Characterisation of main pests on apple tree

Method/protocol submitted by:

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Objectives of the method/protocol:

Quantifying 2 diseases (apple scab, powdery mildew) and 8 sorts of animal pests (codling moth, oriental fruit moth, tortrix moths, miner moths, aphids, scales, cicadellidae and mites) on apple, at the field scale.

Brief description of the method/protocol:

This protocol presents a visual non destructive quantification method based on abundance classes to quantify diseases and animal pests on apple.

Possible uses of this method/protocol:

Characterisation of pest pressure in a region.
The protocol is currently used by technical advisers in the Tuscany region in Italy. The data collected on several farms is aimed at editing weekly phytosanitary and phenological reports for farmers.

Method/protocol:

- Observation unit:

The observation unit is the field.

- Abundance classes:

Each field is assigned to a qualitative abundance class for each of the animal pests or diseases studied.
The observations are carried out weekly. The diseases and animal pests observed depend on the moment of the year.
The date and sort of the last treatment in each field are noted.
The abundance classes for the different pests are presented in the tables below:

Apple scab (*Venturia inaequalis (Cke) Wint*)

- Apple scab on the leaves:

Visual observation of the leaves allows the experimenter to assign the field to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no symptom on the leaves
Low	a few plants in the field show low-level symptoms (5-10% of attacked leaves)
Medium	the majority of the plants shows low-level symptoms (5-10% of attacked leaves), or some plants show high-level symptoms (more than 30% of attacked leaves)
High	the majority of the plants show high-level symptoms (more than 30% of leaves with symptoms)

- Apple scab on the fruits:

Visual observation of the fruits allows the experimenter to assign the field to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no symptom on the fruits
Low	a few plants in the field show low-level symptoms (1-5% of attacked fruits)
Medium	the majority of the plants shows low-level symptoms (1-5% of attacked leaves), or some plants show high-level symptoms (more than 10% of attacked fruits)
High	the majority of the plants shows high-level symptoms (more than 10% of attacked fruits)

- Leaf wetness condition:

This factor has to be checked if rainfall has occurred in the week preceding the observation. This data can be observed using a specific sensor

o Powdery mildew (*Podosphaera leucotricha*) on leaves and fruits

- Powdery mildew on the leaves:

Visual observation of the leaves allows the experimenter to assign the field to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no symptom on the leaves
Low	a few plants in the field show low-level symptoms (1-5% of attacked leaves/shoots)
Medium	the majority of the plants shows low-level symptoms (more than 5% of attacked leaves/shoots), or some plants show high-level symptoms (more than 30% of attacked leaves/shoots)
High	the majority of the plants show high-level symptoms (more than 30% of leaves/shoots with symptoms)

- Powdery mildew on the fruits:

Visual observation of the fruits allows the experimenter to assign the field to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no symptom on the fruits
Low	a few plants in the field show low-level symptoms (1-5% of attacked fruits)
Medium	the majority of the plants shows low-level symptoms (1-5% of attacked fruits), or some plants show high-level symptoms (more than 10% of attacked fruits)
High	the majority of the plants show high-level symptoms (more than 10% of fruits with symptoms)

- o Codling moth (*Cydia pomonella*) on fruits

  - Infestation level:

Visual observation of the fruits allows the experimenter to assign the field to one of the following classes, depending on the infestation level of the field:

Level	**Description**
Absence	no symptom in the field
Low	a limited number of fruits (1-2%) are injured by codling moth
Medium	about 2% of the fruits are injured by codling moth
High	More than 2% of the fruits are injured by codling moth

  - Characterisation of the infestation:

The main development stage present in the field is indicated according to the following categories:

Development stage	**Description**
Absence	no codling moth in any development stage observed. No symptoms observed
Eggs	eggs of codling moth are observed on the fruits
Larvae	larvae are observed in the fruits
Signs of former presence of larvae in the fruits	no larvae are observed in the injured fruits but signs of former presence is visible (holes where the larvae went in/out of the fruits)

- o Oriental fruit moth (*Cydia molesta*) on fruits

  - Infestation level:

Visual observation of the fruits allows the experimenter to assign the field to one of the following classes, depending on the infestation level of the field:

Level	**Description**
Absence	no symptom in the field
Low	a limited number of fruits (1-2%) are injured by oriental fruit moth
Medium	about 2% of the fruits are injured by oriental fruit moth
High	More than 2% of the fruits are injured by oriental fruit moth

  - Characterisation of the infestation:

The main development stage present in the field is indicated according to the following categories:

Development stage	**Description**
Absence	no oriental fruit moth in any development stage observed. No symptoms observed
Eggs	eggs of oriental fruit moth are observed on the fruits
Larvae	larvae are observed in the fruits
Signs of former presence of larvae in the fruits	no larvae are observed in the injured fruits but signs of former presence is visible (holes where the larvae went in/out of the fruits)

- o Apple leaf miner
  - Infestation level:

Visual observation of the field allows the experimenter to assign it to one of the following classes, regarding the level of infestation:

Level	Description
Absence	no symptom observed
Presence, treatment realised	injuries are visible but are limited by a treatment
Presence, no treatment realised	Injuries are visible, no treatment has been realised yet

The main species of miner moth present is noted:

- No species of miner moth present
- The main species present is *Leucoptera malifoliella*
- The main species present is *Phyllonorycter blancardella*

o Tortrix moths

- Infestation level:

Visual observation of the field allows the experimenter to assign it to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no symptom observed
Presence, treatment realised	injuries are visible but are limited by a treatment
Presence, no treatment realised	Injuries are visible, no treatment has been realised yet

The main species of tortrix moth present is noted:

- No species of tortrix moth present
- The main species present is *Pandemis heparana*
- The main species present is *Archips rosana*
- The main species present is *Archips podana*
- The main species present is *Eulia*

o Aphids

- Rosy apple aphid *(Dysaphis plantaginea)*

Visual observation of the field allows the experimenter to assign it to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no presence of rosy apple aphid
Below treshold	low-level infestation. Less than 5% of the shoots/fruits are colonised.
Above treshold	more than 5% of the shoots/fruits are colonised

- Woolly apple aphid *(Eriosoma lanigerum*)

Visual observation of the field allows the experimenter to assign it to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no presence of wolly apple aphid
Below treshold	low-level infestation. Less than 8-10% of the fruits are colonised.
Above treshold	more than 10% of the fruits are colonised

- Green apple aphid (*Aphis pomi*)

Visual observation of the field allows the experimenter to assign it to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no presence of green apple aphid
Below treshold	low-level infestation. Less than 10% of the leaves/shoots are colonised.
Above treshold	more than 10% of the leaves/shoots are colonised

o San José scale *(Quadraspidiotus perniciosus)*

Visual observation of the field allows the experimenter to assign it to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no presence of San José scale
Low	a limited number of trees (1-2%) show signs of infestation
Medium	more than 2% of the trees are infested
High	more than 10% of the trees are infested

o Leafhoppers/cicadellidae

Visual observation of the field allows the experimenter to assign it to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no presence of symptoms
Presence	more than 20% of the leaves are injured

o Mites

Visual observation of the field allows the experimenter to assign it to one of the following classes, depending on the infestation level of the field:

Level	Description
Absence	no presence of mites
Low	presence of mites on some leaves (10-20%) of a limited number of trees (5-10%). Presence of *Phytoseiidae*
Medium	presence of mite injuries on more than 20-50% of the leaves of more than 10% of the trees, or on all the leaves of a limited number of trees (2-5%). Absence of *Phytoseiidae*
High	Presence of mite infestation on more than 50% of the leaves of more than 10% of the trees

Advantages / Disadvantages of the method/protocol (for instance time-consumption, number of people involved, difficulty of the measures…):

Field monitoring takes about 20-30 minutes and it can be carried out by one advisor.

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

Web-site of Agroambiente: http://agroambiente.info.arsia.toscana.it/arsia/arsia?