

European Project "VIRTIGATION"- Emerging viral diseases in tomatoes and cucurbits: implementation of mitigation strategies for durable disease management.

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INTRODUCTION

FAO estimates that annually up to 40 percent of global crop production is lost to pests. In Europe, crop losses caused by viral diseases have reached an estimated annual value of 34.5 billion EUR. Virus symptoms could be difficult to identify by the farmers. These cases are intensified when the virus is an emergent new virus. Moreover, some plants viruses need a biological vector to spread its disease, farmers have been forced to increase the use of chemical treatments, although this has resulted in an increase in costs for the farmers and a higher exposure to pesticide residues for the consumers. The European project VIRTIGATION has the main goal of developing rapid and lasting solutions to emerging viral diseases caused by begomoviruses (whitefly-transmitted) and tobamoviruses (mechanically transmitted) on cucurbits and tomato in Northern Europe and the Mediterranean Basin as well as at increasing knowledge to better control and manage the viral diseases. Within the VIRTIGATION project, Fundación TECNOMA (TEC, Almería, Spain) and Landwirtschaftskammer Nordrhein-Westfalen (LNW, Germany) work together in the task "Optimization of eradication methods after tobamovirus outbreaks". Institutes are working on the validation of solarization and steaming methods to eradicate tobamoviruses in contaminated cocopeat bags by TMV (Tobacco mosaic virus). TEC is using the special temperature conditions of the months of September to November in Almería, with temperatures similar to north and centre of Europe in summer. LNW is using steaming with temperatures of minimum 90°C. In addition, it tries to discern if the substrate must necessarily be free of crop residues or not.

Disinfection of TMV contaminated substrate using SOLARIZATION

MATERIALS AND METHODS

- Plants:
 - MoneyMaker(MM) → susceptible variety against TMV
 - AlvaladeRZ (ARz) → resistant variety against TMV
- TMV virus inoculation (twice on seedling with 15 days and 40 days)
- Solarization: 60 days (from September 9th to November 9th).
 - Two treatments → (A) just cocopeat (without organic material)
 - Two treatments → (B) cocopeat with roots and rest of infected leaves.
- Bioassay test post solarization
 - New healthy tomato plants were transplanted on the cocopeat solarized bags.
 - Later, TMV symptoms on tomato plants were looking for.
- Laboratory test: TMV ImmunoStrips before and after solarization and PCR.

RESULTS AND DISCUSSION

Logger	Plot	Treatment	Tmax (°C)	Tmin (°C)	Tave (°C)	Days > 40°C	ImmunoStrip post-solarization	PCR post-solarization
1	1-1	B	44.0	15.6	27.8	15	Negative	ND
2	1-2	B	44.9	15.5	28.1	21	Negative	ND
3	1-3	B	44.6	16.0	28.0	19	Negative	ND
4	2-1	A	43.6	15.6	28.0	12	Negative	TMV
5	2-2	A	42.8	16.3	28.3	13	Negative	TMV
6	2-3	A	42.8	16.3	28.3	10	Negative	ND
7	3-1	B	44.0	15.8	27.6	15	Negative	ND
8	3-2	B	45.3	15.4	28.0	22	Negative	ND
9	3-3	B	44.7	15.7	27.9	23	Negative	ND
10	3-4	B	44.9	15.7	27.9	20	Negative	ND
11	4-1	A	43.0	16.0	28.3	11	Negative	ND
12	4-2	A	43.2	15.9	28.2	13	Negative	ND
13	4-3	A	43.0	16.2	28.3	11	Negative	ND
14	4-4	A	42.3	16.2	27.9	7	Negative	ND
15	5-1	B	44.5	15.3	27.7	14	Negative	ND
16	5-2	B	45.0	15.8	28.0	21	Negative	ND
17	5-3	B	45.9	16.1	28.7	34	Negative	ND
18	5-4	B	46.2	15.2	27.8	24	Negative	ND
20	6-1	A	43.1	15.4	27.6	7	Negative	ND
21	6-2	A	42.4	15.2	27.3	6	Negative	ND
22	6-3	A	43.3	16.2	28.2	9	Negative	ND
23	6-4	A	43.8	15.6	27.9	7	Negative	ND
24	6-5	A	42.1	15.5	27.5	7	Negative	ND

*ND: TMV not detected

According to bibliography, soil solarization practices require soil temperatures reach 35-60°C, which kills pathogens at the top 30 cm of soil.

Disinfection of TMV contaminated substrate using STEAMING

MATERIALS AND METHODS

- Plants:
 - MoneyMaker(MM) → susceptible variety against TMV
- TMV virus inoculation
- Steaming
 - Test 1: 20 min, 90 °C; Test 2: 40 min, 90 °C
 - Treatments → (A) just cocopeat (without organic material)
 - Treatments → (B) 350 g incorporated fresh infected tomato root material + 500 g infected tomato leaf material
- Bioassay test post solarization on tobacco (N. tabacum "xanthinc")
- Laboratory test: Elisa analysis and future PCR.

RESULTS AND DISCUSSION



INFECTED PLANTS



FIRST RESULTS AFTER STEAMING:

- Tomato plant growth deteriorated. Plants in the non-steamed bags show better fitness than the steamed variants.
- Growth of mold fungi could be observed on the substrate. The natural microbiome was apparently eliminated by steaming and the niche created allowed harmful organisms to accumulate in the bags.
- Due to the accumulation of harmful microorganisms, substrate bags must be used immediately and cannot be stored for a while.

BIOASSAY IS IN PROGRESS

REFERENCES & ACKNOWLEDGMENTS

(1) Katan, Jaacov; Gamliel, Abraham (2017-08-02), "SECTION 3: SoilSolarization as IntegratedPest Management", SoilSolarization: Theoryand Practice, The American PhytopathologicalSociety, pp.89–90,doi:10.1094/9780890544198.012,ISBN 9780890544198

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CONCLUSIONS

- Leave the roots and rest of the crop inside of the substrate bags help to increase the temperature for the solarization process.
- In countries where the temperature are higher than 40°C during more than 14 consecutive days, it is possible to perform a success solarization, as long as the disinfection time is extended to at least 60 days.
- Steaming results are coming soon.