

Effects of a Streak Virus - Stunted Growth & Variegations in *Axonopus compressus* (cowgrass)

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Introduction

Variegated leaves have long been valued by horticulturists for their attractive display of different colours in mosaic and shapes. Common variegated plants include *Ficus nitida* 'Golden', *Ophiopogon jaburan* 'Vittatus' and variegated *Stenotaphrum secundatum* (St Augustinegrass), (Fig. 1). Variegations can be manifested as white, yellow or red zones in the green leaves. White and yellow variegated regions of the leaf are the result of the plant's inability to synthesize green chlorophyll pigments in that zone, therefore unmasking orange carotenoid and yellow xanthophyll pigments, causing them to appear as yellow. Light green variegated zones result from a reduced production of the green chlorophyll pigments while reddish or purplish leaves are due to accumulation of red anthocyanin masking the green chlorophyll pigments. Plant variegations either arise through random mutations of the meristematic tissues or a result of viral infections. The variegated patterns caused by viral infections are often characteristic of the virus. Examples are mosaic viruses that produce mosaic mottling (blotchy spots), or streak viruses that produce streaked bands on leaves.

This Research Technical Note (RTN) reports the symptoms of viral infection in cowgrass plants for Singapore and provides first experimental evidence on the effects of the streak virus on vegetative growth of cowgrass plants.

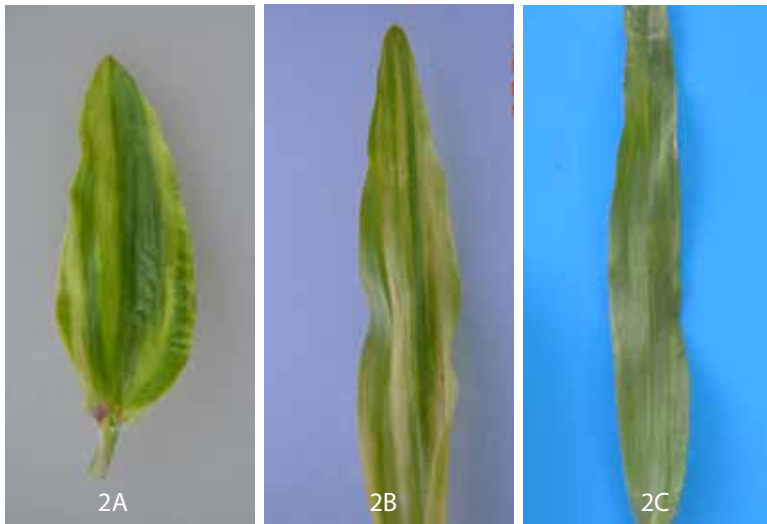


Fig. 1 Variegated *Stenotaphrum secundatum* (St Augustinegrass)

Viral Infection and Streak Variegation in *Axonopus compressus* (cowgrass)

Streak variegations in cowgrass were observed in April-2014 and documented here for the first time. The streak symptoms were suspected and later confirmed by Plant Health Laboratory Services of the Agri-Food & Veterinary Authority of Singapore (AVA) to be a result of viral infection. In addition, visual symptoms of the viral infection were also validated by a local plant virologist (Professor Wong Sek Man) at the National University of Singapore (NUS).

The general symptoms of the streak viral infection in cowgrass are described below:



1. Chlorotic streaks (bands) running the length of the leaf
2. Chlorotic streaks on emerging leaves (**Fig. 2A**) are more distinct than maturing (**Fig. 2B**) or mature leaves (**Fig. 2C**)
3. Vegetative growth and leaf morphology (form) are drastically reduced, see discussion below

The streak symptoms of the viral infection in cowgrass appear to resemble some descriptive streak viral symptoms manifested in the *Axonopus compressus* reported for Nigeria, Africa (Oluwafemi et al., 2014). The African strain of *A. compressus* streak virus has been identified to be a class of geminivirus that is known to be transmitted by leafhoppers. It is, however, not known whether the streak virus infecting cowgrass is a geminivirus or the identity of the vectors that are responsible for transmitting the virus in Singapore. Moreover, there are no studies undertaken to characterize the effects of streak viruses on vegetative growth in *Axonopus compressus*.

Effects of Streak Viral Infection on Vegetative Growth of Cowgrass

The vegetative growth of cowgrass plant is evaluated by the following growth parameters:

1. Height
2. Length of tiller
3. Coverage
4. Horizontal growth
5. Stolon morphology (Stolon internode and Stolon diameter)
6. Leaf morphology (Leaf length, width, leaf length: width ratio and leaf area)

The following summarizes the effects of the streak viral infection on the vegetative growth of cowgrass plants in Singapore. The data were obtained from four statistical replicates or a total of 20 readings for the above parameters studied. All readings reported here are statistically significant.

GROWTH PARAMETER:

Height

EFFECTS OF STREAK VIRUS:

Height **REDUCED** by 50%



Non-infected



Virus-infected

GROWTH PARAMETER:

Length of Tiller*

*Tiller: new shoot with leaves & roots

EFFECTS OF STREAK VIRUS:

Length of tiller **REDUCED** by 50%



Non-infected

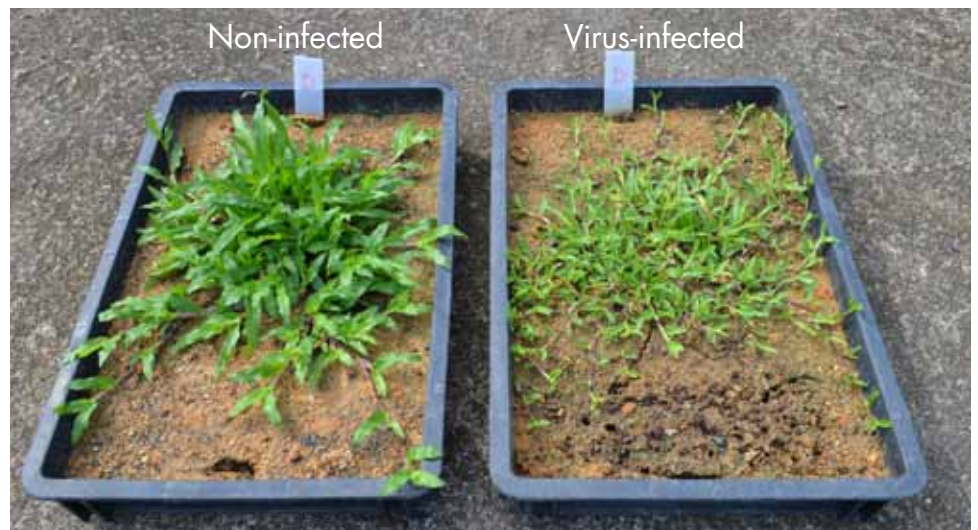
Virus-infected

GROWTH PARAMETER:

Coverage

EFFECTS OF STREAK VIRUS:

1. Coverage **REDUCED** by 75%
2. Rate of turf coverage **REDUCED** by 79%

**GROWTH PARAMETER:**

Horizontal Growth

EFFECTS OF STREAK VIRUS:

Horizontal growth (number of branching stolons) **INCREASED**



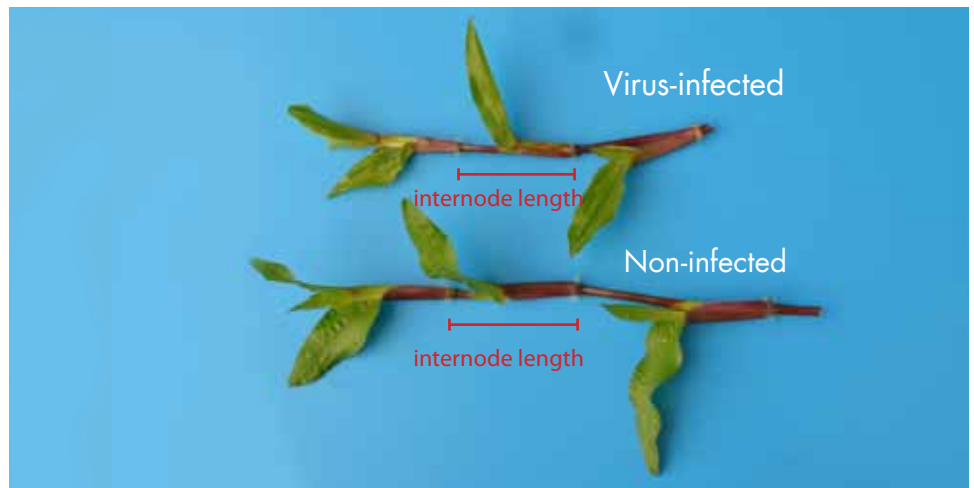
GROWTH PARAMETER:

Stolon* Morphology

*Stolon: horizontal running stem

EFFECTS OF STREAK VIRUS:

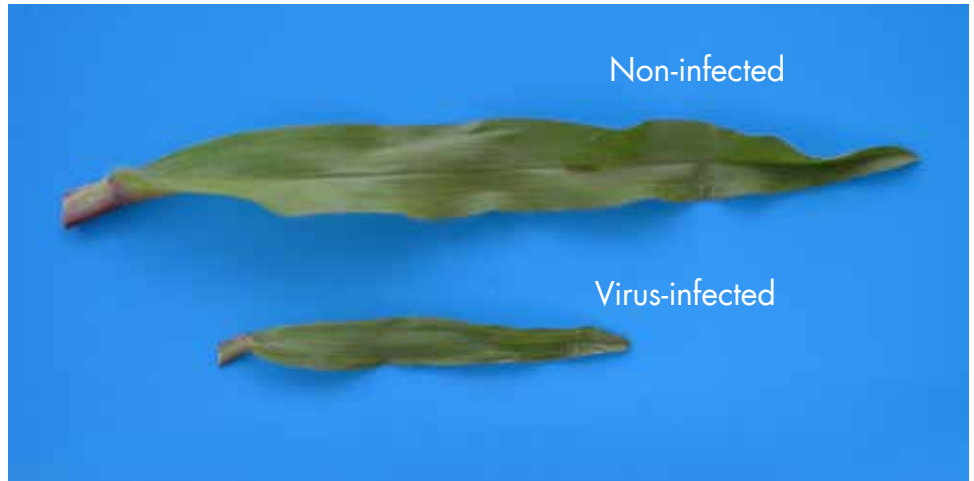
1. Stolon internode length **REDUCED** by 16%
2. Stolon diameter **REDUCED** by 23%

**GROWTH PARAMETER:**

Leaf Morphology

EFFECTS OF STREAK VIRUS:

1. Leaf length **REDUCED** by 60%
2. Leaf width **REDUCED** by 35%
3. Leaf length: width ratio **REDUCED** by 34%
4. Leaf area **REDUCED** by 71%



In summary, significant reduction in vegetative and leaf morphologies are observed in cowgrass plants that are infected with the streak virus. However, substantial horizontal growth, in terms of the number of branching stolons, can be observed in the viral infected plots. Further studies are needed to affirm the significance of such branching pattern.

The current control option to prevent the spread of the streak virus in Singapore is to control the vector. This method of control is not sustainable until a virus-resistant variety of cowgrass is developed. On the other hand, the stunting / dwarfing of the cowgrass plants (reduction in plant height) as a result of the viral infection might be a potential horticultural trait that can be selected by local growers. Dwarf varieties of turfgrasses e.g. 'Captiva' St Augustinegrass and 'Tifdwarf' Bermudagrass (*Cynodon dactylon*) have been purposefully selected and developed as a desirable trait to reduce grass-cutting maintenance in home lawns and improve ball-roll in golf greens respectively.

Reference

Oluwafemi S, Kraberger S, Shepherd DN, Martin DP, Varsani A. 2014. A high degree of African streak virus diversity within Nigerian maize fields include a new mastrevirus from *Axonopus compressus*. Archives of Virology.