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LITERATURE REVIEW ON BIOCONTROL

In her foreword to the book **Hulot, J.F. and Hiller, N. (2021) 'Exploring the benefits of biocontrol for sustainable agriculture – A literature review on biocontrol in light of the European Green Deal'**, Dr. Faustine Bas-Defossez, External Impact Director at Institute for European Environmental Policy (IEEP), states that "The science is unequivocal on the need to move rapidly towards a sustainable food and farming system in order to stay within planetary boundaries. The European Green Deal, in particular its Farm to Fork and Biodiversity strategies, aims at setting the way towards that new system of food production and consumption. As a systemic and balanced alternative to chemical inputs in farming, biocontrol is certainly an enabler of that system change.
As an independent think tank striving for sustainability and science-based policymaking, we were very enthusiastic when IBMA approached us to conduct a literature review on the benefits of biocontrol for the environment and its wider economic, climate and governance impacts. We indeed believe that such evidence is needed for informed and sound decision-making on the European Green Deal objectives implementation".

Reducing harmful pressures on the environment is key to creating a sustainable and healthy food system. The political and technical conversation about agricultural production and plant protection methods, especially in the context of the European Green Deal and the Farm-to-Fork strategy, increasingly revolves around the effects of different inputs on biodiversity and health. Biocontrol, at its core, aims at not causing harm to the environment, non-targeted species and

human health. The four technical categories of biocontrol are macro-organisms (invertebrates), micro-organisms (viruses, bacteria and fungi), semio-chemicals (pheromones) and natural substances. Compared to the typically linear vision to plant protection with chemical products, biocontrol considers the structural approach of understanding the farm ecosystem of life cycles, insects' behavior and the influence of agronomic practices on plant health. Biocontrol thereby becomes a key enabler of the European Green Deal in forming part of a system approach to sustainable agriculture. Based on a literature review, this paper explores the roles of biocontrol in a pathway towards sustainable agriculture, with both a focus on biodiversity and health and its potential wider impacts.

Drawing from the literature, biocontrol functions for plant protection and supports of biodiversity by significantly reducing the chemical pressure in the field. As a targeted measure, it has few adverse effects on non-targeted fauna and flora, thereby contributing to the maintenance and improvement of agricultural biodiversity. Soil quality and health equally benefit from decreasing harmful residues and contamination. The use of biocontrol can thereby contribute to a favorable status of microbial communities. Lower negative impacts on human health can equally be identified, where biological approaches can deliver for the safety of both consumers and farmworkers. The effectiveness of natural pest control enemies can be amplified by creating ecological focus areas. In addition, biocontrol performs best in a system of sustainable farming practices. Growing evidence for the efficacy of biocontrol products, in the EU and around the world, resulted both in a higher EU approval rate and an expected market growth for products of around 15% a year over the next five years.

The deployment of biocontrol, by incorporating farmers' experiences in the implementation process, paves the way for widespread adoption of Integrated Pest Management techniques, organic agriculture and agro-ecological farming. Based on the literature review, policy considerations include a need for a common EU definition for greater clarity in political discussions, an assessment of the legal framework, a push for greater field application and further research needs. While more research of concrete interactions between all categories of biocontrol and biodiversity support is suggested, the literature highlights the positive impact of biocontrol in lowering chemical residues, its benefits in favorable environments and its targeted use. As a non-chemical input, biocontrol can offer a systemic and balanced solution for sustainable agriculture. The video of the launching event can be viewed here: https://www.youtube.com/watch?v=B1KXR12PBoM

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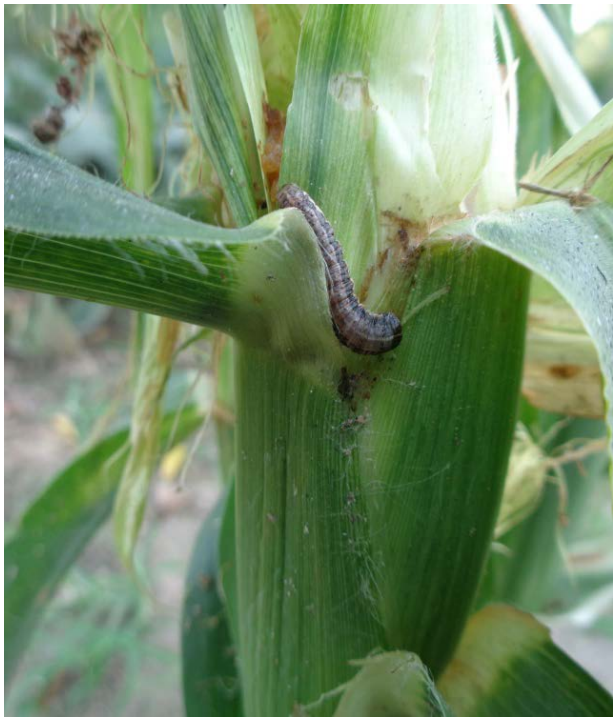
HEAVY INFESTATIONS BY INVASIVE FALL ARMYWORM (*SPODOPTERA FRUGIPERDA*) IN JAMMU

Fall armyworm (*Spodoptera frugiperda* J.E. Smith), native to the tropical regions of the western hemisphere, arrived in the southern states of India in 2018, has now slowly entered the northern

states and has become a very serious pest of maize from 2020 onwards. The pest has also been found feeding on other adjoining crops *viz.*, mungbean, urdbean, cowpea, okra, rice, grown during the season. However, the most severe attacks have been observed on maize crops. It has been recorded from all maize growing districts of Jammu region (Samba, Kathua, Jammu, Udhampur, Reasi, Poonch). Its infestations were first noticed during 2019, however during 2020, the specimen samples of the pest were collected from different locations and submitted to the National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru, India where its identity was confirmed by molecular analysis courtesy of Dr. T. Venkatasan.

Early instars were noticed feeding in the central whorl of the maize plant, thereby damaging the growing point and destroying the potential plant growth. The presence of larval frass in the central whorl along with the feeding damage are clear indications of the presence of this pest (picture on the left). Older instars move out of the central whorl and feed on the whole leaf lamina, giving it a ragged look. Larvae causing direct injury to the cob or silk have also been noticed (picture on the right). The pest was found to be active during dawn and dusk, however during daytime when temperatures were comparatively high (35 – 42ºC), the larvae were found hiding mainly inside the whorls. Maize growers of the area were quite devastated by its attack and looking for efficient control solutions.



To keep in check further spread and infestations by these pests, the following management strategies were recommended to the farmers of the region:

- Installation of pheromone traps @ 25/ha.
- Releasing egg parasitoid (3-4 releases of *Trichogramma chilonis* @ 1,00,000 adults/ha or *Telenomus remus* @ 15,000- 20,000 adults/ha) at weekly interval when 1-2 adult moths are caught in pheromone trap.
- Spray of neem oil @ 3ml/lire or 5% Neem Seed Kernel emulsion (NSKE) or azadirachtin 1500ppm @ 5ml/l water to kill eggs and neonates.

- Application of *Bacillus thuringiensis* var. *kurstaki* @ 20 ml/litre after one week of the neem spray (for early instars).
- Application of *Metarhizium anisopliae* (1×10^8 cfu/g) @ 5gm/litre for instars.
- As a last resort, any one of the chemical insecticide may be applied – Emamectin benzoate 5% SG @ 200 g a.i./ha, Emamectin benzoate 5% + Lufenuron 40% WG @ 36 g a.i./ha, Chlorantraniliprole 18.5%SC @ 40 g a.i./ha, Thiodicarb 75% WP @ 750 g a.i./ha or Spinetoram 11.7% w/w @ 30 g a.i./ha.

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IAPPS Mission: to provide a global forum for the purpose of identifying, evaluating, integrating, and promoting plant protection concepts, technologies, and policies that are economically, environmentally, and socially acceptable.

It seeks to provide a global umbrella for the plant protection sciences to facilitate and promote the application of the Integrated Pest Management (IPM) approach to the world's crop and forest ecosystems.

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