Central Queensland sunflower disorder

– Tobacco streak virus

CROP NOTE

Background

In recent years many sunflower crops across the Central Highlands region of Queensland have been devastated by an unknown plant disorder. The symptoms did not match any of the documented disorders of sunflowers and were inconsistent in their distribution across locations. The disorder was widespread and caused severe symptoms on plants in 2004, which led to further investigations taking place. Anecdotal and photographic evidence suggests the virus was present in crops prior to 2004 but its impact on crop production was minimal.

A range of potential causes of the disorder were suggested including herbicide drift, soil residual herbicide damage, an unknown pathogen, insect damage and soil or environmental stresses. In early 2006, a research project was established by the Department of Primary Industries and Fisheries, Queensland and the Grains Research and Development Corporation to identify the cause of the disorder and to develop management solutions. This research has now confirmed the cause of the disorder as the pathogen Tobacco streak virus (TSV).

TSV is widespread across the world with more than 200 plant species recorded as being susceptible to the virus. Generally TSV does not appear in epidemic proportions but the recorded exceptions are in India on sunflowers and peanuts, and now in Australia on sunflowers.

The purpose of this publication is to summarise current knowledge of the disorder, its symptoms and effects and preliminary recommendations regarding management options. Further research continues to confirm vectors (method of disease transfer), alternative hosts and management recommendations.

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GRDC Grains Research & Development Corporation

Queensland Government Department of Primary Industries and Fisheries

Deformed growing point, shortened internodes and yellow blotches on leaves

Base of stem black and weakened causing lodging

What does TSV in sunflowers look like?

The symptoms of TSV on sunflowers include:

- Black streak on the stem and leaf stalks
- Stunted growth
- Shortened internodes
- Deformed growing tip
- Yellow blotches on leaves
- Plant death, especially in plants that become infected in early stages of development
- Lodging of older plants due to weakened stems and blackened pith.

What damage does TSV cause to sunflower crops?

Once it infects the plant, TSV reproduces and causes the death of plant tissue in the vicinity of the infection. It spreads throughout the plant along the vascular (nutrient conducting) tissue and can cause death of this tissue, leading to wilting and death of other plant parts including leaves and seed heads.

The extent of plant damage depends on the growth stage of the plant at the time of infection. If plants are infected as seedlings, the whole plant may be killed. If infection occurs in the mid stages of plant growth, infection may result in death of leaves and deformation and reduction in size of seed heads. If infected late in the plants lifecycle, only minor, visual symptoms may result, with little effect on plant growth or yield.

The level of infection within a sunflower crop can vary widely. In some cases, only a small proportion of plants are affected (‹1%) while in other cases a high proportion of plants can be affected, in patches or scattered throughout the paddock, resulting in significant levels of yield loss (›50%).

What other plants are hosts of TSV?

Because it cannot survive for long outside a living plant, the infection of crops by TSV relies on the virus surviving in living plants (other crops or weeds) during periods when the crop is not present.

Other crops that are known to be susceptible to TSV (and therefore may act as a host) include chickpeas, cotton, mungbeans, peanuts and soybeans. TSV is also known to infect a wide range of weeds including some that are common in central Queensland such as parthenium weed, black pigweed, blackberry nightshade, green amaranth, and common thornapple.

Pinched lower stem

Plant death

How is TSV transmitted?

The major method of transmission of TSV is by infected pollen, which can be spread by wind or carried by insects. Thrips are the only known insect vector of TSV. Thrips do not become infected with the virus, but transport the infected pollen on their bodies. Transmission of TSV to plants relies on virus from the infected pollen entering plant cells through the feeding injury caused by thrips.

A number of thrips species are known vectors of TSV. They include:

Frankliniella schultzei (tomato thrips)
Megalurothrips usitatus (bean blossom thrips)
Scirtothrips doralis (strawberry thrips)
Thrips parvispinus (Taiwanese thrips)
Thrips tabaci (onion thrips)
Frankliniella occidentalis (Western flower thrips)
Microcephalothrips abdominalis (composite thrips)

Taiwanese thrips

Western flower thrips

The photos show the Taiwanese and Western flower thrips species. The other species are similar in appearance. All thrips are less than two millimetres in length.

International research has not been able to identify seed transmission in sunflowers, although TSV is seed transmitted in some other weed and crop species.

TSV relies on living plant tissue or pollen to survive. It cannot survive in the soil, or on machinery, and has a very short life outside living susceptible host plant material.

Seedling death

Black streak on stem

What research is planned for the future?

Now that TSV has been identified, research will focus on minimising the impact of the disease through the development of control and management strategies.

Glasshouse tests indicate there may be significant differences in resistance between cultivars.

Field monitoring and survey data indicates that some protection from TSV can be obtained by controlling thrips early in crop growth through the use of a residual systemic insecticide seed treatment.

Thrips are difficult to control with foliar applied insecticides. An Australian colony of the Western flower thrips has been identified as having resistance to all known chemicals when applied as a foliar spray.

Collection of thrips from central Queensland crops displaying signs of TSV identified four different thrips species, all known vectors of the disorder. The Western flower thrips was not identified in these collections.

Sampling of chickpea crops has also identified some plants affected by TSV. At this stage it is unknown what the impact of TSV will be in chickpeas.

Research priorities in the coming 12 months are:

- Monitor and sample possible host plant species through the year
- Identify thrips species present in TSV affected areas
- Identify other possible crop hosts of TSV
- Conduct trials at sites with a history of high infection levels to evaluate seed treatments to identify possible thrips control options
- Identify cultural practices to provide barriers to thrips movement and
- Survey other regions and crops for the presence of TSV.

Diseased plant on left with rotten pith compared to healthy plant on right

Mature plant lodged because of weakened stem

What can you do now to minimise the impact of TSV?

At this stage it is not known whether the presence or severity of TSV is influenced by differences between sunflower varieties or agronomic practices such as early and late plantings, plant population or row spacing.

However, based on current knowledge and experience with other plant diseases transmitted by insects, a number of existing control strategies should assist in decreasing the incidence of TSV in sunflower crops. These include:

1. Use seed treated with a residual systemic insecticide. This will provide approximately three weeks protection to the plant, at the current registered rates, during what is believed to be the most susceptible stage. (Gaucho and Cruiser are the only currently registered seed treatment products for sunflowers that appear to provide some protection).
2. Practice good farm hygiene. Control weeds along fence lines, in the crop and in pasture areas. Parthenium is a host in India and is likely to be a host in Australia. Parthenium produces a lot of pollen at the critical time for sunflowers. Pollen will host the virus, and be transmitted on thrips.
3. Plant a quick growing barrier crop, for example forage sorghum, around your commercial crop. This may decrease the movement of thrips and pollen into your crop.
4. Where possible avoid planting sunflowers close to weedy areas (including weedy pastures) that may act as a host of the virus.

Black streak on stem and abnormal growing point

Black streaks on leaf petioles

Three components needed to transmit TSV and produce severe symptoms in a crop

Susceptible crops

Sunflowers
Chickpeas
Peanuts
Mungbeans
Cotton
Soybeans
Cowpea
Wide range of weed species

A vector (thrips)

The number of thrips present and the distance between the infected pollen source and the crop may influence the severity of TSV occurrence.

An alternative host (pollen source)

When the crop is not present, the virus requires an alternative host (a living plant) to survive. This alternative host must produce infected pollen that can be transmitted to the crop at a susceptible stage.

High levels of infected pollen and high thrips numbers at a stage when the crop is susceptible may lead to epidemic infection of a crop, resulting in yield losses.

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