs biological component*

- The ARC's carrot bioassay strongly supports a pathological component to gall formation.
- One can morphologically separate crown gall from callus formation. Crown galls consist of an undifferentiated mass of cells that cannot subsequently differentiate to any organized tissues like roots or vascular tissue.
- Some technical experts have also observed higher than normal and more severe woolly apple aphid infestations on root systems. It is relatively easy to distinguish between galls caused by the feeding of woolly apple aphids and crown gall.

### *Management/ treatment*

- Based on the information gathered by Prof Karen Theron, it is not possible to identify any management practice that might increase the risk of gall formation.

# FRESH NOTES

A TECHNICAL UPDATE PUBLISHED BY HORTGRO SCIENCE

- International literature generally indicates that the non-pathogenic *A. radiobacter* race K84, whilst effective in preventing crown gall in stone fruit, is not or much less effective in apple. Private consultant and crown gall expert Ferdi van Zyl disputes this information and has found K84 to be effective on apple.
- *A. tumefaciens* infestation of soil is generally not effectively treated by soil fumigation.
- Chemical control of crown gall is generally not feasible.
- Minimising wounding and sterilising nursery equipment remains the most viable preventative treatments. Infested trees should be destroyed by burning.

## Growth responses

- Based on literature and on a few local observations, the location of galls on the tree and the severity of gall formation has an impact on subsequent tree performance. Galls high on the rootstock above the root system and circumventing the trunk have the most negative outcome. Galls on the crown generally have a more severe impact than galls on roots.

## What further actions are being taken?

- The Plant Disease Clinic initiated glasshouse trials to see whether gall formation can be induced in healthy apple rootstocks and to assess the effect of soil sterilisation. Results will be forthcoming over the next three to four months.
- Dr Yolanda Petersen of the ARC Infruitec-Nietvoobij will initiate a new project with the following objectives:
  - Characterise the causal organism.
  - Evaluate the tolerance of a range of apple rootstocks to the organism.
  - Investigate potential biocontrol of the causal organism.

## So what is the bottom line?

- We don't yet have any concrete results on the cause of the outbreak, but a new research project will hopefully shed more light on the matter.
- In the absence of more definitive results, it is not advisable, impossible, and irresponsible to conclude on the risk level of planting trees with galls.
- Based on observations of the galls and the epidemiology thereof, scrutiny of literature and consultation with experts, we believe that we are dealing with an outbreak of crown gall.

# FRESH NOTES

A TECHNICAL UPDATE PUBLISHED BY HORTGRO SCIENCE

- Since we do have evidence that a biological agent is causing the formation of the galls, the recommendation in freshNOTES 197 to treat the galls as if caused by *A. tumefaciens* remains valid.
- **Hence, in summary, the responsible course of action is for both nurserymen and apple growers to treat the galls on apple rootstocks as an epidemic caused by a pathogenic strain of *A. tumefaciens* (or at least a similar pathogenic organism).**
- Irrespective of the causal organism, please take note of the following excerpt from the Scheme: “*Plant material shall not show any signs of drying out or physiological, chemical, hail, cold, insect or pathogen damage or serious mechanical damage*”. Also take note of the following requirements for the sale of uncertified trees as governed by the Act: “*(iii) geen teken van 'n voedingsgebrek, uitdroging of fisiologiese, chemiese, insek-, patogeen-, hael-, koue- of ernstige meganiese beskadiging op sodanige plant sigbaar is nie.*”

## Thanks are due to:

- Prof Adele McLeod and Sonja Coertze from the Plant Disease Clinic as well as Dr Yolanda Petersen from the ARC Infruitec-Nietvoobij for their efforts in trying to identify the cause of the galls on the apples. Their efforts went beyond the call of duty.
- Prof Karen Theron for visiting the various nurseries and trying to identify practices and treatments that might causally relate to the incidence and severity of gall symptoms.
- The nurseries who willingly shared their information to the benefit of the industry.