

## BIOCONTROL AGENTS IN ARABLE CROPS

# HOW TO INTEGRATE THEIR IMPACT into pest control



*The development of tools designed to forecast the potential level of natural pest control in a field should help to reduce the use of plant protection products.*

**How can we help to develop integrated pest management? The ARENA project is expecting to make available to farmers the relevant knowledge and tools needed to estimate the potential offered by biocontrol agents.**

**P**ublic policies are encouraging producers to reduce their use of chemical inputs by 50% (French Ecophyto II plan). The agricultural sector is therefore looking for alternative solutions to keep meeting an increasing demand for food, both in respect of quality and of quantity.

One way of reducing plant protection product (PPP) usage is to encourage natural control in the fields. That is the objective of the ARENA project (1) (Anticiper les REgulations NATurelles, led by ARVALIS-Institut du Végétal), which is about to establish an in-field observation network that will stay in place for three years in at least eight regions, in order to assess the effectiveness of biocontrol agents in controlling pests in various arable landscapes.

The resources produced by the project (knowledge, observation methods, diagnosis and forecasting tools) will be tested by farmers and advisors to promote their use and the introduction of this ecosystem service into integrated crop protection strategies.

**« PESTS AND BIOCONTROL AGENTS:  
their populations must be studied  
simultaneously »**

### **Keeping a close watch on arable crops**

In 2015, cereal, oilseed and protein crops covered 42% of the utilised agricultural area in France (2). This means that any action capable of reducing PPP use and/or their impact will have an effect on a rather large scale. Acquiring knowledge on natural pest control by biocontrol agents should help to develop various methods designed to optimise the use of insecticides and biocontrol techniques, and therefore to be as environmentally friendly as possible.

The project will focus primarily on a few pests that impact the main arable crops, whether they are grown on their own or with a companion legume crop. The pests in question will be slugs, spring and autumn aphids, and oilseed rape weevils, which are among the most devastating for those particular crops.

Indeed, in years when conditions particularly suit them, slug populations can reach very high levels and can destroy crops in some places, including oilseed rape and sunflowers that they find particularly palatable. As for autumn aphids, trials carried out by ARVALIS in 2014 showed a yield differential of up to 6 t/ha between treated and untreated barley parcels.

## To what extent are biocontrol agents useful?

Although the value of biological control through conservation has been recognised (*see insert*), the studies carried out up to now focussed primarily on characterising the biocontrol agents present in and around cropped parcels, and identifying the actions that encourage their presence. As a result, the actual level of natural pest control occurring has seldom been quantified. To what extent, and in what conditions are biocontrol agents able to control pests? The lack of knowledge in that respect seriously restricts the ability to take them into account in the development of crop protection strategies.

It is therefore crucial to quantify the pest control potential offered by biocontrol agents, using methods that can be applied by farmers in their fields. This observation data will have to, for example, estimate what density of population must be observed for any particular biocontrol agent in a field before deciding to dispense with certain preventative treatments.



*A better understanding of the relationship between prey and predator or parasite should help to forecast the development of the different populations.*

The methods used to observe biocontrol agents and their effectiveness in controlling pests will be applied through three networks of parcels cropped by farmers, as well as eight experimental networks. A first series of observations will aim to simultaneously monitor the dynamics within the biocontrol agent and pest populations, in order to check whether there is indeed a correlation between their respective developments. The acquisition of experimental data in spring and autumn should help to gain a better understanding of the natural control process that occurs at those times of the year. Also, so far there have been very few studies of the autumnal activity of biocontrol agents in crops. So, visual observations and traps will help to quantify the populations of the main pests being studied, as well as those of the associated biocontrol agents.

« 2 to 3 times its body weight: that is the quantity of prey (molluscs, small insect larvae and adults) that a beetle can eat every day. »

(1) ARENA was the successful candidate of CASDAR's 2016 call for projects, and is a partnership between ARVALIS - Institut du végétal, ACTA, Terres Inovia, the University of Lorraine, AgroCampus Ouest, the Dijon Quétigny, Auzeville, Arras and la Roche sur Yon agricultural colleges, and the Hauts de France, Centre Val-de-Loire and Vendée "chambres d'agriculture".

(2) Source: Statistique Agricole Annuelle (Annual agricultural statistics).

## Field assessment of the control potential

The new protocols used nowadays to evaluate the natural control potential of biocontrol agents have not yet been properly standardised and are unfortunately very seldom applied. This project aims to ascertain their practical value, by putting in place a series of complementary observations. For example, a prey exposure device will be set up in a few fields; prey will be stuck on a plate and their predation will be monitored over time. The device will be linked to cameras to identify the organisms that consume the prey. To this will be added the results of stomach content analysis performed on biocontrol agents captured in those parcels. The data collected in the fields will also help to assess the impact that different cropping practices and landscapes have on natural control. The effect of the association of oilseed rape with other species, as well as of min-till techniques on slug control by biocontrol agents will be one of the aspects studied in the "cropping system" trials.



*Pests (aphids in this case) are exposed in a field in the exclusion cage and counted daily, in order to estimate the level of control achieved by biocontrol agents. This device differentiates one biocontrol agent from another from the way they move.*

Ultimately, this experimental information will be combined with the results of similar studies to build simple models that describe and forecast pest control phenomena. The project intends verifying that it is possible to describe pest and biocontrol agent development dynamics based on the characteristics of a field (cropping system, landscape, soil characteristics and conditions, farming practices, etc.), and the initial state of the populations (field by field pest and biocontrol agent observation data).

The agricultural industry's expectations are at the heart of this work. Producers and advisors have been involved at the start of the project to get a clearer picture of their needs regarding methods and tools to help them observe and interpret the natural control potential in their fields. This in turn will help to calibrate the resources that will then be produced. Tool prototypes will be offered to farmers and advisors involved in the networks for testing, before they are finalised with a view to making them available for general use.

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### **A la carte menus for biocontrol agents**

A female hoverfly (a flying biocontrol agent) selects a laying site partly because of the aphid species and density present around it. Lab studies have revealed that a larva can devour several hundred aphids before its metamorphosis. A small study has shown that flying biocontrol agents are the most effective ones to control aphids, and that biocontrol is most effective on the periphery of a parcel.

Adult beetles (a crawling biocontrol agent) consume molluscs (slugs and snails) and small insect larvae and adults in quantities reaching up to 2 or 3 times their body weight in a single day! Their larvae are exclusively carnivorous.

Other crawling biocontrol agents include rove beetles, that act as a predator as a larva as well as an adult. The bigger species consume soil pests such as slugs, whereas smaller ones mainly eat mites. Web spiders eat flying aphids, psyllids, leafhoppers and diptera. Hunting spiders feed on ground insects and larvae, and sometimes on slug eggs.