



Tomato Spotted Wilt Virus

The tomato spotted wilt virus was discovered in Israel approximately 10 years ago within its global spread over the last 20 years. The virus causes serious damage to a range of crops, including tomatoes, peppers and various cut flowers, including Chrysanthemums and Statice. The virus is transmitted from plant to plant by the western (Californian) flower thrips (WFT).

TSWV was first discovered in the 1920s in Australia. The virus belongs to the Tospovirus family and attacks a wide range of hosts, more than 650 species in more than 60 botanical families. The damage caused by the spread of the disease ranges from damage to crops to destruction of entire fields. After a plant is infected, there is no way to treat the disease.



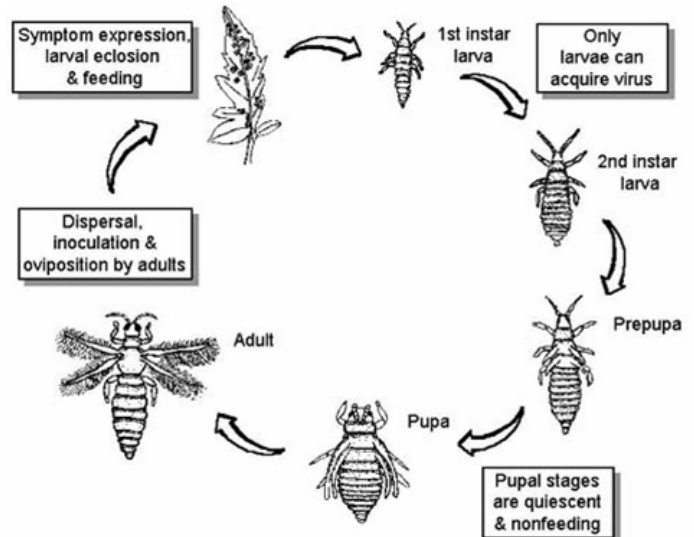
Method of spread and infection process

The virus is spread by thrips of various species but mainly by the western flower thrips (*Frankliniella occidentalis*). In addition, the virus can spread by cuttings from infected mother plants. In order to understand the method of which the virus infects the plants; the lifecycle of the vector – the thrips – must first be understood.

The western flower thrips has a short generation period and pre-maturity stages that takes 14-18 days. The adult stages may live approximately 30-40 days. The peak populations are in the spring and autumn. In the winter, the pest is found mainly in greenhouses. The thrips starts its life as an egg in the plant tissue. From the egg, the first, bright yellow instar larva hatches, from which the second, yellow lemon instar develops. The larva has a serpentine movement pattern. When they hatch from the egg, the young instars start to feed off the plant tissue, nectar and pollen. As the larva is approaching pupation, it descends to hiding places on the ground. It will spend the pre-pupa and pupa stages while hiding in the soil or between remains of leaves. The mature thrips feeds on leaf tissue, nectar or pollen. The adult female will lay 150-300 eggs in the leaf tissue of various leaves. The virus is transmitted from infected plants to the thrips in the larva stage. If the plant that the larva feeds on is infected with TSWV, it is enough for the larva to feed for 15 minutes in order to become infected with the virus. When the virus enters the larva's body, it starts its journey from the gastrointestinal tract to the salivary glands. After reaching the salivary glands, the virus starts to replicate. This stage in the virus development can last 3-12 days. This is the reason why the young instars of thrips cannot perform as vectors of the virus. The thrips secretes saliva on the leaf while feeding. If the thrips is a vector, it will take 5 minutes of eating to transmit the virus to the plant. As it can fly in its adult stage, it can infect completely different plants to the

ones it fed on as a larva. The older the plants are (more than 50 days after planting) the harder it gets for them to be infected.

The larva instar is the one that acquires the virus. The adult is the one that infects the plant. The virus replicates inside the thrips' body but cannot be transmitted to its progeny.



The lifecycle of the western flower thrips



Growth stages of the western flower thrips

Damage of TSWV

The damage of the western flower thrips is well known and includes direct damage to the shape and color of the leaves and petals of the flower. It must be emphasized that thrips is a quarantine pest in many countries. The signs of viral damage differ from crop to crop and include a range of instances. The virus received its name from two major phenomena that are caused by it: the first is that the young leaves turn brown and then have chlorotic or necrotic spots or rings on them. The other is that the leaves become weak and give the plant a wilted appearance. Other possible symptoms are: moderate to severe necrosis of the stem, dwarfism, a slight mosaic in leaves and browning of the leaf ends. The symptoms in Chrysanthemums are: black stripes on the stem, withering and wilting of leaves. It is noted that the appearance differs

between different *Chrysanthemum* varieties. Certain identification of a plant affected with the virus is only possible using laboratory measures.



Symptoms of TSWV in a range of crops

Prevention and extermination

Preventing TSWV is effectively preventing the western flower thrips. Without the thrips, the virus cannot be transmitted from generation to generation. Coping with the thrips must be divided into prevention and extermination. There are major difficulties in exterminating the thrips. The egg is relatively resistant to pesticides and is well hidden in the plant tissue. The pre-pupa and pupa are hidden in the ground and are difficult to reach. Extermination is therefore possible at the larva and adult stages. However, here too, it is not simple, because the adults are agile and skip from place to place, and when they are not moving they hide in the inner parts of the flower and the apex. It is noted that in addition to these, the thrips develop relatively easily resistance to pesticides. This resistance is achieved due to a combination of short generation time and parthenogenesis (eggs that develop without fertilization, which form females that are genetically identical to their mothers), as well as an intergenerational overlap and lack of natural enemies.

Prevention

- Destruction of residues of plants and weeds in or near the growing area, in order to reduce infection sources.
- Upon discovering infected plants in the field, they must be uprooted and removed from the area.
- Use of colored shade nets and/or plastic cover that absorb ultraviolet light, in order to cause confusion for the thrips.
- Use of sheets for soil covering in order to deny hiding places for the pre-pupa and pupa stages.
- Use of insect proof nets for preventing the thrips from penetrating the greenhouse.
- Use of yellow and blue sticky traps, for monitoring the population growth and destroying the individuals. Larger sheets may be improvised out of sticky polyethylene.
- Soil and greenhouse disinfecting for killing the pre-pupal and pupal instars in the soil.

- Planting a belt of trap crops around the cultivation area.

Trap crops are crops that are liked by certain pests. For this reason, the pest proliferates quickly on the trap crop belt. When the pest population develops, the trap crops are sprayed, preventing the pest from passing to the cultivation area. The plants that are known as trap crops for the thrips are: *Tagetes* spp (Marigold) and *Verbena litoralis*.

Extermination

Pesticides must be used wisely, making sure to switch preparations containing different active agents and modes of action. It is possible to use a rotation of pesticides, i.e. use each pesticide once. Another option is using a certain pesticide for about two weeks (based on the thrips generation time) and then switch to another pesticide with a different mode of action. The principle in this method of operation is based on most of the surviving thrips population being resistant to a certain agent and a change in the agent will exterminate the remaining population. Preference must be given to spraying with small drops or spraying at high pressure with a high volume of water, which may allow for better penetration of the spray into the thrips' hiding places on the plant. In the case of severe infection, 3-4 consecutive treatments should be given every 2-3 days. After the pest population decreases, treatments must be spread out, switching to a spraying regimen of once every 5-7 days.

Effective pesticides in Israel against the western flower thrips

Active ingredient	Efficiency
SPINOSAD	Very good
ACRINATHRIN	Very good
DDVP	Good
DDVP	Good. Short term.
CYPERMETHRIN	Good
BIFENTHRIN	Good
METHIOCARB	Good. Toxic. Short term
CYHALOTHRIN	Moderate

Rooted and unrooted cuttings that are TSWV free are an essential condition for prevention of viral infection in the growing area. We at Danziger – Dan Flower Farm make every effort to keep our mother stock healthy and free of the virus. To ensure that this is the case, we use the most advanced identification methods alongside with experts from the Volcani Institute-Agricultural Research Organization.

Prevention of the spread of the Tomato Spotted Wilt Virus in your field is part of the set of actions that you must take to succeed in raising crops.

Written by Nadav Rotem, Far East sales manager /July 2008

Note: The growing instructions above should be considered as general recommendations only. Make the necessary modifications for different growing conditions or climatic areas. Danziger – Dan Flower Farm will not assume liability for damage that results from applying these recommendations.