Tomato Spotted Wilt VIRUS

a threat to potato production in South Africa?

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During the summer season of 1997/1998 a severe threat to potato production in the Northern Cape and North-West Provinces occurred. This problem was diagnosed as being caused by tomato spotted wilt virus (TSWV), or "kromnek" virus as it is known in South Africa. Infection by this virus resulted in fields of seed potatoes being rejected for certification and yields of drastically reduced commercial plantings. An additional problem is that this virus can induce symptoms in the tubers which results in them being rejected on the market due to the fact that infected tubers are not suitable for commercial use.

Kromnek was first recognised in this country in 1905 in the Eastern Cape and has always been a limiting factor to the production of crops like tomato and tobacco in the Western and Eastern Cape, especially in the late summer months. With the arrival of the Western flower thrips, *Frankliniella occidentals* in 1987/1988 in South Africa the incidence of this virus has been on the increase in other crops and in other provinces. Thrips is a very efficient vector of the TSWV virus and is also resistant to many insecticide groups.

TSWV has occurred in the two affected regions for many years, but has seldom led to crop losses. In most instances this increase in the incidence of TSWV has been associated with the production of paprika in the region. Both this crop and groundnuts, which is also produced in these regions, were found to be infected with TSWV. During the past season TSWV has been reported on potatoes in other districts as well.

It is, therefore, important that all factors that can result in a TSWV epidemic in potatoes should be investigated to develop effective control measures. Research is being undertaken by the ARC-Roodeplaat, with financial support from Potatoes South Africa, to determine the distribution patterns of both the virus and its vectors in the Vryburg and Barkly West districts. In order to apply any control measures effectively, it is also important to understand certain characteristics of the virus.

Symptoms on Potatoes

SA Primary symptoms are necrotic spots on the leaves, sometimes seen as concentric rings. These spots can easily be confused with those of early blight. This can be followed by stem necrosis, death of the top of one or more stems, and occasionally death of the whole plant. More frequently on the upper parts die, and then secondary shoots showing yellow spots, develop.

Tubers produced by infected plants may appear normal or they may be malformed, with cracks and internal rusty or dark necrotic lesions. The lesions are visible when the tuber is cut or it may be visible through the skin, similar to damage caused by bruising. Shoots from infected tubers might show necrotic or yellow spots, or necrosis, early death or dwarfing. The question has been raised whether the virus is tuber transmitted, and to what extent. This issue is currently being investigated under controlled conditions. Plants grown from infected tubers of different cultivars that were collected from infected fields were infected with the virus. Most volunteer plants collected from infected fields to date have also been found to be infected. Research in Australia showed that only 32% of tubers from infected plants of Russet Burbank showed virus symptoms compared with 84% of Shepody. Furthermore, when these tubers were planted, only 20% plants of Russet Burbank were infected compared with 78% plants of Shepody.

It is important to realize that symptoms can vary greatly due to different virus strains, age of the plant at infection as well as environmental factors such as temperature and nutritional status of the plant. The cultivar can also have an influence. It has been observed in the field that some cultivars are less susceptible than others. Some cultivars showed few symptoms (Totharo, Ropedi, BP1) while others showed mild symptoms (Dawn, Darius, Buffelspoort) and other cultivars were severely affected (Vanderplank, Aviva, Devlin, Up-to-Date).

Host Range of TSWV

One of the major problems in controlling TSWV is that it can infect an extremely wide range of plants, up to 500 species from 40 different families. More than 36 plant species have been recorded as

Table 1: Efficiency of different thrip species in transmitting TSWV

Thrip species	Common name	Percentage transmission
Frankliniella occidentalis	Western Flower thrip (WFT)	66
F.schultzel	Blossom thrip	14
F.intonsa		32
Thrips tabaci	Onion thrip	10

being infected by TSWV in South Africa including potato, peppers, paprika, pineapple, peas and other legumes. It is important in crops such as tomato, tobacco, lettuce, groundnuts, chrysanthemums and garden plants such as sweet peas and Inca lilies. The virus was isolated once from onions. Several weed species have also been identified as hosts of TSWV.

TSWV is the prototype of the Tospovirus family in the family Bunyaviridae. Fourteen members of this family have been identified worldwide, but only TSWV and groundnut ring spot virus (GRSV) have been identified in South Africa. It has been reported that GRSV can affect potatoes.

Table 2: Percentage weeds infected with TSWV.

Species	July	Nov	Jan	April	July	Nov	Jan	April
Spiny emex	50	-	-	-	83	2	-	0
Cape weed	60	-	-	25	86	-	-	-
Small mallow	66	-	-	12.5	71	-	-	0
Knorweed	-	-	-0	-	66	0	-	0
Yellow flowered Mexican poppy	50	0	-	0	66	31	-	31
Spiny sow thistle	57	25	-	-	-	25	-	-
Horseweed	0	-	-	-	54	-	-	-
Starvation senecio	18	-	-	-	15	-	-	-
White goosefoot	10	-	-	0	-	-	-	-
Nettle-leaved goosefoot	-	-	-	-	6	-	-	0
Common thorne-apple	-	0	0	0	-	0	20	63
Spiderwisp	-	0	-	-	-	0	11	5
Wild sunflower	-	21	48	4	-	-	-	-
Common dubbeltjie	-	-	33	-	-	-	0	-
Dwarf marigold	-	-	0	-	-	-	-	-
Evening primrose	0	-	-	-	0	-	-	-
Helichrysum sp	-	-	-	-	0	-	-	-
Hairy wild lettuce	-	-	-	-	-	-	-	8
Pidweed	-	-	-	-	-	-	-	0
Bladder Hibiscus	-	-	-	-	-	-	-	0
Common morning glory	-	-	-	-	-	-	-	75
Averva leucura	-	-	-	-	-	-		0

- not collected

Transmission of TSWV

TSWV is transmitted by thrips, small sucking insects of the order Thysenoptera, that can physically damage plants, especially onions. The following table summarises which thrips species can transmit TSWV.

The life cycle of the thrips also plays an important role in the spread of the virus. Only the larval stage of the thrips can acquire the virus by feeding on infected plants, but the virus is mainly transmitted by the adult thrips. It takes the larvae approximately 15 minutes to acquire the virus, after which there is an incubation or latent period of 4 to 10 days, depending on the temperature. At 27°C the incubation period can be as short as 80 hours. The incubation period is normally long enough to allow the larvae to transform into pupae. The pupae fall to the ground where they can survive for several months. Infection of a healthy plant by adult thrips can also occur very rapidly, within a few minutes of feeding. The life cycle of the thrips is very short (2-3 weeks) and populations can reach high levels very rapidly. However the virus is not transmitted to the next generation through the eggs.

The problem is exaggerated by the ability of the thrips to feed on a large host range. Thrips can easily move from one host species to another, mainly by wind, and they will also move from weeds to adjacent planted crops. The most important infections of TSWV are associated with the primary movement of thrips into a planted field. It is thus important to prevent the building up of thrip populations in adjacent crops.

Epidemiology and spread of TSWV
The spread and survival of a plant virus is dependent on three factors:

(a) source of the virus
(b) its vector and
(c) the environment.

To be a threat to a potato field there must be an alternate host near the field, thrips must feed on the alternate host at the larval stage, and the virus must be present on the parts of the plant where the larvae feed. Research was conducted in the Vryburg and Barkly West districts to determine which host plants are important at different stages of the year and also which vector species feed on them.

Samples of crops and weeds were collected on three farms in each district during field trips in July and November 1998 and January and April 1999 and analysed for the presence of TSWV. The results are summarized in Table 2. Several weed species that can be infected by TSWV, have been identified. The spiny emex, cape weed and small mallow are highly susceptible to TSWV infection. The knotweed, yellow-flowered Mexican poppy, spiny sow thrisle, horseweed, wild sunflower, common morning glory, white goosefoot nettleleaved foosefoot, common thorn apple, spiderwisp, starvation senecio, common dubbeltjie, and hariry wild lettuce are also susceptible to TSWV infection. The dwarf marigold, evening primrose, *Helichrysum* sp., bladder hibiscus, and pigweed are not susceptible to TSWV infection.

The incidence of TSWV infection in the weeds was much higher during July in comparison to November, January and April. The percentage infection of the spiny emex dropped from 81% in July to only 1.8% in November. Similarly the yellow-flowered Mexican poppy was 57% infected in July against only 25% in November. All volunteer potatoes and tubers that were collected in July were infected with TSWV. In November samples were collected from a cultivar trial and tested for the presence of TSWV. Only plants from three of the 66 demonstration plots were infected with the virus, indicating that very little virus transmission occurred during November. Potato plantings in the Barkly West district looked healthy, however, a large percentage of the samples tested in January were infected with the virus. Although most of the samples and potato leaves of the cultivar BP1 collected in January from a farm in the Coetzersdam district were infected with TSWV, the yield was good and few of the tubers showed symptoms. Groundnuts in the vicinity of potato fields were also infected with TSWV.

The thrips *Frankliniella occidentalis* and *F. schultzei* were collected from weeds and potatoes that were TSWV infected. *Thrips tabaci* was only identified once on potatoes from the cultivar trial in the Barkly West district and once on onions

in Vryburg during November.

Control Measures

Certain control measures can be recommended to limit the effects of TSWV on potatoes. The success of these measures will be monitored during the following season.

Sanitation and removal of virus sources

- Destroy and control all weeds especially surrounding old fields before spring planting.
- Rigorously control volunteer potatoes in old fields even if planted to another crop such as maize.
- Rogue all plants showing symptoms especially during early stages of growth.

Insect control

- Monitor thrips activity. If necessary have major thrips species identified.
- Control thrips by spraying insecticides.
- No insecticides are registered for thrips control on potatoes but some of those registered against aphids and tuber moths are registered against thrips on other crops.
- Ensure that the chemicals are applied effectively to reach all areas where the thrips may hide such as leaf crevices and inside flowers.
- Ensure that the water quality is correct for optimal effectiveness of the chemicals applied. Use a buffer if necessary.
- Apply a strict rotation of chemicals with different active ingredients to prevent resistance build-up to any of the chemical groups.
- Check that the insecticide is being effective against the stage of the insect it is registered for by doing follow-up scouting for live specimens of that stage.

Production practices

- Do not plant potatoes during periods of peak thrips activity, for example in the late summer.
- Do not plant near to other susceptible crops such as paprika and groudnuts. Try and maintain a distance of at least 500m between such crops and potato fields and between successive potato plantings.
- Use cultivars such as Rotharo, Ropedi or BP1 that are less susceptible to TSWV infection.
- Intercrop with plants such as maize or sunflower which grow taller than potatoes, thus acting as a barrier to potatoes, and are also not susceptible to TSWV.