NATAE
North African Transition to AgroEcology

Plants alternative to chemical inputs in Mediterranean agrosystems

Agroecological zones

Suburban | Cereal plain | Mountains | Irrigated | Oasis

Introduction

The Mediterranean basin is a rich reservoir of biodiversity. Several local plants can be used as biological alternatives to chemical inputs in agriculture, as biopesticides, biostimulants, green manures or biocontrol products. In addition, several species introduced in the Mediterranean region can adapt to the region's climate and enrich the range of available crops.

Source: INAT, Tunisia

The benefits of using common plants as alternatives to chemical inputs

Using plants and plant-based products as alternative to chemical inputs enhances local biodiversity and helps preserve it. It reduces the impact of farming practices on the environment, and reduces farmers' dependence on external markets. Many common plants, easy to grow and therefore accessible to small-scale farmers can be beneficial in agroecological systems.

Plants used to produce organic alternatives to chemical inputs

a. Biopesticides

Biopesticides are substances of biological origin used to combat pests, diseases and weeds. Several common Mediterranean plants are rich in active compounds capable of acting as pest and disease control agents.

- **Neem (*Azadirachta indica*):** Neem, a tree native to India, is very well adapted to Mediterranean regions. Its leaves, bark and seeds contain azadirachtin, an active ingredient that is a natural insecticide against numerous pests such as aphids, whiteflies and caterpillars. Neem disrupts insect metabolism and can also have a repellent effect.
- **Eucalyptus (*Eucalyptus globulus*):** Native to Australia, eucalyptus is now a very common tree in Mediterranean countries. Eucalyptus essential oil has repellent properties against various insects, and can help controlling pathogenic fungi of the genus Fusarium.
- **Lavender (*Lavandula spp.*):** Lavender is also a natural repellent against several types of insects, including aphids and mites. It can be used as an infusion or essential oil to create organic pest treatments.
- **Mint (*Mentha spp.*):** The strong scent of mint repels many pests. Mint leaves can be used to produce decoctions or essential oils to combat aphids and ants.
- **Tansy (*Tanacetum vulgare*):** Tansy is used as a natural insecticide, particularly against aphids, mites and beetles including the Colorado beetle. It contains thujones, compounds that are toxic to insects but harmless to humans in small doses.

b. Biostimulants

Biostimulants are natural substances that improve plant growth, stress resistance and yield. Some Mediterranean plants contain active molecules that can be used to stimulate crops.

- **Nettle (*Urtica dioica*):** Nettle is a plant rich in nitrogen, silica and minerals, which can be used to produce nettle compost tea. Nettle compost tea can stimulate plant growth and improve resistance to diseases, particularly fungal diseases.
- **Comfrey (*Symphytum officinale*):** Comfrey is used to produce potassium-rich green manures and compost teas, particularly useful for stimulating plant flowering and fruiting. Those can also be used to improve soil structure and increase water retention.

c. Green manure

Green manures are crops grown primarily to improve soil quality by incorporating organic matter into the soil. The following leguminous crops also fix nitrogen from the air in the soil:

- **Alfalfa (*Medicago sativa*):** Particularly useful for nitrogen-poor soils and for enriching the soil after intensive cultivation.
- **Clover (*Trifolium spp.*):** Can be sown between crops to improve soil structure, control erosion and provide organic matter.
- **Vetches (*Vicia spp.*):** Adapted to nitrogen-poor soils, vetches can be included in crop rotations or in fodder associations. Vetches should be grown in soils free from broomrape, a common parasitic plant in Mediterranean cereal-growing systems.

d. Biofumigants

Biofumigants are plant substances that release biologically active compounds capable of killing or inhibiting soil pathogens (such as fungi, bacteria, etc.).

- **Mustard (*Brassica spp.*):** Mustard plants are rich in isothiocyanates, natural compounds that act as fumigants to kill soil pests and pathogens. Mustard can be used as a biofumigant green manure.
- **Radish (*Raphanus sativus*):** Radish, especially in combination with mustard, can help control certain soil parasites such as nematodes (*Meloidogyne, Globodera*...). It is used in rotations to prevent the spread of certain soil diseases, including *Fusarium.*

Methods to produce and use plants alternative to chemical inputs

Herbal preparations can be made in several ways:

- **Infusions or decoctions:** Boil plants (such as nettle, tansy or mint) to extract their active ingredients.
- **Compost teas:** Fermenting plants in water for several days at room temperature releases the nutrients and active ingredients into the water.
- **Oily or alcoholic extracts:** Some plants, such as neem, can be infused in oils or alcohol to extract their active essential oils.

The products prepared can be applied by:

- **Foliar treatment:** Apply biopesticides or biostimulants directly to the leaves of crops to treat pests or stimulate growth.
- **Soil amendment:** Incorporating crop residues or green manures into the soil to improve its structure and fertility. Green manures are ploughed in when vegetative development is complete, and before grain formation, to maximise nutrient release.

To maximise the effectiveness of plants or plant-based products, those must be applied at the right times, taking into account crop cycles, crop needs, weather conditions and observations on the presence and development stages of pathogens or pests.

Repellent and trap plants

Agroecological systems based on the use of repellent plants and trap plants strategically combine crops to limit pests without resorting to chemical pesticides.

Repellent plants emit compounds that repel pests or inhibit the growth of parasitic plants. They can, for example, be intercropped with the main crop to limit attacks by certain insects or the growth of parasitic plants.

Source: INAT, Tunisia

Some plants are used to attract insect pests. In this case, they are planted outside the crop to be protected, in areas where the pest population can be controlled, either by natural enemies or by other biological management techniques.

Other plants attract pests' natural predators (e.g. ladybirds). Those should be planted close to the crop to be protected.

Plants grown to repel or attract pests can also be used as fodder or green manure, particularly in the case of legumes.

The main examples of agroecological systems using this type of interaction on a large scale have emerged outside of the Mediterranean region, notably East and Southern Africa, for the protection of maize and sorghum. But many crop associations are also used in small-scale, non-mechanised market gardening, including in the Mediterranean. Many of those combine vegetables with aromatic and medicinal plants grown as intercrops (basil) or at the edges of the plots (lavender, rosemary). The effectiveness of these crop associations depends on how the crops are arranged in space and time, and is the subject of numerous trials, particularly by market-garden farmers.

In North Africa, trials to combat broomrape infestations are introducing rotational trap crops as part of a range of complementary methods (e.g. flax and coriander, which stimulate the germination of broomrape without being attacked by this parasitic plant).

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