Greenresilient Factsheet

Agroecological service crops in Southern European greenhouse

In the Greenresilient project, Agroecological Service Crops (ASCs) were introduced and tested in organic greenhouse production systems. ASCs can be used as a diversification strategy to contribute to soil fertility, plant nutrition and to reduce weed, pest and disease prevalence in the following crop. This leaflet explains why and how ASCs can be an innovative tool for provisioning ecological services in Southern European greenhouses.

What are Agroecological Service Crops?

Agroecological Service Crops are the plant species in a crop rotation that are grown to provide ecosystem services to the agroecosystem (e.g., cover crops, catch crops, living mulches, flower strips) rather than for yield purposes. Introducing ASCs into a crop rotation can help improve soil fertility and biodiversity in time and space, increase the presence of beneficial insects, improve water and nutrient cycles and decrease the pressure from pest arthropods, crop diseases and weeds. Indeed, they can be considered 'ecological infrastructure' and 'ecological corridors' within cropped fields, adding resilience to the system dynamics. They also allow environments to be re-colonised by wildlife, like flora or arthropods, in the event of a disturbance (e.g., tillage).

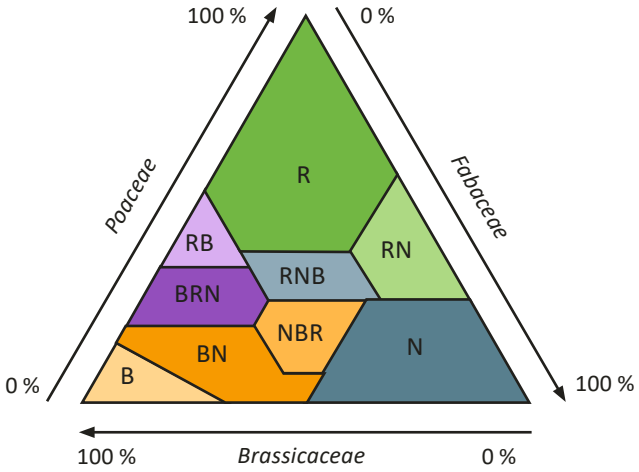

Figure 1. Services related to different plant families
(R = weed reduction effect, N = nutritional effect, B = biofumigant effect)

Source: Ciaccia et al. 2019

Image 1 and 2. Different examples of Agricultural Service Crops composition.

1: Sunn hemp (*Crotalaria juncea*) is a leguminous, fast-growing species

2: an example of ASC mixture including Tillage radish (*Raphanus sativus*), Sunn hemp (*Crotalaria juncea*), Cowpea (*Vigna sinensis*), Sorgum-Sudan grass (*Sorghum bicolour x S. sudanense*)

Source: Fabio Tittarelli, CREA.

Ecological services depend on Agricultural Service Crop species and management

The agroecological services provided by ASCs depend on three main aspects:

I. ASC species;
II. position within the rotation;
III. management strategies.

Species-specific contributions to ecological services differ depending on their particular characteristics; these are called attributes. These attributes are associated with one or more ecological services, then called functional attributes. An example is the nectar accessibility of flower (attribute), which determines insects' attraction to the flower (functional attribute). A species' functional attributes, related to one or more services, are defined by its functional identity. Hence, ASC species should be chosen based on the functional attributes desired and their water requirements, heat tolerance and growth cycle.

Consequently, the ASC species mixture composition introduced will drive the type of services provided to the agroecosystem (see figure 1). Examples of ASC composition are shown in images 1 and 2.

How to manage Agricultural Service Crops in Southern European greenhouses

Greenhouse systems in Southern Europe are characterised by unheated tunnels with continuous cultivation of a few cash crops. ASCs can be introduced in the rotation as cover crops; a two- three- month time window in the summertime can be exploited for ASCs cultivation as an alternative to soil solarisation or a cash crop. The ASCs can be included as green manure, limiting weed development via direct resource and light competition, while improving soil fertility through their root activity. ASC plant residues can be incorporated into the soil at termination. An alternative to ASCs as a cover crop is planting them along the greenhouse's side edges as flower strips to attract beneficial insects.

In such intensive systems, the choice of the ASCs should be directed towards short cycles and heat-tolerant species to reduce the non-productive period in the greenhouse. In table 1, some examples of species suitable for Southern European greenhouses are featured.

Table 1. Agricultural Service Crop (ASC) species as cover crops in Mediterranean greenhouses and their main functional attributes provided. The table is based on the experience carried out by CREA within the Greenresilient project. Performance for each ecological service shown as: +++ strong, ++ moderate, + satisfactory, - not relevant.

ASC species	Common name	Family	Nutrient cycling	Weed reduction	Nematode control	Attractive potential	Notes
Brassica juncea	Brown mustard	Brassicaceae	++	++	+++	-	Biofumigant
Crotalaria juncea	Sunn hemp	Fabaceae	+++	+	++	-	Fast-growing drought-tolerant
Lablab purpureus	Lablab	Fabaceae	+++	++	-	+	Slow growth at first stages
Pennisetum glaucum	Pearl millet	Poaceae	+	+++	+	-	Soil-born disease suppression
Phacelia tanacetifolia	Phacelia	Boraginaceae	++	+	-	+++	Usually used in mixtures
Raphanus sativus	Tillage radish	Brassicaceae	+	+++	+++	++	Biofumigant Allelopathic
Setaria italica	Foxtail millet	Poaceae	+	++	-	-	Short cycle Drought resistant
Sorghum Sudangrass	Sudan grass	Poaceae	++	+++	+	+	Fast-growing Shelter for insects
Vigna sinensis	Cowpea	Fabaceae	+++	+	-	++	Heat tolerant Phosphorus availability

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Cover picture: Agroecological Service Crops (ASCs) in a greenhouse in Capua (CE) – La Colombaia farm. Source: Fabio Tittarelli, CREA, Italy.

About Greenresilient: This factsheet was elaborated in the project Greenresilient – Organic and bio-dynamic vegetable production in low-energy GREENhouses – sustainable, RESILIENT and innovative food production systems, running 2018 to 2021. The main objective of Greenresilient is to demonstrate that an agroecological approach to greenhouse production is feasible and allows the establishment of robust agroecosystems in different European areas.

Project partners: Agroscope, Switzerland; AU-FOOD – Aarhus University, Department of Food Science, Denmark; CREA – Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Italy; FiBL – Research Institute of Organic Agriculture, Switzerland; GRAB – Groupe de Recherche en Agriculture Biologique, France; HBLFA – Horticultural College and Research Institute, Austria; ILVO – Institute for Agricultural and Fisheries Research, Belgium; La Colombaia – Società Agricola Semplice LA COLOMBAIA, Italy; PCG – Vegetable Research Centre Kruishoutem, Belgium; SLU – Swedish University of Agricultural Sciences, Sweden; UvA – Institute for Biodiversity and Ecosystem Dynamics, Netherlands; WUR – Stichting Wageningen Research, research institute Wageningen Plant Research, Netherlands

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