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Agroecological biocontrol

Learning from Toni Ballesta Cámara



Agroecological biocontrol for food and ecosystem health without synthetic pesticides

Learning from the ground | Toni Ballesta Cámara

Photo: Intercropping watermelon and *Lobularia maritima* to control aphids and increase pollination



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Background

Broadly speaking, biological pest control measures, often called **biocontrol**, refer to the use of **living biocontrol agents and non-living nature-based substances** to control pests (Stenberg et al., 2021). While biocontrol is often reduced to the sole sale, purchase and applications of biocontrol products, it can rely also on bottom-up, locally adapted **agri-system redesign practices** to manage pests, pathogens, or weeds.

This factsheet presents a real-life example of **agroecological biocontrol** from Toni Ballesta Cámara, a young biologist and independent farm advisor from Alicante (Spain), demonstrating that by redesigning agricultural systems, it is possible to protect crops while also safeguarding farmers' livelihoods, consumers, and nature.

This story comes at a crucial time, as the European Parliament recently adopted its [INI Report](#), an initiative for ensuring faster registration and uptake of biological control agents. Furthermore, the EU regulatory framework for pesticides is undergoing strong weakening efforts through the reform of **Regulation (EC) No 1107/2009**, which governs their placing on the market. This reform is closely linked to the **Sustainable Use of Pesticides Directive (SUD)**, which requires the Member States to put in place national plans for the reduction of pesticide risks and promote non-chemical alternatives.

Learning from the ground

Like many actors in the agroecology movement, Toni Ballesta Cámara wears many hats: he is a biologist, independent farm advisor, researcher, teacher, farmer, blogger, YouTuber, and much more all at once. He has delivered more than 50 environmental education workshops for children, farmers, schools, local associations, and municipalities. He studied Biology at the University of Valencia and completed a Master's in Agronomy at the Polytechnic University of Valencia (UPV).

He gained research experience at the Valencian Institute for Agrarian Research (IVIA), where he conducted bioassays with parasitosis and entomopathogenic viruses to control fruit-fly pests. Later, he created Biosoluciones Agro, an independent advisory service that offers monitoring, biodiversity assessment, biological releases, and farmer training.



Toni's work is based in Mediterranean Spain, where he supports horticultural and fruit producers in moving away from dependence on synthetic inputs. His goal is to build resilient agroecosystems that sustain productivity and biodiversity simultaneously.

Photo: Workshop of seed diversity and harvesting



Photo credit: Toni Ballesta Cámara

Example of biocontrol practices applied by Toni Ballesta Cámara in Spain

Toni applies several concrete practices in his daily work:

- **Field monitoring of pests through sticky traps**, pheromone traps, and light traps to identify both pest insects and beneficial natural enemies. This approach allows him to decide whether an intervention is necessary and when it should occur.
- **Intercropping and installation of customized biocorridors (without using pesticides or chemical fertilizers)**, such as floral strips, multifunctional hedges, water, existing refuges, and other non-productive spaces designed to provide habitat for beneficial wildlife in our fields.
- **Field trials and collaboration with researchers**, for example on the invasive pest *Pulvinaria polygonata* in citrus crops. Toni and his collaborators monitored pest populations, collected samples, and worked with UPV and the Plant Health Service to design biological control solutions.
- **Training and education**, including workshops for farmers, youth, and schools so that they themselves are empowered to manage pest monitoring, composting, and biodiversity for agriculture. This work encourages awareness, information dissemination, knowledge sharing, and capacity building in rural areas.

Photo: Flowers of *Lobularia maritima* for intercropping



Photo credit: Verdcamp Fruits

Results obtained by Toni's experience

Toni's fieldwork demonstrates that agroecological biocontrol, based on the redesign of agroecosystems – by itself, or in combination with the purchase of invertebrates and microorganisms (van Lenteren et al., 2018), can deliver both agronomic and social benefits.

- **Local adaptation has proven essential.** Biocontrol strategies based on the redesign of functional biodiversity must be chosen according to the crop, climate, and farming context, since uniform recipes rarely work.
- **Experimentation and learning are vital.** Transitioning away from chemicals requires the application of many tested and proven approaches, as well as the patience and a ability to test, fail, and adjust until the system stabilises.
- **Knowledge sharing creates collective progress.** Toni regularly exchanges information and results with farmers, researchers, and fellow agronomists, helping to build a community of practice.
- **His approach also strengthens the rural economy** by generating local, technical jobs for young agronomists and reducing farmers' dependency on imported inputs.
- Farmers who have adopted monitoring and redesign system have significantly **reduced their use of synthetic pesticides**, which **lowers input costs** and **environmental risks**.

What does science say about biocontrol based on agroecosystems redesign?

A robust body of scientific evidence demonstrates that a functional biodiversity – **and more importantly the presence of particular plant species that provide suitable resources to biocontrol agents or pollinators** – enhances pest regulation and pollination services, leading to more resilient and productive cropping systems, a core tenet of agroecology. (Letourneau et al., 2011; Marshall et al., 2003; Pretty et al., 2018; Wäckers & van Rijn, 2012; Winkler et al., 2010). Meta-analyses typically show that in about 50% of the studies, increasing botanical diversity improves natural pest control; in about a third of the cases, there is no effect; and in the remaining 15% of the cases, pest pressure increases (Campbell et al., 2012). For this reason, we need to take a scientific approach and improve success rate by looking at the functional traits of the plant species. This is what “functional biodiversity” entails.

Not everyone sees natural diversity as an ally for pest regulation and food production. Tscharntke et al., (2016) found out that the “*relative importance of natural habitat for biocontrol can vary dramatically depending on type of crop, pest, predator, land management, and landscape structure*”. This implies that intercropping, long-term crop rotations, landscape features, habitat management used in agroecology for biological pest or weed control need to be

integrated in EU farmland, for instance via the respect of good agricultural and environmental conditions (GAECs) for receiving CAP direct payments.

Contrary to those promoting biocontrol alongside chemical pesticides without considering the negative effects on natural predators, science shows that biocontrol works better when integrated GAECs. Agroecological biocontrol using agroecosystem redesign can be also integratable with organic plant protection products and other safe biocontrol agents that avoid patenting seeds (e.g. GMO, NGTs) and are any other negative sustainability effects (high purchasing costs for farmers, limited effectiveness without the right conditions, long-term persistence in the environment).

Towards agroecological biocontrol - lessons learned from the field

The work of Toni teaches us that nature offers a wide toolbox for farmers. Pest management is not always an individual farmer's concern, but rather a collective one at landscape, regional or international level. The following elements summarise what makes Toni's work an example of **agroecological biocontrol** based on functional biodiversity, rather than an industrial or conventional approach.

Box 1. Some characteristics of agroecological biocontrol

1. It avoids genetically modified organisms and patented technologies.
2. It relies on a mix of coherent and locally adapted practices, e.g. functional biodiversity, crop rotations, and the application of non-living nature-based substances.
3. It focuses on strengthening the natural resilience and self-sustaining capacity of the farm instead of creating dependency on external inputs.
4. It treats the farmland as a living system, not as a set of inputs to be managed separately.
5. It avoids the combined use of biological agents with synthetic pesticides, moving beyond the limited concept of integrated pest management.
6. It promotes knowledge co-creation through collaboration among farmers, youth, researchers, and local communities.
7. It keeps control of knowledge and data in the hands of farmers rather than proprietary precision-agriculture platforms.
8. It contributes to rural development by creating meaningful work for young professionals in farming regions.
9. It is based on science and field evidence, showing measurable improvements in pest control and biodiversity.

10. It also promotes habitat complexity, soil health, and crop diversity to create long-term resilience.

Final reflections for science and policy

Biocontrol is a cornerstone of agroecology because it enables farmers to produce healthy food while protecting biodiversity, soils, and water. By replacing synthetic pesticides with natural solutions, biocontrol contributes to food security, ecosystem protection, rural employment, and farmer autonomy.

The experience of Toni shows that agroecological biocontrol is not only feasible but necessary for the future of European agriculture and rural areas. It reduces chemical risks, protects biodiversity, and strengthens local economies while maintaining crop health.

As the European co-legislators are revising Regulation 1107/2009 and the Member States continue to update and implement their Integrated Pest Management Plans (SUD), it is crucial that policies, farm advisory and science efforts at all levels recognise and support these on-the-ground biocontrol experiences, especially when coming from the youth engaged in intergenerational fairness and knowledge co-creation.

Encouraging **agroecological biocontrol means investing in farmer autonomy**, local knowledge systems, and the next generation of agronomists who are rebuilding the relationship between farming and nature. The upcoming [Agroecology Partnership](#), as well as EU and other national research programmes can target their efforts in supporting grassroots, applied farm advisory and scientific research, led and conducted directly with farmers on the ground, at individual or landscape levels, to further advance our understanding and adoption of agroecological biocontrol.

Given its co-benefits for farm autonomy and for rural society as a whole, agroecological biocontrol has the potential to play a much greater role in implementing the **EU strategy for generational renewal**, but also in the implementation of the **Nature Restoration Regulation**, and the **Common Agricultural Policy**. To achieve the objectives of pesticides reduction, competitiveness and resilience, it is crucial that the EU and Member States not only improve the availability of not-harmful biocontrol agents purchasable on the market, but also the adoption of biocontrol practices and processes based on agroecological principles.

Bibliography

Campbell, A. J., Biesmeijer, J. C., Varma, V., & Wäckers, F. L. (2012). Realising multiple ecosystem services based on the response of three beneficial insect

- groups to floral traits and trait diversity. *Basic and Applied Ecology*, 13(4), 363–370. <https://doi.org/10.1016/J.BAAE.2012.04.003>
- Letourneau, D. K., Armbrrecht, I., Rivera, B. S., Lerma, J., Carmona, E. J., Daza, M. C., Escobar, S., Galindo, V., Gutiérrez, C., López, S. D., Mejía, J. L., Rangel, A. M. A., Rangel, J. H., Rivera, L., Saavedra, C. A., Torres, A. M., & Trujillo, A. R. (2011). Does plant diversity benefit agroecosystems? A synthetic review. *Ecological Applications: A Publication of the Ecological Society of America*, 21(1), 9–21. <https://doi.org/10.1890/09-2026.1>
- Marshall, E. J. P., Brown, V. K., Boatman, N. D., Lutman, P. J. W., Squire, G. R., & Ward, L. K. (2003). The role of weeds in supporting biological diversity within crop fields. *Weed Research*, 43(2), 77–89. <https://doi.org/10.1046/J.1365-3180.2003.00326.X;PAGE:STRING:ARTICLE/CHAPTER>
- Pretty, J., Benton, T. G., Bharucha, Z. P., Dicks, L. V., Flora, C. B., Godfray, H. C. J., Goulson, D., Hartley, S., Lampkin, N., Morris, C., Pierzynski, G., Prasad, P. V. V., Reganold, J., Rockström, J., Smith, P., Thorne, P., & Wratten, S. (2018). Global assessment of agricultural system redesign for sustainable intensification. *Nature Sustainability* 2018 1:8, 1(8), 441–446. <https://doi.org/10.1038/s41893-018-0114-0>
- Stenberg, J. A., Sundh, I., Becher, P. G., Björkman, C., Dubey, M., Egan, P. A., Friberg, H., Gil, J. F., Jensen, D. F., Jonsson, M., Karlsson, M., Khalil, S., Ninkovic, V., Rehmann, G., Vetukuri, R. R., & Viketoft, M. (2021). When is it biological control? A framework of definitions, mechanisms, and classifications. *Journal of Pest Science* 2021 94:3, 94(3), 665–676. <https://doi.org/10.1007/S10340-021-01354-7>
- Tscharntke, T., Karp, D. S., Chaplin-Kramer, R., Batáry, P., DeClerck, F., Gratton, C., Hunt, L., Ives, A., Jonsson, M., Larsen, A., Martin, E. A., Martínez-Salinas, A., Meehan, T. D., O'Rourke, M., Poveda, K., Rosenheim, J. A., Rusch, A., Schellhorn, N., Wanger, T. C., ... Zhang, W. (2016). When natural habitat fails to enhance biological pest control – Five hypotheses. *Biological Conservation*, 204, 449–458. <https://doi.org/10.1016/J.BIOCON.2016.10.001>
- van Lenteren, J. C., Bolckmans, K., Köhl, J., Ravensberg, W. J., & Urbaneja, A. (2018). Biological control using invertebrates and microorganisms: plenty of new opportunities. *BioControl*, 63(1), 39–59. <https://doi.org/10.1007/S10526-017-9801-4>
- Wäckers, F. L., & van Rijn, P. C. J. (2012). Pick and Mix: Selecting Flowering Plants to Meet the Requirements of Target Biological Control Insects. *Biodiversity and Insect Pests: Key Issues for Sustainable Management*, 139–165. <https://doi.org/10.1002/9781118231838.CH9>
- Winkler, K., Wäckers, F. L., Termorshuizen, A. J., & van Lenteren, J. C. (2010). Assessing risks and benefits of floral supplements in conservation biological

control. *BioControl* 2010 55:6, 55(6), 719–727. <https://doi.org/10.1007/S10526-010-9296-8>