2.1 Practice Abstract 15

TITLE: **Experimental methods to test the transmission of plant viruses by aphids or whiteflies**

This summary refers to a collaboration of researchers at CRAG (Centre for Research in Agrigenomics, CSIC-IRTA-UAB-UB) in Barcelona, and colleagues at IHSM (Institute for subtropical and Mediterranean Horticulture "La Mayora", CSIC-UMA) in Malaga, and intends to provide descriptive procedures for studying in laboratory conditions the transmission of plant pathogenic viruses by insect vectors, coonsidering the most frequent and important vector organisms like aphids and whiteflies. Indeed, **many species of plant viruses are naturally disseminated through specific transmission by insect vector**s, mainly phytophagous homopterans including aphids and whiteflies.

Practical information: For a successful transmission, and depending on the vector specificity and the mode of transmission, different durations of the periods for acquisition, retention, and inoculation are required. Therefore, the experimental setup to perform controlled transmission experiments under laboratory conditions involves handling the vector organisms and managing the times for the different steps of the process to optimize and standardize the results. The basic procedures that can be applied to vector-mediated transmission experiments are described, giving examples for selected viruses and different host plants.

Additional information: https://pubmed.ncbi.nlm.nih.gov/37987905/

NKB: Mariana B. Lorbach

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Métodos experimentales para probar la transmisión de virus de plantas por pulgones o moscas blancas

Este resumen se refiere a una colaboración de investigadores del CRAG (Centro de Investigación en Agrigenómica, CSIC-IRTA-UAB-UB) en Barcelona y colegas del IHSM (Instituto de Hortofruticultura Subtropical y Mediterránea "La Mayora", CSIC-UMA) en Málaga, y tiene la intención de proporcionar procedimientos descriptivos para estudiar, en condiciones de laboratorio, la transmisión de virus patógenos de plantas por insectos vectores, considerando los organismos vectores más frecuentes e importantes como los pulgones y las moscas blancas. De hecho, muchas especies de virus de plantas se diseminan naturalmente a través de la transmisión específica por insectos vectores, principalmente homópteros fitófagos, incluidos pulgones y moscas blancas.

Información práctica: Para poder reproducir una transmisión eficiente, y dependiendo de la especificidad del vector y del modo de transmisión, se requieren duraciones diferentes para los períodos de adquisición, retención e inoculación. Por lo tanto, la configuración experimental para realizar ensayos de transmisión controlados en condiciones de laboratorio implica el manejo de los organismos vectores y la gestión de los tiempos para los diferentes pasos del proceso, de forma que se puedan optimizar y estandarizar los resultados. Se describen los procedimientos básicos que se pueden aplicar a los experimentos de transmisión mediada por vectores, aportando ejemplos con virus seleccionados y diferentes plantas hospedadoras.

Información Adicional: https://pubmed.ncbi.nlm.nih.gov/37987905/

NKB: Mariana B. Lorbach

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.2 Practice Abstract 16

TITLE: The study of tomato genes that are activated or repressed when the plant is infected by the virus ToCV allows the identification of virus susceptibility

In a collaborative study performed by researchers at CRAG (Centre for Research in Agrigenomics, CSIC-IRTA-UAB-UB) in Barcelona and at IHSM (Institute for Subtropical and Mediterranean Horticulture "La Mayora", CSIC-UMA) in Málaga, we have analyzed the genes of tomato plants that were activated or repressed after 2, 7, and 14 days after infection with the Tomato chlorosis crinivirus, ToCV. The results showed an early activation of response mechanisms to infestation by the insect vector, in our case the viruliferous whiteflies used for the inoculation, and later on, once the virus was established, lead to the activation of antiviral defense systems. To confirm these results, two genes previously related to plant immunity, named Hsp90 and Sgt1, were selected from the list of genes with altered expression, and their importance was verified through specific experiments in which their expression was silenced. To do so, the virus accumulations were quantified after artificially reducing the expression levels of the selected genes, finding that in parallel the plants' susceptibility to the virus infection was increased.

Practical information: These results, which served to identify components of the cellular machinery responding to virosis, will help us to design control strategies that utilize the enhancement of the plants' natural defenses to fight against viruses.

Additional information: https://www.mdpi.com/1999-4915/15/12/2370

NKB: Mariana B. Lorbach

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: El estudio de genes de tomate que se activan o reprimen cuando la planta se infecta por el virus ToCV permite identificar factores de susceptibilidad

En un trabajo de colaboración de investigadores del CRAG (Centro de Investigación en Agrigenómica, CSIC-IRTA-UAB-UB) en Barcelona y del IHSM (Instituto de Hortofruticultura Subtropical y Mediterránea "La Mayora", CSIC-UMA) en Málaga, se han analizado los genes de las plantas de tomate que se activan o reprimen después de 2, 7 y 14 días de haber sido infectadas por el crinivirus causante de la clorosis del tomate, ToCV. Los resultados mostraron una activación temprana de mecanismos de respuesta a la infestación por el insecto vector, en nuestro caso las moscas blancas virulíferas usadas para la infección, derivando más adelante, y una vez establecido el virus , hacia la activación de los sistemas de defensa antiviral. Para confirmar los resultados, se seleccionaron de la lista de genes con expresión alterada dos genes previamente relacionados con inmunidad en plantas, denominados Hsp90 y Sgt1, y se verificó su importancia mediante experimentos en los que se silenciaba su expresión. Para ello se analizaron las acumulaciones de virus al reducir artificialmente los niveles de expresión de los genes seleccionados, encontrando que de forma paralela se aumentaba la susceptibilidad de las plantas a la infección por el virus.

Información práctica: Estos resultados en los que se identifican componentes de la maquinaria celular de respuesta a virosis ayudarán a diseñar estrategias de control que utilicen la potenciación de las defensas naturales de las plantas.

Información Adicional: https://www.mdpi.com/1999-4915/15/12/2370

NKB: Mariana B. Lorbach

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.3 Practice Abstract 17

TITLE: Sticky trichomes provide promising resistance against whiteflies and spider mites in tomato

Wageningen University & Research provided a tomato line with highly developed trichomes that were tested at Proefcentrum Hoogstraten in a 400 m² greenhouse compartment that combined 60% WUR-trichome plants with 40% commercial plants. Bemisia populations (2,800 adults) were introduced, and after a waiting period of six weeks, adult and nymph populations were monitored over four weeks. Results showed a clear preference of Bemisia for commercial plants: 75% of WUR-trichome leaf tips remained free of adults versus only 19% in commercial plants. Nymph densities mirrored this pattern, and population build-up in WUR plants was strongly suppressed, while commercial plants experienced explosive growth over the following four weeks. The WUR-trichome plants also resisted spider mites, which thrived on commercial plants. Although promising for integrated pest management, the WUR line is not yet market-ready due to poor fruit quality. Ongoing research aims to transfer trichome traits into commercial cultivars while evaluating compatibility with beneficial insects.

Practical information: Whiteflies are a persistent pest in tomato cultivation, weakening plants through sap feeding in case of Bemisia Tabaci, possible infecting the crop with virus such as TYLCV and ToLCNDV. Bemisia is challenging to combat due to rapid reproduction and insecticide resistance. Within the VIRTIGATION project, alternative strategies focus on enhancing plant defense mechanisms. A promising approach is breeding tomato lines with dense trichomes that secrete sticky or odorous substances, deterring or physically trapping insects.

Additional information:

https://www.proeftuinnieuws.be/rubrieken/thema/natuurlijke-weerbaarheid-nieuwe-troef-tegen-bemisia-in-tomaat/

https://www.youtube.com/watch?v=yunbP_obARk

NKB: Lise Soetemans

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Kleverige trichomen bieden veelbelovende weerstand tegen wittevliegen en spint in tomaat

Wageningen University & Research leverde een tomatenlijn met sterk ontwikkelde trichomen, getest in een kas van 400 m² bij Proefcentrum Hoogstraten. 60% WUR-planten werden gemengd met 40% commerciële planten, en 2.800 Bemisia-volwassenen werden uitgezet. Na zes weken werden volwassen wittevliegen en nimfen vier weken lang gemonitord. Resultaten toonden een duidelijke voorkeur van Bemisia voor commerciële planten: 75% van de WUR-bladtoppen bleef vrij van volwassenen versus 19% bij commerciële planten. Nymfenpatronen volgden hetzelfde patroon en populatiegroei bleef bij WUR-planten sterk beperkt, terwijl commerciële planten explosief groeiden. WUR-planten bleken ook resistent tegen spint. Hoewel veelbelovend voor geïntegreerde gewasbescherming, is de WUR-lijn nog niet marktgereed vanwege lage vruchtkwaliteit. Onderzoek richt zich nu op het inbouwen van trichoom-eigenschappen in commerciële rassen en het evalueren van effecten op nuttige insecten.

Praktische informatie: Wittevliegen zijn een hardnekkige plaag in tomaten, waarbij Bemisia tabaci planten verzwakt en virussen zoals TYLCV en ToLCNDV kan overdragen. Bemisia is lastig te bestrijden door snelle voortplanting en resistentie tegen insecticiden. Binnen het VIRTIGATION-project ligt de focus op alternatieve strategieën die het afweersysteem van de plant versterken. Een veelbelovende aanpak is het veredelen van tomaten met dichte trichomen die kleverige of geurige stoffen afscheiden en insecten ontmoedigen of vangen.

Aanvullende informatie:

https://www.proeftuinnieuws.be/rubrieken/thema/natuurlijke-weerbaarheid-nieuwe-troef-tegen-bemisia-in-tomaat/

https://www.youtube.com/watch?v=yunbP_obARk

NKB: Lise Soetemans

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.4 Practice Abstract 18

TITLE: Botanical plant extracts provide effective and predator-friendly control of whiteflies in tomato

The greenhouse whitefly (T. vaporariorum) and tobacco whitefly (B. tabaci) frequently co-occur in tomato crops, complicating visual identification and pest management. This trial evaluated the efficacy of two botanical plant extracts, that have showed good efficacy towards B. tabaci in previous trials, against T. vaporariorum under commercial greenhouse conditions. Tomatoes were grown in a 450 m² compartment with naturally high whitefly pressure. The predatory mirid Macrolophus pygmaeus was released to support biological control, while weekly applications of the botanical extracts were performed over four consecutive weeks. Results demonstrated that both extracts substantially reduced whitefly nymph densities. For one extract, the proportion of leaves with >250 nymphs decreased from 31% to 19%, while the other extract increased the proportion of leaves without nymphs from 33% to 50%. In contrast, the chemical reference was largely ineffective, and the biological reference showed only moderate, inconsistent effects. Importantly, neither botanical extract negatively affected Macrolophus, which remained stable across treatments and likely contributed to population suppression in combination with the extracts.

Practical information: These findings indicate that the botanical extracts are effective and predator-compatible tools for integrated whitefly management. They outperform both chemical and biological references under commercial conditions and show potential for inclusion in sustainable pest management strategies.

Additional information:

https://www.proeftuinnieuws.be/rubrieken/thema/biologische-plantextracten-tonen-potentieel-tegen-kaswittevlieg-in-tomaat/?highlight=extracten

NKB: Lise Soetemans

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Botanische plantenextracten bieden effectieve en predatorvriendelijke bestrijding van wittevliegen in tomaat

De gewone kaswittevlieg (T. vaporariorum) en de tabakswittevlieg (B. tabaci) komen vaak gezamenlijk voor in tomatengewassen, wat visuele identificatie en plaagbeheer bemoeilijkt. In deze proef werd de werkzaamheid van twee botanische plantenextracten, die in eerdere proeven tegen B. tabaci goede resultaten lieten zien, getest tegen T. vaporariorum onder commerciële kasomstandigheden. Tomaten werden geteeld in een kasafdeling van 450 m² met van nature hoge wittevliegdruk. De predatore miride Macrolophus pygmaeus werd uitgezet ter ondersteuning van biologische bestrijding, terwijl de botanische extracten vier weken achtereenwekelijks werden toegepast.De resultaten toonden aan dat beide extracten de dichtheid van wittevliegnimfen aanzienlijk verminderden. Bij het ene extract daalde het aandeel bladeren met >250 nimfen van 31% naar 19%, terwijl het andere extract het aandeel bladeren zonder nimfen verhoogde van 33% naar 50%. Daarentegen was de chemische referentie grotendeels ineffectief en de biologische referentie toonde slechts matige, inconsistente effecten. Belangrijk is dat geen van de botanische extracten een negatief effect had op Macrolophus, dat in alle behandelingen stabiel bleef en waarschijnlijk bijdroeg aan de populatieremming in combinatie met de extracten.

Praktische informatie: Deze bevindingen wijzen erop dat de botanische extracten effectieve en predatorvriendelijke middelen zijn voor geïntegreerde bestrijding van wittevliegen. Ze presteren beter dan zowel chemische als biologische referenties onder commerciële omstandigheden en tonen potentieel voor toepassing in duurzame plaagbeheersstrategieën.

Aanvullende informatie:

https://www.proeftuinnieuws.be/rubrieken/thema/biologische-plantextracten-tonen-potentieel-tegen-kaswittevlieg-in-tomaat/?highlight=extracten

NKB: Lise Soetemans

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.5 Practice Abstract 19

TITLE: Steaming as an Effective Method to Eliminate Tobamoviruses in Tomato Substrates

Steaming of organic substrates has been developed as a method to inactivate tobamoviruses in tomato production. Laboratory trials by Landwirtschaftskammer Nordrhein-Westfalen showed that steaming substrate slabs at 90 °C for 20–40 minutes completely eliminated Tobacco mosaic virus (TMV). In summer 2024, a commercial Belgian tomato farm (1.5 ha) infected with Tomato brown rugose fruit virus (ToBRFV) applied a commercial-scale steaming protocol. Approximately 2,000 substrate slabs were stacked under airtight tarpaulins, heated to 90 °C for 60 minutes, then cooled. qPCR analyses confirmed complete inactivation of ToBRFV. A feasibility study compared steaming to the mandatory composting procedure regarding technical, operational, economic, and environmental aspects. Steaming is rapid, reliable, and applicable to diverse substrates, with a low risk of cross-contamination, but requires high energy input and precise process control. Composting is more economical and environmentally friendly, but limited to organic substrates, slower, and less predictable for complete virus inactivation. Both methods require trained personnel and careful management to avoid virus spread.

Practical information: These results demonstrate that steaming is an effective and practical method for eliminating tobamoviruses in commercial substrates, enabling safe reuse or disposal.

Additional information:

Deliverable 5.3

https://www.proeftuinnieuws.be/rubrieken/thema/organisch-substraat-tobrfv-vrij-te-maken-door-stomen/?highlight=Organisch%20substraat%20ToBRFV-vrij%20te%20maken%20door%20stomen

NKB: Lise Soetemans

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Stomen als effectieve methode om tobamovirussen in tomatensubstraten te elimineren

Het stomen van organische substraten is ontwikkeld als methode om tobamovirussen in de tomatenteelt te inactiveren. Laboratoriumproeven van de Landwirtschaftskammer Nordrhein-Westfalen toonden aan dat stomen van substraatplaten bij 90 °C gedurende 20–40 minuten het Tobacco mosaic virus (TMV) volledig elimineert. In de zomer van 2024 paste een commerciële Belgische tomatenkwekerij (1,5 ha) die besmet was met Tomato brown rugose fruit virus (ToBRFV) een stoomprotocol op commerciële schaal toe. Ongeveer 2.000 substraatmatten werden gestapeld onder luchtdichte zeilen, verwarmd tot 90 °C gedurende 60 minuten en vervolgens afgekoeld. qPCR-analyses bevestigden de volledige inactivatie van ToBRFV. Een haalbaarheidsstudie vergeleek stomen met de verplichte composteerprocedure op technisch, operationeel, economisch en ecologisch vlak. Stomen is snel, betrouwbaar en toepasbaar op diverse substraten, met een laag risico op kruisbesmetting, maar vereist een hoge energie-input en nauwkeurige procescontrole. Composteren is goedkoper en milieuvriendelijker, maar beperkt tot organische substraten, trager en minder voorspelbaar voor volledige virusinactivatie. Beide methoden vereisen getraind personeel en zorgvuldige uitvoering om verspreiding van het virus te voorkomen.

Praktische informatie: Deze resultaten tonen aan dat stomen een effectieve en praktische methode is om tobamovirussen in commerciële substraten te elimineren, waardoor veilig hergebruik of afvoer mogelijk is.

Aanvullende informatie:

Deliverable 5.3

https://www.proeftuinnieuws.be/rubrieken/thema/organisch-substraat-tobrfv-vrij-te-maken-door-stomen/?highlight=Organisch%20substraat%20ToBRFV-vrij%20te%20maken%20door%20stomen

NKB: Lise Soetemans

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.6 Practice Abstract 20

TITLE: Is my virus dead or alive?

"Tomato brown rugose fruit virus (ToBRFV) is causing serious damage in tomato production worldwide. Since it first discovery around 2016 is has spread very quickly and often unnoticed. Important reasons for this are that even symptomless fruits from infected plants can contain very high virus concentrations. Sap from those fruits can therefore be very infectious.

ToBRFV belongs to the group of tobamoviruses which are notoriously difficult to eliminate. It can withstand temperatures of up to 80C for 10 min, so effectively disinfecting contaminated surfaces or tools is a real challenge. Current tests for the virus are very sensitive but cannot tell if the virus is infectious ('alive') or not infectious ('dead'). Tests may therefore not reliably tell if there is still any danger of infection.

Wageningen Plant Research has developed a laboratory test that can determine if a tobamovirus is still infectious or not. It is equally sensitive as current tests and can be used to determine if positive results with previous tests indeed represent infectious virus. It can be used to determine if disinfection strategies are effective and in the future this test format can be extended to other viruses.

Practical information:

- This test can be used as a stand-alone test for the presence of ToBRFV.
- This test can also be used in the risk assessment of (positive) test results for ToBRFV.
- This test can be used to determine how effective certain virus disinfection procedures are.

Additional information:

https://www.youtube.com/watch?v=0TsEfh9vtLg

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Is mijn virus levend of dood?

"Tomato brown rugose fruit virus (ToBRFV) is een groot probleem in de tomatenteelt wereldwijd. Sinds de eerste ontdekking in 2016 heeft het zich zeer snel en vaak ongemerkt verspreid. Belangrijke redenen hiervoor zijn dat het virus zich makkelijk via zaad verspreid en dat zelfs symptoomloze vruchten van geïnfecteerde planten hoge concentraties virus kunnen bevatten. Sap van deze vruchten kas dus erg infectieus zijn.

ToBRFV behoort tot de groep van de tobamovirussen die notoir moeilijk zijn af te doden. Deze virussen kunnen temperaturen van wel 80□C gedurende 10 minuten weerstaan dus een effectieve ontsmetting van oppervlaktes, gereedschappen of fust is een echte uitdaging. Huidige virustesten zijn er gevoelig maar kunnen geen onderscheid maken tussen infectieus ('levend') or niet infectieus ('dood') virus. Deze testen kunnen daarom niet betrouwbaar voorspellen of er nog gevaar voor infecties is.

Wageningen Plant Research heeft daarom een laboratoriumtoets ontwikkeld die kan bepalen of een tobamovirus nog infectieus is of niet. Deze test is even gevoelig als de huidige testen en kan ook worden gebruikt om te beslissen of een positieve uitslag voor ToBRFV ook daadwerkelijk infectieus virus betekent. De test kan ook worden gebruikt om te controleren hoe effectief bepaalde ontsmettingstrategieën zijn. In de toekomst kan dit testformat verder ontwikkeld worden voor andere virussen.

Praktische informatie:

- Deze toets kan worden gebruikt als losstaande test op de aanwezigheid van ToBRFV.
- Deze toets kan ook worden gebruikt in de risicobeoordeling van (positieve) testuitslagen op ToBRFV.
- Deze toets kan gebruikt worden om te bepalen hoe effectief bepaalde virus ontsmettingsprocedures zijn.

Additional information:

https://www.youtube.com/watch?v=0TsEfh9vtLg

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.7 Practice Abstract 21

TITLE: Tm-1 back in business: an allele from Solanum pennellii accessions plays a major role in ToBRFV resistance

"Tomato brown rugose fruit virus (ToBRFV) has become one of the most serious problems for tomato growers, as it can infect most commercial varieties and cause strong leaf and fruit damage. Researchers have found that some wild tomato plants (Solanum pennellii) show complete natural resistance to this virus. The study revealed that a specific gene, called Tm-1, protects these plants by stopping the virus from multiplying. When this gene was switched off, plants became infected again, confirming its protective role. However, the best resistance was obtained when Tm-1 acted together with another companion gene also present in S. pennellii.

Practical information:

- Wild tomato types such as S. pennellii LA0716 and LA0750 can be used as sources of strong, long-lasting resistance against ToBRFV.
- Breeders should combine the Tm-1 gene with its second resistance factor to ensure stable protection in new commercial varieties.
- This natural resistance will help reduce production losses, limit the spread of the virus, and cut the costs and environmental impact of disinfecting greenhouses.

Additional information: https://link.springer.com/article/10.1007/s00122-025-05036-1

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Το Tm-1 επιστρέφει στο προσκήνιο: ένα γονίδιο από αγρια συγκενικά ειδη τοματας παίζει καθοριστικό ρόλο στην ανθεκτικότητα απέναντι στο ToBRFV

"Ο ιός Tomato brown rugose fruit virus (ToBRFV) έχει εξελιχθεί σε ένα από τα πιο σοβαρά προβλήματα για τους καλλιεργητές τομάτας, καθώς μπορεί να μολύνει τις περισσότερες εμπορικές ποικιλίες και να προκαλέσει έντονη ζημιά στα φύλλα και στους καρπούς. Οι ερευνητές διαπίστωσαν ότι ορισμένα άγρια είδη τομάτας (Solanum pennellii) εμφανίζουν πλήρη φυσική ανθεκτικότητα στον ιό. Η μελέτη αποκάλυψε ότι ένα συγκεκριμένο γονίδιο, το Tm-1, προστατεύει αυτά τα φυτά εμποδίζοντας τον ιό να πολλαπλασιαστεί. Όταν το γονίδιο αυτό απενεργοποιήθηκε, τα φυτά μολύνθηκαν ξανά, επιβεβαιώνοντας τον προστατευτικό του ρόλο. Ωστόσο, η ισχυρότερη ανθεκτικότητα επιτεύχθηκε όταν το Tm-1 λειτούργησε σε συνδυασμό με έναν δεύτερο συνοδό παράγοντα ανθεκτικότητας που υπάρχει επίσης στο S. pennellii.

Κύριες πρακτικές συστάσεις:

- Τα άγρια είδη τομάτας όπως τα S. pennellii LA0716 και LA0750 μπορούν να αξιοποιηθούν ως πηγές ισχυρής και μακροχρόνιας ανθεκτικότητας απέναντι στο ToBRFV.
- Οι βελτιωτές ποικιλιών θα πρέπει να συνδυάσουν το γονίδιο Tm-1 με τον δεύτερο παράγοντα ανθεκτικότητας που υπάρχει στις ανθεκτικές S. pennellii, καθώς και με άλλα χαρακτηριστικά ανθεκτικότητας, ώστε να εξασφαλίσουν ισχυρή και διαρκή προστασία στις νέες εμπορικές ποικιλίες.
- Η αξιοποίηση αυτής της φυσικής ανθεκτικότητας θα συμβάλει στη μείωση των απωλειών παραγωγής, στον περιορισμό της εξάπλωσης του ιού και στη μείωση του κόστους και του περιβαλλοντικού αντίκτυπου από τις απαιτούμενες απολυμάνσεις στα θερμοκήπια.

Additional information: https://link.springer.com/article/10.1007/s00122-025-05036-1

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.8 Practice Abstract 22

TITLE: Directions from Nature: How to Halt the Tomato Brown Rugose Fruit Virus

Tomato brown rugose fruit virus (ToBRFV) is a new and aggressive disease that spreads quickly through contact and contaminated materials, severely affecting tomato production worldwide. This review gathers scientific knowledge to help stop ToBRFV using natural plant mechanisms. The authors explain that ToBRFV, like all viruses, depends on specific tomato genes—called susceptibility genes (S-genes)—to infect the plant. When these genes are modified or impaired, the virus can no longer infect the plants effectively. This resistance strategy can be used to develop tomato varieties with robust and durable resistance to ToBRFV and other similar viruses.

Practical information:

- The most effective long-term solution is to develop new tomato varieties that carry resistance from wild species and/or have inactivated susceptibility genes.
- Clean handling, disinfection of tools, and avoiding plant contact remain essential to prevent spread.
- Combining genetic resistance with good hygiene and monitoring can drastically reduce ToBRFV outbreaks and limit economic losses for growers.

Additional information: https://www.mdpi.com/2073-4395/13/5/1300

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Φυσικές λύσεις για την αντιμετώπιση του ιού Tomato Brown Rugose Fruit Virus

Ο ιός Tomato brown rugose fruit virus (ToBRFV) αποτελεί μια νέα και ιδιαίτερα επιθετική ασθένεια που εξαπλώνεται γρήγορα μέσω επαφής και μολυσμένων υλικών, προκαλώντας σοβαρές απώλειες στην παραγωγή τομάτας παγκοσμίως. Η παρούσα ανασκόπηση συγκεντρώνει επιστημονικές γνώσεις με στόχο την αντιμετώπιση του ToBRFV μέσω φυσικών μηχανισμών των φυτών. Οι συγγραφείς εξηγούν ότι ο ToBRFV, όπως όλοι οι ιοί, εξαρτάται από συγκεκριμένα γονίδια της τομάτας — γνωστά ως γονίδια ευπάθειας (S-genes) — για να μολύνει το φυτό. Όταν αυτά τα γονίδια τροποποιηθούν ή απενεργοποιηθούν, ο ιός δεν μπορεί πλέον να μολύνει αποτελεσματικά τα φυτά. Αυτή η στρατηγική ανθεκτικότητας μπορεί να αξιοποιηθεί για την ανάπτυξη ποικιλιών τομάτας με ισχυρή και διαρκή ανθεκτικότητα απέναντι στο ToBRFV και άλλους παρόμοιους ιούς.

Κύριες πρακτικές συστάσεις:

- Η πιο αποτελεσματική λύση μακροπρόθεσμα είναι η ανάπτυξη νέων ποικιλιών τομάτας που φέρουν ανθεκτικότητα από άγρια είδη και/ή έχουν απενεργοποιημένα γονίδια ευπάθειας.
- Η καθαρή διαχείριση, η απολύμανση εργαλείων και η αποφυγή επαφής μεταξύ φυτών παραμένουν απαραίτητες για την αποτροπή της εξάπλωσης.
- Ο συνδυασμός γενετικής ανθεκτικότητας με καλή υγιεινή και συστηματική παρακολούθηση μπορεί να μειώσει σημαντικά τις μολύνσεις από ToBRFV και να περιορίσει τις οικονομικές απώλειες για τους παραγωγούς.

Additional information: https://www.mdpi.com/2073-4395/13/5/1300

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.9 Practice Abstract 23

TITLE: Can Macrolophus pygmaeus (Hemiptera: Miridae) mitigate the damage caused to plants by Bemisia tabaci (Hemiptera: Aleyrodidae)?)

In protected vegetable crops, Bemisia tabaci is a major pest that reduces yield and quality, while biological control represents the most sustainable alternative to chemical pesticides. The predatory bug Macrolophus pygmaeus is widely used against whiteflies, but it can sometimes feed on plants, raising concerns among growers. This study evaluated the combined effects of whiteflies and M. pygmaeus on eggplant growth under laboratory conditions. Plants infested only by whiteflies showed strong reductions in chlorophyll content, and leaf development, whereas plants exposed to both insects experienced significantly lower damage, demonstrating that M. pygmaeus can effectively reduce the harmful impact of whitefly infestations. A moderate decrease in root growth was observed when both species were present, but overall plant health improved compared with plants infested only by whiteflies. These results highlight the value of using M. pygmaeus as an effective biological control agent.

Practical information:

Farmers can benefit by carefully monitoring predator and pest populations to maintain balance and minimize potential plant damage caused by feeding, integrating predator releases with other biological control measures to reduce chemical pesticide use. Correct management of M. pygmaeus enhances sustainability, lowers input costs, and improves crop quality, offering a cost-effective and environmentally friendly solution for growers aiming for healthy and productive crops.

Additional information: https://www.mdpi.com/2075-4450/14/2/164

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Macrolophus pygmaeus (Hemiptera: Miridae) può ridurre i danni alle piante causati da Bemisia tabaci (Hemiptera: Aleyrodidae)?

Nei sistemi di coltivazione protetta, l'aleirode Bemisia tabaci è un importante fitofago che riduce resa e qualità delle colture, mentre il controllo biologico rappresenta l'alternativa più sostenibile ai pesticidi chimici. Il predatore Macrolophus pygmaeus è ampiamente utilizzato per controllare la mosca bianca, ma può talvolta nutrirsi delle piante, suscitando preoccupazioni tra gli agricoltori. Questo studio ha valutato gli effetti combinati di B. tabaci e M. pygmaeus sulla crescita delle piante di melanzana in condizioni di laboratorio. Le piante attaccate solo dall'aleirode hanno mostrato forti riduzioni di clorofilla e sviluppo fogliare, mentre le piante esposte a entrambi gli insetti hanno subito danni significativamente inferiori, dimostrando che M. pygmaeus può limitare efficacemente l'impatto negativo delle infestazioni di mosca bianca. Si è osservata una moderata riduzione della crescita radicale quando erano presenti entrambe le specie, ma complessivamente la salute delle piante risultava migliorata rispetto a quelle infestate solo da B. tabaci. I risultati evidenziano il valore di M. pygmaeus come efficace agente di controllo biologico.

Informazioni pratiche:

Una gestione corretta del predatore contribuisce a migliorare la sostenibilità, ridurre i costi di produzione e aumentare la qualità delle colture. Il monitoraggio attento delle popolazioni di fitofagi e dei loro predatori permette di mantenere un equilibrio ecologico stabile e di limitare i danni da alimentazione sulle piante. Inoltre, l'integrazione dei rilasci di M. pygmaeus con altre strategie di controllo può ulteriormente ridurre l'uso di pesticidi chimici, promuovendo una gestione più sostenibile delle colture.

Informazioni aggiuntive: https://www.mdpi.com/2075-4450/14/2/164

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.10 Practice Abstract 24

TITLE: The entomopathogenic fungus Metarhizium brunneum Petch for the control of whiteflies in protected cultivation

Recent research in Sicily tested a Metarhizium brunneum-based wettable powder (WP) mycoinsecticide for controlling whiteflies on greenhouse-grown eggplants. Three application doses (1, 1.5, and 2 kg/ha) were compared with untreated plants and a Beauveria bassiana-based oil dispersion (OD) product. The M. brunneum formulation showed strong performance, particularly 21 and 28 days after the first application, effectively reducing both adult and nymph of whiteflies. It also demonstrated a longer-lasting effect than the B. bassiana product, highlighting its potential as a reliable alternative to synthetic insecticides within integrated pest management (IPM) programs.

Practical information:

For farmers, this product offers several practical advantages. It provides effective control of whiteflies on both adults and nymphs, with consistent protection over several weeks, and its effects last longer than some other fungal products, reducing the need for frequent applications. Being environmentally friendly, it can substitute chemical insecticides, supporting IPM strategies and helping to reduce pesticide residues. The product is effective across multiple doses (1–2 kg/ha), allowing farmers to adjust application rates according to crop size and pest pressure. Fewer applications also mean savings in labour and operational costs while maintaining crop protection and yield quality.

Additional information: https://zenodo.org/records/13984384

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Il fungo entomopatogeno Metarhizium brunneum Petch per il controllo della mosca bianca in coltivazioni protette

Recenti ricerche in Sicilia hanno testato un insetticida a base del fungo Metarhizium brunneum in formulazione polvere bagnabile (WP) per il controllo degli aleirodi su piante di melanzana coltivate in serra. Sono state confrontate tre dosi di applicazione (1, 1,5 e 2 kg/ha) con piante non trattate e con un prodotto a base del fungo Beauveria bassiana in formulazione olio dispersione (OD). La formulazione a base di M. brunneum ha mostrato ottime prestazioni, in particolare a 21 e 28 giorni dalla prima applicazione, riducendo efficacemente sia gli adulti sia le neanidi della mosca bianca. Ha inoltre evidenziato un effetto più duraturo rispetto al prodotto a base di B. bassiana, sottolineando il suo potenziale come valida alternativa agli insetticidi chimici nell'ambito di programmi di gestione integrata dei parassiti.

Informazioni pratiche:

Per gli agricoltori, questo prodotto offre diversi vantaggi pratici: garantisce un controllo efficace degli aleirodi su adulti e neanidi, con protezione costante per diverse settimane, e i suoi effetti persistono più a lungo rispetto ad altri prodotti fungini, riducendo la necessità di applicazioni frequenti. Essendo ecologico, può sostituire gli insetticidi chimici, supportando le strategie IPM e contribuendo a ridurre i residui di pesticidi. Il prodotto è efficace su diverse dosi, permettendo di modulare l'applicazione in base all'estensione della coltura e alla pressione del parassita. Meno applicazioni significano anche risparmio di lavoro e costi operativi, mantenendo protezione delle colture e qualità della produzione.

Informazioni aggiuntive: https://zenodo.org/records/13984384

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.11 Practice Abstract 25

TITLE: Susceptibility of different cucumber genotypes to the sweet potato whitefly Bemisia tabaci

Whiteflies, particularly Bemisia tabaci, are a major pest for vegetable crops in southern Italy, causing significant losses. This research tested seventeen cucumber genotypes, selected for potential resistance, under semi-field conditions using choice and no-choice tests. The results showed that some genotypes exhibited promising resistance: in the choice test, some genotypes were less attractive to whiteflies, resulting in lower colonization by adults and nymphs of the whitefly, and also in the no-choice tests, some accessions appeared to limit whitefly development. These findings suggest that certain cucumber varieties carry morphological or biochemical traits that negatively affect whitefly oviposition, or life cycle development.

Practical information:

For farmers, this means that growing resistant cucumber varieties can naturally reduce whitefly infestations, lower the need for chemical applications, save costs, and minimize pesticide residues. Using these varieties can improve plant health, crop quality, and yield, while supporting environmentally friendly and sustainable production. By strategically choosing the identified resistant genotypes, farmers can integrate them into greenhouse and broader IPM programs, creating a more resilient and productive cropping system.

Additional information: https://zenodo.org/records/17077760

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Suscettibilità di diversi genotipi di cetriolo contro la mosca bianca della patata dolce Bemisia tabaci

Gli aleirodi, in particolare Bemisia tabaci, rappresentano un importante parassita per le colture orticole del sud Italia, causando perdite significative. Questa ricerca ha testato diciassette genotipi di cetriolo, selezionati per la loro possibile resistenza, in condizioni semi-campo tramite prove di scelta e non scelta. I risultati hanno mostrato che alcuni genotipi presentano livelli promettenti di resistenza: nella prova di scelta alcuni genotipi sono risultati meno attraenti per le mosche bianche, con minore colonizzazione da parte di adulti e neanidi, ma anche nella prova di non scelta, alcune accessioni sembrano limitare lo sviluppo del parassita. Ciò suggerisce che alcune varietà di cetriolo possiedono caratteristiche morfologiche o biochimiche che riducono la capacità dell'aleirode di deporre uova o completare il proprio ciclo vitale.

Informazioni pratiche:

Per gli agricoltori, questo significa che coltivare varietà di cetriolo resistenti può ridurre naturalmente le infestazioni da mosca bianca, diminuire l'uso di insetticidi chimici, abbattere i costi e limitare i residui di pesticidi. L'impiego di queste varietà favorisce piante più sane, una migliore qualità e resa del raccolto e una produzione più sostenibile. Scegliendo strategicamente i genotipi resistenti identificati, è possibile integrarli in coltivazioni in serra e all'interno di programmi di gestione integrata dei parassiti, rendendo le colture più resilienti e produttive.

Informazioni aggiuntive: https://zenodo.org/records/17077760

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.12 Practice Abstract 26

TITLE: Potential use of mealworm frass as fertilizer and repellent in circular economy

The growing need for sustainable and affordable crop nutrition is driving interest in alternative inputs such as insect frass, a by-product of mealworm farming. This study tested different doses of Tenebrio molitor frass on tomato, eggplant, and pepper to assess its fertilizing effect and its potential to reduce whitefly (Bemisia tabaci) infestation in protected crops. Results showed that frass improved plant growth across all crops, with increases in leaf number, leaf area, chlorophyll content, and plant weight comparable or superior to a commercial fertilizer. Tomato and pepper plants did not show reduced whitefly infestation, but in eggplant frass-treated plants supported lower pest populations than untreated controls, suggesting a possible repellent or deterrent effect. Overall, frass represents a promising organic fertilizer that can enhance plant vigor, reduce the need for synthetic inputs, and support more sustainable crop management.

Practical information:

Farmers can incorporate frass into growing substrates to improve crop performance at low cost while contributing to circular economy practices.

Additional information: https://cnie2025siena.com/wp-content/uploads/2025/07/310725_Book_Abstract_CNIE2025-ENG-v2.pdf

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Potenziale utilizzo del frass di tarma della farina come fertilizzante e repellente in un modello di economia circolare

La crescente richiesta di soluzioni sostenibili per la nutrizione delle colture sta favorendo l'uso di prodotti alternativi come il frass, un sottoprodotto dell'allevamento di Tenebrio molitor. In questo studio sono state testate diverse dosi di frass su pomodoro, melanzana e peperone per valutarne l'effetto fertilizzante e l'eventuale capacità di ridurre le infestazioni di Bemisia tabaci in coltivazioni protette. I risultati mostrano che il frass migliora la crescita delle piante in tutte le colture, aumentando numero di foglie, superficie fogliare, contenuto di clorofilla e peso delle piante, con prestazioni pari o superiori a un fertilizzante commerciale. Su pomodoro e peperone non sono emerse riduzioni significative delle infestazioni, mentre su melanzana le piante trattate con frass hanno mostrato densità di aleirodi inferiori rispetto al controllo, suggerendo un possibile effetto repellente. Nel complesso, il frass si conferma un fertilizzante organico promettente, capace di migliorare la vigoria delle piante, ridurre l'uso di input chimici e favorire pratiche agricole più sostenibili.

Informazioni pratiche:

Gli agricoltori possono integrarlo nei substrati di coltivazione come alternativa economica e circolare..

Informazioni aggiuntive: https://cnie2025siena.com/wp-content/uploads/2025/07/310725_Book_Abstract_CNIE2025-ENG-v2.pdf

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.13 Practice Abstract 27

TITLE: The biological control of whiteflies for the protection of horticultural crops: an overview based on a crosssectional survey administered in Sicily

Sicily has the largest area of greenhouse horticulture in Italy, with over 6.000 hectares mainly producing tomato, zucchini, eggplant, and sweet pepper. These crops are heavily affected by whiteflies, especially Bemisia tabaci, due to virus transmission. Despite the effectiveness of biological control, its adoption in Sicilian greenhouses remains limited.

Practical information:

A survey conducted within the VIRTIGATION project revealed that only 32% of farms use natural enemies, with predatory bugs dominating, particularly Nesidiocoris tenuis, Macrolophus pygmaeus, and the mite Typhlodromips swirskii. Parasitoids such as Encarsia formosa and Eretmocerus eremicus are much less used, while microbial control, especially with Beauveria bassiana, is applied in about 75% of farms. The limited spread of classical biological control may result from insufficient technical support, limited market incentives, and concerns about managing predators. Increasing practical training, providing advisory services, and promoting integrated pest management can enhance adoption of eco-sustainable strategies, reduce pesticide use, and improve productivity in protected crops.

Additional information: https://www.iris.unict.it/handle/20.500.11769/618216

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Il controllo biologico degli aleirodi per la protezione delle colture orticole: una panoramica basata su un'indagine trasversale condotta in Sicilia

La Sicilia ospita la più vasta superficie di orticoltura protetta in Italia, con oltre 6.000 ettari dedicati principalmente a pomodoro, zucchine, melanzane e peperoni. Queste colture sono fortemente minacciate dagli aleirodi, in particolare Bemisia tabaci, a causa della trasmissione di virus. Nonostante l'efficacia del controllo biologico, la sua adozione nelle serre siciliane è limitata.

Informazioni pratiche:

Un'indagine del progetto VIRTIGATION ha rilevato che solo il 32% delle aziende utilizza nemici naturali, con predominanza di insetti predatori come Nesidiocoris tenuis, Macrolophus pygmaeus e l'acaro predatore Typhlodromips swirskii, mentre i parassitoidi Encarsia formosa ed Eretmocerus eremicus sono meno diffusi. Invece, il controllo microbiologico, soprattutto con Beauveria bassiana, viene applicato in circa il 75% delle aziende. La diffusione limitata del controllo biologico classico può derivare da supporto tecnico insufficiente, incentivi di mercato limitati e difficoltà nella gestione dei predatori. Migliorare formazione pratica, servizi di consulenza e strategie di lotta integrata può aumentare l'adozione di soluzioni ecosostenibili, ridurre l'uso di pesticidi e migliorare la produttività.

Informazioni aggiuntive: https://www.iris.unict.it/handle/20.500.11769/618216

NKB: Pompeo Suma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.14 Practice Abstract 28

TITLE: Studying tomato brown rugose fruit virus longevity in soil and virion susceptibility to pH treatments helped improve virus control by soil disinfection

Tomato brown rugose fruit virus (ToBRFV) is extremely stable and can persist in soil and crop residues for long periods, making it difficult to eradicate from greenhouses and fields. This study examined how long ToBRFV particles survive in different soil conditions and how pH levels affect their infectivity.

The virus remained viable for several months following a growth cycle of infected crops, and was abolished between 205 and 385 days in untreated soil. ToBRFV lost its activity when exposed to alkaline solutions.

Treatments with adjusted pH above 10 successfully inactivated viral particles, providing an efficient and low-cost disinfection method for contaminated soils and equipment.

Practical information

- Avoid replanting tomatoes in soils that previously hosted infected crops without prior disinfection.
- Use alkaline pH treatments such as 3% Chlorinated-Trisodium Phosphate (Cl-TSP), pH 11.6 to clean contaminated soil or tools, following safety guidelines.
- Regular monitoring of soil and irrigation systems for ToBRFV residues can prevent reinfection. Integrating soil pH-based sanitation with hygiene practices offers a sustainable way to control ToBRFV in intensive tomato production.

Additional information: https://link.springer.com/article/10.1007/s11104-024-06690-y

NKB: Guadalupe López

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: מחברים :אורי מולד ,אלישבע סמיט ,נטע לוריא ,אלנה בקלמן ,עודד לכמן ,מיטל רכס ואביב דומברובסקי

על ,בקרקע ,צמחית בפסולת גבוהה השתמרות יכולת ,אחרים טובמו לנגיפי בדומה ,ToBRFV לנגיף הנגיף של העולמית התפוצה בזירוז סייעו אלו ותכונות ,בזרעים ואף חקלאיים כלים על ,משטחים גבי. יבשות בקרקעות ToBRFV של ההשתמרות יכולת בבחינת התמקד המחקר של הראשון החלק מודבקים עגבנייה צמחי גידול מחזורי לאחר שנאספו ורטובות.

ברמה pH-ב כתלות הנגיפיים הגרעין וחומצת החלקיק יציבות להבנת ניסויים התבצעו במקביל חודשים מספר בקרקע משתמר הווירוס .ביולוגיים במבחנים בוחן בצמחי שימוש י""וע מולקולרית אינו הווירוס הגידול מחזור לאחר יום 385 -205 ובין מודבקים עגבנייה צמחי של גידול מחזור לאחר יותר פעיל.

10. מעל גבוה pH-ל נחשף כשהוא פעילות מאבד הווירוס

מעשיות המלצות:

הקרקע חיטוי ללא בנגיף נגועים עגבנייה צמחי של גידול לאחר עגבנייה צמחי משתילת להימנע. לחיטוי (Cl-TSP) chlorinated-trisodium phosphate כמו גבוה pH בעלות בתמיסות להיעזר בטיחות כללי על שמירה תוך העבודה וכלי הקרקע.

הדבקות מניעת יאפשרו ToBRFV לנוכחות ההשקיה ומערכת הקרקע של חוזרות בדיקות.

הדבקות מניעת יאפשרו היגיינה על ושמירה גבוה pH בעלת תמיסה עם הקרקע חיטוי של שלוב ב-ToBRFV חוזרות .

Additional information: https://link.springer.com/article/10.1007/s11104-024-06690-y

NKB: Guadalupe López

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.15 Practice Abstract 29

TITLE: Adapting Biological Whitefly Control to a Warmer Climate

Warmer future climates will shorten the lifespan and activity of whitefly parasitoids Eretmocerus eremicus and Encarsia formosa, two key biological control agents in greenhouse crops. Experiments simulating mid-century conditions showed that their survival drops by about half, with faster pest development and slightly lower parasitisation.

Practical information:

For farmers, this means that biological control may remain effective only if management is adapted. More frequent or better-timed releases can compensate for shorter parasitoid lifespan, keeping pest suppression stable and preventing costly whitefly outbreaks. Adjusting release timing to pest peaks and combining with other biological or coltural measures will help maintain productivity, reduce pesticide use and secure sustainable greenhouse production under future climate conditions.

Additional information:

https://link.springer.com/article/10.1007/s12600-023-01088-5

https://www.sciencedirect.com/science/article/pii/S1049964423002074

NKB: Heiko Ziebell

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Anpassung der biologischen Weißen-Fliegen-Bekämpfung an ein wärmeres Klima

Zukünftige höhere Temperaturen verkürzen die Lebensdauer und Wirksamkeit der Schlupfwespen Eretmocerus eremicus und Encarsia formosa, die im Gewächshaus zur Bekämpfung von Weißen Fliegen eingesetzt werden. Laborversuche unter Klimabedingungen der 2060er-Jahre zeigen, dass die Lebensdauer etwa halbiert wird und die Parasitierungsrate leicht sinkt.

Praktische Informationen:

Für Praktiker bedeutet das: Die biologische Bekämpfung bleibt wirksam, wenn die Strategie angepasst wird. Häufigere oder gezielter terminierte Ausbringung der Nützlinge gleicht die kürzere Wirkzeit aus und verhindert Ausbrüche der Weißen Fliege. Durch angepasste Freilassungszeitpunkte und Kombination mit anderen Maßnahmen lassen sich Ertragseinbußen vermeiden, Pflanzenschutzkosten senken und eine nachhaltige Produktion auch unter zukünftigen Klimabedingungen sichern.

Additional information:

https://link.springer.com/article/10.1007/s12600-023-01088-5

https://www.sciencedirect.com/science/article/pii/S1049964423002074

NKB: Heiko Ziebell

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.16 Practice Abstract 30

TITLE: Impact of future climate on the whitefly parasitoid Eretmocerus eremicus

This study examined how the whitefly parasitoid Eretmocerus eremicus survives under current climate conditions compared with a future climate scenario projected for Central Europe. The results show a clear reduction in adult longevity under the future scenario. Median survival decreased from about 22 days under present conditions to 13 days under future conditions. Likewise, 75% of adults died within 14 days in the future-climate treatment, whereas the same mortality level was reached only after about 30 days under current conditions. Maximum lifespan also declined substantially, from 35 days in the present climate to 18 days in the future scenario.

Practical information:

In both climate treatments, adults kept without food survived only around 2–3 days, demonstrating that the main difference between scenarios was related to climate effects rather than nutritional status. Overall, the study shows that projected mid-century temperature and CO_2 conditions can significantly shorten the lifespan of E. eremicus adults.

Additional information:

https://link.springer.com/article/10.1007/s12600-023-01088-5

NKB: Heiko Ziebell

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Auswirkungen des zukünftigen Klimas auf den Weißenfliegen-Parasitoiden Eretmocerus eremicus

Diese Studie untersuchte, wie der Weißenfliegen-Parasitoid Eretmocerus eremicus unter den aktuellen Klimabedingungen im Vergleich zu einem für Mitteleuropa prognostizierten zukünftigen Klimaszenario überlebt. Die Ergebnisse zeigen eine deutliche Verringerung der Lebensdauer der adulten Tiere unter dem zukünftigen Szenario. Die mittlere Überlebenszeit sank von etwa 22 Tagen unter den heutigen Bedingungen auf 13 Tage unter den zukünftigen Bedingungen. Ebenso starben 75% der Erwachsenen innerhalb von 14 Tagen unter den zukünftigen Klimabedingungen, während dieses Sterblichkeitsniveau unter den aktuellen Bedingungen erst nach etwa 30 Tagen erreicht wurde. Auch die maximale Lebensdauer nahm deutlich ab, von 35 Tagen im gegenwärtigen Klima auf 18 Tage im zukünftigen Szenario.

Praktische Informationen:

In beiden Klimabehandlungen überlebten adulte Tiere ohne Nahrung nur etwa 2–3 Tage, was zeigt, dass der Hauptunterschied zwischen den Szenarien auf Klimaeinflüsse und nicht auf Ernährungsfaktoren zurückzuführen ist. Insgesamt zeigt die Studie, dass die für die Mitte des Jahrhunderts prognostizierten Temperaturen und CO_2-Konzentrationen die Lebensdauer von E. eremicus deutlich verkürzen können.

Additional information:

https://link.springer.com/article/10.1007/s12600-023-01088-5

NKB: Heiko Ziebell

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2.17 Practice Abstract 31

TITLE: Impact of future climate on the whitefly parasitoid Encarsia formosa

This study tested how the whitefly parasitoid Encarsia formosa performs under a climate expected for Central Europe around 2061–2070. In the future-climate treatment, the wasps developed faster, needing about 18 days from egg to adult instead of 26.6 days in present control conditions. Their parasitization rate increased, with an average of 18.2 offspring emerging per cage compared with 1.2 under present conditions. At the same time, adult lifespan became shorter: the parental generation lived about 22.4 days instead of 36.2 days, and the offspring generation about 15.2 instead of 26.1 days.

Practical information:

For practitioners using E. formosa in protected crops these results show that warmer future conditions can lead to quicker parasitoid development and higher number of offspring, meaning the parasitoid can exert stronger pressure on whiteflies within each generation. However, because adults live for a shorter period, the active time window of each release becomes smaller. Growers relying on this biocontrol agent may therefore need to pay closer attention to the timing and frequency of releases to ensure that enough adult wasps are present during periods of whitefly activity.

Additional information:

https://www.sciencedirect.com/science/article/pii/S1049964423002074

NKB: Heiko Ziebell

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TITLE: Auswirkungen des zukünftigen Klimas auf den Weißenfliegen-Parasitoiden Encarsia formosa

Diese Studie untersuchte, wie der Weißenfliegen-Parasitoid Encarsia formosa unter einem für Mitteleuropa um 2061–2070 erwarteten Klima abschneidet. Unter den zukünftigen Klimabedingungen entwickelten sich die Wespen schneller und benötigten etwa 18 Tage vom Ei bis zum Adultstadium statt 26,6 Tagen unter aktuellen Bedingungen. Die Parasitierungsrate stieg deutlich an, mit durchschnittlich 18,2 Nachkommen pro Käfig im Vergleich zu 1,2 Nachkommen unter heutigen Bedingungen. Gleichzeitig verkürzte sich die Lebensdauer der adulten Tiere: Die Elterngeneration lebte etwa 22,4 Tage statt 36,2 Tage, und die Nachfolgegeneration etwa 15,2 Tage statt 26,1 Tage.

Praktische Informationen:

Für Praktiker, die E. formosa im geschützten Anbau einsetzen, zeigen diese Ergebnisse, dass wärmere zukünftige Bedingungen zu einer schnelleren Entwicklung und einer höheren Nachkommenzahl führen können, was zu einem stärkeren Druck auf Weiße Fliegen pro Generation führt. Da die Adulttiere jedoch kürzer leben, verkleinert sich das aktive Wirkungsfenster jeder Freilassung. Erzeuger, die auf diesen Nützling setzen, sollten daher besonders auf das Timing und die Frequenz der Ausbringung achten, um sicherzustellen, dass genügend erwachsene Wespen während Phasen hoher Weißenfliegen-Aktivität vorhanden sind.

Additional information:

https://www.sciencedirect.com/science/article/pii/S1049964423002074

NKB: Heiko Ziebell

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.18 Practice Abstract 32

TITLE: El análisis de la secuencia de nucleótidos revela la presencia de aislados de PVY-Tam que afectan al tamarillo en Colombia

Tamarillo (Solanum betaceum Cav.), also known as tree tomato, is an important fruit crop in Colombia. Due to the high incidence of a complex of viral diseases known as virosis, farmers in the country are facing severe yield losses in tamarillo cultivation. Using next generation sequencing, this study identified mixed infections of multiple viruses from different genera in tamarillo. A novel isolate of potato virus Y-Tamarillo (PVY-Tam) was identified that, when present in the plant, enhanced the severity of infections in the field. Researchers proposed that PVY-Tam likely originated in the Andean region and carries unique mutations that may help it adapt specifically to tamarillo. Overall, these findings contribute to understanding tamarillo virosis for the development of effective diagnostic and control strategies.

Practical information:

- Early and accurate virus diagnosis is essential before propagating tamarillo, as mixed infections can remain hidden.
- Certified virus-free planting material should be used to reduce disease spread.
- Monitoring programs in production areas should include PVY-Tam to prevent regional dissemination.
- Breeding and selection of tolerant or resistant tamarillo genotypes can help secure production in tamarillo-cultivating regions of Colombia.

Additional information:

https://www.biorxiv.org/content/10.1101/2025.07.18.664922v1

NKB: Mariana B. Lorbach

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Effetti di *Bemisia tabaci* e *Macrolophus pygmaeus* sui tratti morfo-fisiologici delle piante

El tamarillo (Solanum betaceum Cav.), también conocido como tomate de árbol, es un cultivo frutal importante en Colombia. Debido a la alta incidencia de un complejo de enfermedades virales conocido como virosis, los agricultores del país están enfrentando graves pérdidas de rendimiento en el cultivo de tamarillo. Mediante el uso de secuenciación de nueva generación, este estudio identificó infecciones mixtas de múltiples virus pertenecientes a diferentes géneros en tamarillo. Se identificó un nuevo aislado del virus Y de la papa - Tamarillo (PVY-Tam) que, cuando está presente en la planta, incrementa la severidad de las infecciones en campo. Los investigadores propusieron que el PVY-Tam probablemente se originó en la región andina y presenta mutaciones únicas que pueden facilitar su adaptación específica al tamarillo. En general, estos hallazgos contribuyen a comprender la virosis del tamarillo para el desarrollo de estrategias efectivas de diagnóstico y control.

Información práctica:

- El diagnóstico temprano y preciso de virus es esencial antes de propagar tamarillo, ya que las infecciones mixtas pueden pasar desapercibidas.
- Debe utilizarse material de siembra certificado y libre de virus para reducir la diseminación de enfermedades.
- Los programas de monitoreo en las zonas de producción deben incluir PVY-Tam para prevenir su dispersión regional.
- La selección y el mejoramiento de genotipos de tamarillo tolerantes o resistentes pueden ayudar a asegurar la producción en las regiones cultivadoras de tamarillo en Colombia.

Información adicional:

https://www.biorxiv.org/content/10.1101/2025.07.18.664922v1

NKB: Mariana B. Lorbach

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.19 Practice Abstract 33

TITLE: Naming virus lineages: a lineage nomenclature to aid genomic surveillance of dengue virus

Dengue virus causes millions of infections every year and is spreading to new regions due to climate change and the expansion of mosquito vectors. Monitoring its genetic evolution is essential to predict outbreaks and improve control measures. This study introduces a new standardized system for naming dengue virus genetic lineages, based on full-genome analysis. The new classification adds two extra levels of resolution—major and minor lineages—allowing scientists and health authorities to track virus evolution with greater precision.

Practical information:

The system is publicly available and works with both full and partial genome sequences, facilitating real-time genomic surveillance across countries. The nomenclature system introduced in this paper can be translated to other viruses, including plant viruses.

Additional information: https://pubmed.ncbi.nlm.nih.gov/38798319/

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

TITLE: Virusvarianten benoemen: een nomenclatuur ter ondersteuning van de genomische kiemsurveillance van het dengue virus

Het denguevirus veroorzaakt jaarlijks miljoenen infecties en verspreidt zich naar nieuwe regio's als gevolg van klimaatverandering en de toename van muggen als vector. Het monitoren van de genetische evolutie ervan is essentieel om uitbraken te voorspellen en bestrijdingsmaatregelen te verbeteren. Deze studie introduceert een nieuw gestandaardiseerd systeem voor het benoemen van genetische afstammingslijnen van het denguevirus, gebaseerd op volledige genoomanalyse. De nieuwe classificatie voegt twee extra resolutieniveaus toe waardoor wetenschappers en gezondheidsautoriteiten de evolutie van het virus nauwkeuriger kunnen volgen.

Praktische informatie:

Het systeem is openbaar beschikbaar en werkt met zowel volledige als gedeeltelijke genoomsequenties, wat realtime genomische surveillance in verschillende landen mogelijk maakt. Het in dit artikel geïntroduceerde nomenclatuursysteem kan worden vertaald naar andere virussen, waaronder plant virussen.

Additional information: https://pubmed.ncbi.nlm.nih.gov/38798319/

NKB: Rene Van Dervlugt

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000570

2.20 Practice Abstract 34

TITLE: High-Resolution Analysis of Circular DNA Virus Populations

Viral diseases represent a critical economic risk, frequently overcoming expensive genetic resistance in crops. Standard diagnostic tools often fail to capture the full picture, missing rare virus mutations that drive these resistance breakdowns. We have validated a robust diagnostic pipeline using Nanopore sequencing, demonstrated effectively on Tomato yellow leaf curl virus and Banana bunchy top virus. Unlike traditional methods, this tool detects rare variants (down to 1% abundance) that standard tests miss.

This technology delivers a complete "health check" of the viral population within a crop. It successfully identifies specific genetic changes that signal if a virus is evolving toward hyper-virulence or adapting to new host plants. It provides an unambiguous profile of the virus, distinguishing between severe and defective genomic components.

Practical information:

For agronomists and farmers, this tool transforms disease management from reactive to proactive. By detecting "breakthrough" strains early, you can adjust crop management strategies before an epidemic spreads, saving significant treatment and loss costs. The most significant entrepreneurial opportunity lies in the identification of mild virus variants. These native, mild strains can be isolated and utilized for "cross-protection", essentially vaccinating your crops against severe natural isolates. Adopting this deep-profiling approach secures long-term productivity by enabling precise interventions and smarter selection of resistant varieties, ultimately protecting your bottom line against viral volatility.

Additional information: https://academic.oup.com/nar/article/53/6/gkaf221/8103999

NKB: Rene Van Dervlugt

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