NATAE
North African Transition to AgroEcology

Integrated crop protection in the Mediterranean

Agroecological zones

Suburban | Cereal plain | Mountains | Irrigated | Oasis

Introduction

Integrated Crop Protection (ICP) involves combining different strategies to prevent and manage plant diseases, parasites, pests and weeds effectively and sustainably, while minimizing the use of chemical products. Integrated protection limits the emergence of resistance.

Picture: Broomrape (Orobanche crenata)
Source: Dr. Reuven Jacobsohn, bugwood.org

Picture by INRAE: Trichogramma, a microscopic insect that feeds on the eggs of certain butterflies and prevents caterpillars from developing, used as a biological control agent

Principles of integrated crop protection

Integrated crop protection is based on several principles:

- **Prevention:** Measures are taken to prevent the appearance of phytosanitary problems and weeds through cultivation techniques such as crop diversification (rotation, association), the choice of tolerant species, appropriate management of crop residues, and cleaning or disinfecting farm equipment after use on an infested plot.

- **Creating conditions favourable to crop auxiliaries:** Planting hedges, borders or refuge areas provides shelter for crop auxiliary insects (such as bees, parasitic wasps, ladybugs, etc.) and predators (birds, etc.) that limit pest populations. Crop auxiliaries can also be introduced as part of a biological control program, while ensuring the balance of local ecosystems by avoiding the introduction of invasive species or predators of endogenous species.

- **Observation and proactive management:** Careful, regular crop monitoring is necessary to detect the first signs of stress, disease or pests. This makes it possible to intervene quickly and effectively before infestations get out of control. **Visual observation** can be complemented by the use of **insect traps** and the **monitoring of weather conditions**, such as humidity, temperature and rainfall, which influence the proliferation of pests and diseases. **National** monitoring **programmes** can also inform farmers about the local spread of pests and diseases.

Source: INAT, Tunisia

- **Substitution by biological alternatives:** The use of **chemical products is avoided or minimized**, by favouring natural alternatives and biological treatments. In integrated pest management systems, chemicals are only used as a last resort.
  - **Biological control** involves using **living organisms** to control populations of pests, diseases and parasites. This may involve introducing **predatory insects**, such as ladybugs to control aphids, or parasitic wasps to control caterpillars. **Micro-organisms** (fungi, bacteria and viruses) can be used to combat fungal or bacterial diseases. For example, *Bacillus thuringiensis* is an effective biological agent against certain caterpillars, or the carob moth *(Ectomyelois ceratoniae*) which affects dates and pomegranates. Certain crops can be used as **trap plants** to attract pests away from the main crop, or to induce the growth of parasitic plants without allowing them to develop. **Allelopathic plants**, used as intercrops or in rotation, inhibit weed growth.
  - **Natural phytosanitary products** of plant, mineral or microbial origin can be less harmful than their chemical alternatives for non-target organisms and the environment. For example, **sulphur powder and copper** are widely used against fungal diseases of grapevines, olives and tomatoes. **Nettle compost tea** is used as an insecticide to control aphids.

Selective mass trapping of insects is sometimes used, for example in North Africa to control several pests including the Mediterranean fruit fly (Ceratitis capitata). Sexual confusion is another technique based on the diffusion of specific synthetic pheromones that disrupt the orientation of male moths, reducing mating and therefore egg production.

Example: integrated control of broomrape

Broomrape is a widespread crop parasite in North Africa (Egypt, Morocco, Tunisia...). Various species of broomrape infest different crops. *Orobanche creanata* in particular infests leguminous crops such as broad beans and vegetables, and can destroy the entire production. Broomrape tiny seeds persist in the soil for a long time (10 years or more).

No single control method is fully effective against broomrape. A number of research programmes define integrated pest management protocols to combat broomrape infestations in specific environments and crops.

In potentially contaminated areas, **early observation** of infestations is important. The first symptoms of parasitism can appear as early as in the winter (broomrape tubers develop on the roots of the crop). Those can be observed by pulling out the plant and observing its roots.

Manual removal of broomrape stalks before seed formation, and burning of the stalks are recommended for small areas, when infestation is limited.

Long **rotations** are often necessary to minimize broomrape. The use of **trap plants** in rotation, such as **flax** and **coriander**, gives good results. These plants stimulate broomrape germination, but are not attacked by them, so broomrape germinate without reproducing, reducing the broomrape seed bank in the soil. Some research suggests, for example, planting flax 4 to 6 weeks before tomatoes.

Fodder plants such as certain vetches (Vicia dasycarpa) and bersim (Trifolium alexandrinum) are also reputed to reduce the broomrape seed bank in the soil.

Low soil temperatures reduce the germination of broomrape. **So late sowing dates** are often recommended for winter crops. Conversely, early sowing is advisable for spring crops. Research provides information on the dates and varieties that give good yields, despite late or early sowing.

Increased **nitrogen and phosphorus fertilization** also reduce broomrape infestations by reducing their ability to germinate and attach to their hosts. Saline and flooded soils are also less affected.

Research has also led to the selection of **resistant varieties**, notably for sunflowers, certain vegetables and, to a certain extent, broad beans (e.g. cultivar Giza 402 selected in Egypt).

Soil solarization takes advantage of solar radiation to heat the soil to temperatures that are lethal to many fungal pathogens, nematodes, and weed seeds. On small areas, **solarization** of broomrape (over 30 to 50 days in the dry season) has produced good results, particularly when combined with a nitrogen-rich fertilizer (e.g. poultry droppings).

Certain insects, fungi and bacteria offer interesting prospects for **biological control** of broomrape, such as Phytomyza orobanchia, an insect that occurs naturally in Morocco, and Fusarium oxysporum fsp orthoceras, a fungus used, for example, on tobacco crops.

The use of **herbicides**, in particular foliar glyphosate in low doses at the appearance of the broomrape tuber stage, often complements other integrated pest management methods for the production of food legumes (broomrape tubers are observed by pulling up the plants; they are yellow-orange in colour, unlike the nodules of food legume crops, which are whitish).

The most effective research results generally combine cultivation methods (choice of variety, trap plants in rotation, sowing dates), biological control and chemical control.

Challenges and limitations

- **Research** is often needed to define IPM protocols adapted to local conditions and challenges.
- **Training and awareness-raising:** Good practices need to be disseminated and explained to farmers through training and awareness-raising programmes.
- **Availability of control and monitoring methods:** Products alternative to chemicals, pheromone confusion agents and population monitoring methods such as traps are not always available, which prevents farmers from using them.
- **Scale of intervention:** Good practices are much more effective if they are adopted simultaneously by the majority, or even all, of the farmers in an area. This requires a major effort in terms of awareness-raising and cooperation, and the coordinated provision of appropriate control resources.

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