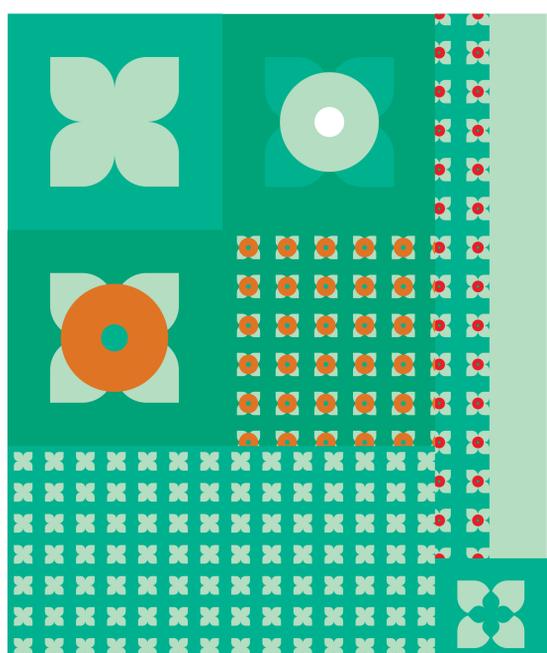


CROP PROTECTION FROM PATHOGENS AND PESTS

Similar to animals and humans, plants can experience different types of diseases. In particular, due to extensive agriculture and varietal selection, crop species are generally more damaged by pathogens and pests than natural vegetation. Plants can be attacked by a number of agents, including fungi, bacteria and viruses, as well as by noxious arthropods and other invertebrates, which may cause yield losses particularly relevant in developing countries. Similar to animals and humans, in their natural environments, plants have evolved a complex immune system to defend themselves from pathogen infections and pests, even if, in crop species, it is not enough efficient.



▼ FUNGI

Plants can be protected from phytopathogenic fungi by the application and integration of different strategies:

- ▶ the **cultivation of varieties resistant to the pathogens**, when possible, i.e. apple cultivars resistant to the scab agent;
- ▶ the adoption of **agronomical practices** aiming at avoiding the conditions suitable for fungal infections, such as high humidity levels that favour grapevine downy mildew epidemics;
- ▶ the application of **fungicides**, in the presence of a real risk of infection of the plant tissues by the fungal pathogens.

▼ BACTERIA

Some bacterial pathogens are associated with plant diseases, i.e. grapevine yellows (GY) and olive quick decline syndrome (OQDS), difficult to be cured.

Such bacteria live within the plant vascular tissues (xylem and phloem) and can move from plant to plant through the feeding activity of insect vectors, able to acquire the pathogen from infected plants and transmit it to healthy plants. Thus, the main strategies used to contain plant diseases associated with these pathogens are based on insecticide treatments against the insect vector populations. To reduce the impact of the conventional agricultural practices on the environment,



Xylella fastidiosa

it is necessary to **develop novel sustainable effective control strategies**, such as the utilization of healthy-certified propagation materials, the employment of plant-associated microorganisms able to antagonize the pathogens, the cultivation of tolerant/resistant varieties/hybrids.

▼ INSECTS

Numerous insect species cause serious economic damage to both agriculture and plant nurseries. Among others, well known are Philaenus spumarius and Rhynchophorus ferrugineus. Philaenus spumarius, also called meadow froghopper, is able to transmit **Xylella fastidiosa**, a bacterial pathogen causing

the collapse of olive trees in Puglia; moreover, Rhynchophorus ferrugineus, also called **red palm weevil**, arrived in Italy in early 2000, devastating a high number of ornamental palms. Nowadays, efficient approach has not been developed for their control.



Grapevine downy mildew

▼ VIRUS

Similar to humans, plant diseases can be caused by viruses, small infective particles able to replicate within the plant cells and to spread throughout the plant by the vascular tissues (mainly the phloem). Up to now, no effective strategy has been developed to the direct elimination of these pathogens. Plant viruses can move from plant to plant mainly by vectors, i.e. insects, mites, soil fungi and nematodes. As virus-infected plants can not be cured, the sole way to stop epidemics of viral plant diseases is the eradication of infected plants. On the other end, the inspection of sanitary condition of young plants (propagation material) by recently developed techniques (the same techniques used to detect human or animal diseases) improves the prevention of viral plant diseases.



Plum pox virus symptoms on peach



Red palm weevil

In agriculture, the most reliable strategy to control plant diseases is based on the rational use of agrochemicals, particularly effective against phytopathogenic fungi (fungicides) and insects (insecticides), whereas infections caused by bacteria and viruses are more difficult to be controlled. Herbicides represent another important category of agrochemicals, due to the damages caused by weeds on crop plants (Agrios 2005, Plant Pathology 5th Edition, Elsevier).

In any case, modern agriculture relies on the reduction of agrochemical use, a main goal in crop protection, by integrating the use of conventional products **with alternative approaches** to control plant diseases based on newly registered formulates with low impact on environment, operators and consumers.

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