Multi-pest monitoring on greenhouse tomato

Method/protocol submitted by:

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Objectives of the method/protocol:

The protocol aims at quantifying populations of animal pests and their natural enemies, as well as fungal diseases, on tomato in warm greenhouse.
The main pests observed are *Trialeurodes vaporariorum, Bemisia tabaci* and *Tuta absoluta* and their natural enemies. Secondary pests are also studied: leafminer flies (*Lyriomyza sp*), aphids (*Aphys gossypi*, *Myzus persicae*, *Macrosiphum euphorbiae*, *Aulacorthum solani*), mites (Tetranychus, Aculops) and the 3 main fungi present on greenhouse tomato: *Botrytis cinerea*, *Leveillula taurica* and *Oidium neolycopersici*.

Brief description of the method/protocol:

This protocol presents sampling and estimation methods to quantify the main pests on tomato in greenhouse.
2 sorts of monitoring are performed:

- An estimation of the initial state of the pest populations, measured at the moment of the plantation
- A weekly survey during the 3 first months of the crop, biweekly afterwards.

Possible uses of this method/protocol:

The method can be used for pest surveys in greenhouse tomato experimentations. It can also help in the elaboration of decision rules in a crop protection context.

Method/protocol:

The data given here correspond to a 250 to 400 sqm greenhouse, i.e 600-1000 plants.

- Estimation of the initial state

These observations are realised at the most 7 days after the installation of the plants in the greenhouse.
50 plants are observed.
The following pests are counted first (exhaustive counting):

- The number of adult whiteflies (without distinguishing the species)
- The number of puparium larvae of whiteflies
- The number of adults and larvae of natural enemies (*Macrolophus pigmaeus*, *Nesidiocoris tenuis*).

The presence of other pests (*Tuta absoluta*, tomato leafminer flies, aphids, thrips…) is also indicated and localised on a rough map of the greenhouse.
Yellow sticky traps are used to monitor adults of whiteflies: the number of whiteflies in the traps is counted at this point of the survey.
Pheromon traps are used to monitor male adults of *Tuta absoluta:* the number of tomato moths in the traps is counted at this point of the survey.

- Weekly monitoring of the plants
  - Whiteflies and *Tuta absoluta*

    Each week, 2 groups of plants are observed.
    - Whiteflies and their natural enemies

      On 15 plants, the upper and the lower sides of the leaves are observed from the top to the bottom. The following countings are realised:
      - Number of adult whiteflies
      - Number of living puparium larvae of whiteflies (L4 instar)
      - Number of puparium larvae of whiteflies (L4 instar) parasitized by *Encarsia Formosa or Eretmocerus mundus*
      - Number of adults of *Macrolophus pigmeus*
      - Number of larvae of *Macrolophus pigmeus*
      - Number of adults of *Nesidiocoris tenuis*
      - Number of old larvae of *Nesidiocoris tenuis*

      If whiteflies develop in colonies (number of adult whiteflies>50), 5 supplementary plants can be observed and the results treated separately.

    - *Tuta absoluta*

      On 30 plants, the following observations are carried out on 2 levels of the plants (bottom and top):
      - Presence of injuries on the apexes
      - Number of galleries on the leaves
      - Attack index/level of the plant (bottom and top). The following classes are used:
        - Low: 1 gallery/leaf
        - Medium: 2-5 galleries/leaf
        - Important: 6-20 galleries/leaf
        - Very important: >20 galleries/leaf
      - Presence of injuries on 3 green fruits (>4 cm in diameter)/level.

  - Other animal pests and diseases This survey is performed after the previous one, at the greenhouse scale. The observer has to walk around the greenhouse.

    The objective is to detect the presence of “secondary” animal pests at an early stage, as well as the attacks of airborne diseases, by localising them on a rough map of the greenhouse and completing a form concerning their distribution, the intensity of the attack and their evolution.
    - Lifeminer flies (*Lyriomyza sp.*)
      - The proportion of plants with at least one gallery is estimated according to the following scale:
        - Absence
        - 0-10%
        - 11-30%
        - >30%
      - The intensity of the attack is estimation by the average number of galleries per leaf:
        - Absence
        - 0-1
        - 2-5
        - >5

      The presence of new galleries and their ascending development on the plants are also noted down.

    - Aphids (*Aphys gossypi, Myus persicae, Macrosiphum euphorbiae, Aulacorthum solani)*
      - The number and the distribution of the colonies are estimated using the following scale:
        - Absence
        - Some colonies: 1-5
        - Numerous colonies: 6-10
        - Generalised colonies: >10

- The instestity of the attack is estimated thanks to the characterisation of the populations observed on the lower side of the leaves:
  - Absence
  - Some alates
  - Small colonies
  - Big colonies
- The parasitism rate is estimated with the following scale:
  - Absence
  - Low: 0-30%
  - Medium: 31-60%
  - Important: 61-100%

o Tetranychus-type mites
- The number and the distribution of the colonies are estimated using the following scale:
  - Absence
  - Some small colonies: 1-5
  - Numerous small colonies or some big ones: 6-10
  - Generalised colonies: >10
- The intensity of the attack is estimated by the leaf area covered by the mites on the lower side of the leaves:
  - Absence
  - 0-10%
  - 11-30%
  - >30%

The presence of predatory natural enemies in the colonies is also indicated.

o Aculops-type mites
- The attacks are estimated by the evaluation of the number and the distribution of host plants:
  - Absence
  - Some plants: 1-5
  - Numerous localised plants: 6-10
  - Very numerous scattered plants: >10

o *Botrytis cinerea*
- The attacked organ is indicated:
  - Stems (canker)
  - Leaves
  - Fruits
- Estimation of the intensity of the attack by counting the cankers:
  - Absence
  - Low: 0-5 cankers
  - Medium: 6-20 cankers
  - Important: >21 cankers

o Powdery mildew (*Leveillula taurica* and *Oidium neolycopersici)*
- The sort of powdery mildew and the abundance of spots are indicated:
  - Absence
  - Some spots
  - Numerous spots
- The intensity of the attack is evaluated thanks to the percentage of leaf area with spores:
  - Absence
  - Low: 0-1%
  - Medium: 1-20%
  - Important: >20%

For all the animal pests and diseases, the evolution of injuries since the last control is estimated:

- Decreasing
- Stationary
- Increasing

Other complementary observations are localised on the map of the greenhouse and commented:
Other animal pests: thrips, bugs (Nezara), Noctuidae, Coccoidea…
Other diseases: Phytophtora, Pythium, Pith necrosis of tomato (*Pseudomonas corrugata*), Corynebacterium…
Phytoviruses: PVY, TSWV, TYLCV, ToTV…

Advantages / Disadvantages of the method/protocol :
The method is global, while remaining precise for the countings of the main pests.

Labor requirements are important, notably for the survey of whiteflies and *Tuta absoluta* that implies countings on the whole plant.
The duration of a complete weekly survey is about 2 to 3 hours for one greenhouse and one observer, using a fork-lift.

The protocol is adapted for greenhouses of 250-400 sqm. It has not been validated for bigger ones (1 to 2 ha).
A quick-sampling method based on the observations of different plant organs is under development.

References or examples of studies carried out by using this method/protocol:

G.RIDRAY, O. BONATO. Decision making in Integrated Pest Management for tomato protected crop. 3rd European Whitefly Symposium. Consejeria de Agricultura y Pesca, 20-24 Octobre 2008. Aguadulce. Espagne.

R. BRUN, G. RIDRAY, B. JEANNEQUIN, C. METAY, C. WQZIEKONSKI and B. SALVADOR. Use of decision rules to manage IPM on rose and tomato crops : an example with whitefly. XXVIIIth International Horticultural Congress (IHC), Lisbon, Portugal, August 2010. Accepted.