



PRACTICES AND RECOMMENDATIONS FOR DISEASE MANAGEMENT AND CONTROL



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TOMATO BROWN RUGOSE FRUIT VIRUS (TOBRFV)

Category: Virus

Family: Virgaviridae

Genre: Tobamovirus

Species: ToBRFV

Known symptoms:

- Slightly rough brown spots develop on pedicels, sepals, and plant stems.
- Yellow spots on ripe fruits.
- Mosaic pattern developed in leaves, and narrowing accompanied by mottled leaves.
- Necrotic symptoms on peduncles, calyxes and petioles.



Tomato brown rugose fruit virus (TOBRFV) - <https://gd.eppo.int>



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MODE OF TRANSMISSION

- Easily transmitted by mechanical means and tools.
- Transmitted through contaminated seeds.
- Infection of seedlings from seed inoculum can be transmitted during transplantation.
- Manipulation of plants in normal production practices can effectively disperse the virus through frequent handling by field workers.
- Can be transmitted by bumblebees.
- Highly infectious viral agent, persistent, aggressive and spreads quickly.
- More aggressive in hot climates and seasons.

IS PRESERVED AND REMAINS FOR UP TO 2 YEARS OR LONGER

- In the soil, substrates and remains of infected roots.
- In the threads or raffia from which the crop is suspended.
- Machinery, agricultural implements and tools.
- Clothes, cell phones and radios.

LIST OF EFFECTIVE PRODUCTS TO DISINFECT

- Virkon S
- Sodium hypochlorite
- Iodine
- 20% fat (skim) milk powder

PRIOR TO TRANSPLANTATION

PREVENTIVE MEASURES ARE ESSENTIAL TO MITIGATE THE SPREAD OF THE VIRUS

- Once the previous cycle is complete, remove weeds and any residue from the previous crop.
- Mesh doors should not be curtain-shaped to minimize contact with the body.
- When plant debris is to be removed from the greenhouse, attention should be paid to any minimal evidence of residues of any type of infected tissue that may have lodged in places such as wires, grids, and pipes.
- Perform a correct disinfection of the structures, facilities in general and the drip system
 - Sodium Hypochlorite.
 - Iodine
- Reduce the planting frame and distance between furrows, preferably not less than 2 meters.
- Change the threads or raffia of the guide as they can be a source of inoculum.
- Disinfection of the soil or substrate in case of handling hydroponics.
 - Many times, the substrates are substituted each season to avoid some source of contamination.
- Confirm that the seeds passed a virus cleaning process
 - Treatment to the conventional seed with a solution of 10% Trisodium Phosphate (Na₃PO₄) for at least 30 minutes mixing the seed constantly.
Never use the treatment with pre-germinated seed (PRIMED).
 - Use sleeve for seedling production tray to prevent damage to roots when transplanting. Damage to the roots makes the plant more susceptible to contracting the virus.
 - Transplanted seedlings should be disease-free, and hands should be washed with soap and water before and after handling plants to inactivate the virus. *Seedlings should not be transplanted into fields where there are traces of roots contaminated from previous harvests.*

DEPENDING ON THE PRODUCTION AREA, THE FOLLOWING RECOMMENDATIONS MAY BE OPTIONS FOR CONSIDERATION

- It is very important to try to look for early hybrids; this way less time is given to the virus to attack the plants.
- Do not incorporate organic material if it is not adequately composted and certified free of pathogens.
- Two crops of 9 to 10 bunches seem better than long cycles (if the new plants are not placed in contaminated soil or substrate).
 - There is more possibility to protect plants, less virus contamination, and more protection for roots.
- Crop rotation with cucurbits as an alternative.

POST-TRANSPLANT

- Wait at least 2 to 3 weeks before starting cultural work.
- Monitoring before any work or crop management is essential to detect the disease in time.
- Disinfect work tools with high frequency. Disinfection of tools such as pruning shears frequently, preferably between each plant or between a reduced number of plants. **Since the recommended contact time is 5-10 minutes for efficient disinfection**, several sets of tools should be used to avoid work delays. To avoid chronic health hazards from frequent or long-term exposure to severe chemicals, milk powder is recommended as an effective replacement for disinfecting hands and tools. Please note that milk treatment is not effective against all viruses including PepMV. **All workers should brush off any soil that is stuck to the soles of their shoes and disinfect them in footbaths before entering the greenhouse.** Footbaths should be maintained and refilled frequently with disinfectants such as Virkon S.
- Use of suits, boots, coveralls and unique gloves must be mandatory, as well as footbaths with disinfectant at the entrance. Gloves should be changed frequently during pruning, harvesting, or any other activity involving plant management. Since many infections are not detectable (because they are asymptomatic) even in infected plants, the possibility of cross-contamination with others within the greenhouse is high. Therefore, changing gloves or disinfecting them between handling of each plant will limit the spread of viruses that are mechanically dispersed.
- **The most common transport agent are cell phones.** Before entering the field, it is recommended to put the cell phone into a plastic bag with a zipper and discard the bag leaving the field.
- Tobacco products can be virus vectors and can survive on hands for hours after touching the tobacco product. Therefore, workers should wash their hands after smoking or handling tobacco products.
- Promoting handwashing with soap is paramount at the entrance and exit.

ELIMINATE SUSPICIOUS PLANTS FOLLOWING THE FOLLOWING RECOMMENDATIONS: REMOVE THE PLANTS FROM THE ROOT AND THOSE PLANTS IMMEDIATELY CLOSE TO THE INFECTED ONES (6 FOR EACH SIDE) PLACE THEM IN A PLASTIC BAGS.

1. Remove them from the production system without touching any other.
2. Burn them or bury them with lime.
3. Mark the affected area and quarantine--continue monitoring and take other precautions. If convenient, disinfect with Virkon S or Hypochlorite the soil area where the plant was sick.
4. Eliminate weeds and tomato plants born from fruits of previous crop.

DURING THE PRODUCTION CYCLE

- Maintain active monitoring throughout the crop production cycle.
- Mobilize cultural labors from a young crop to an older one.
- Disinfect all and any work utensils that are used in the production area.
- Avoid unnecessary contact with plants.
- Control doors and accesses to the production area.
- Maintain a balanced nutrition of the crop; this because a plant that produces more leaves is more vulnerable to diseases.
- Do not receive unnecessary visits to the production area.

REFERENCES

- Dr. Aviv Dombrovski, Ph.D. : virologist. ARO Volcani Center, Rishon Le Zyyon, Israel
- Dr. Moshe Lapidot, Ph.D.: virologist. ARO Volcani Center, Rishon Le Zyyon, Israel
- Dr. Raymundo García, Ph.D.: Doctor en Ciencias. Investigador Titular C, CIAD, Culiacán, Sinaloa, MX
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- M.Sc. José Natividad Gómez Asesor Independiente y Ex Catedrático de la UAS

FURTHER STUDY

- https://www.researchgate.net/publication/321639141_Seed_Transmission_of_Tobamovirus_es_Aspects_of_Global_Disease_Distribution
- https://www.researchgate.net/publication/312590313_A_New_Israeli_Tobamovirus_Isolate_Infects_Tomato_Plants_Harboring_Tm-2_2_Resistance_Genes
- <https://www.researchgate.net/project/Genetic-resistance-to-viruses>
- <https://www.researchgate.net/project/Developing-tools-for-tobamoviruses-identification-and-management>
- https://www.researchgate.net/publication/324032534_Using_genomic_analysis_to_identify_tomato_Tm-2_resistance-breaking_mutations_and_their_underlying_evolutionary_path_in_a_new_and_emerging_tobamovirus
- https://www.researchgate.net/publication/271594841_Evaluation_of_disinfectants_to_prevent_mechanical_transmission_of_viruses_and_a_viroid_in_greenhouse_tomato_production
- <https://www.researchgate.net/publication/284243103/download>

DISCLAIMER: All information presented herein is based on observations obtained in the field and laboratory. The results depend on several factors out of our control and no guarantee has been given that what is stated here gives the desired results or eliminates possible diseases, under the understanding that what is stated here are only recommendations related to possible diseases and do not bind Ahern Integrated Solutions, its subsidiaries, employees or agents, with respect to the results that may exist according to the management, practice and care of the corresponding crop.