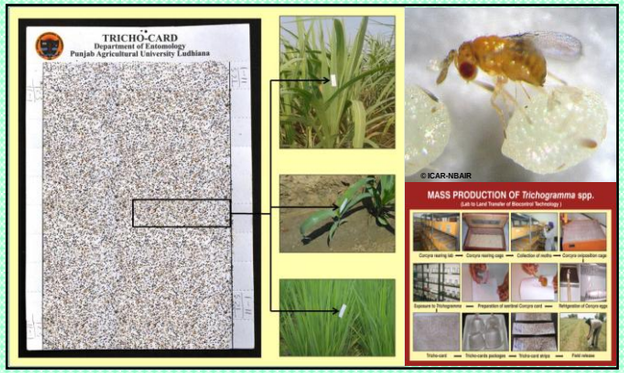
BIOCONTROL OF LEPIDOPTERAN PESTS IN SUGARCANE, MAIZE AND RICE CROPS



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Rice, sugarcane and maize are most important crops grown in *kharif* season under Punjab conditions. The losses due to insect pests are one of the major reasons for achieving optimum yield potential. Chemical insecticides are mainly used for the management of insect pests in these crops. However, the indiscriminate and broadly unscientific application of a number of different recalcitrant synthetic chemicals to control insect pests has led to many ecological backlashes. Due to this, there is renewed interest in eco-friendly approaches to pest management and rationale for bio-intensive pest management (IPM) is irrefutable

NATURE OF DAMAGE

Sugarcane: Three species of borers namely early shoot borer, top borer and stalk borer are very serious in sugarcane crop under Punjab conditions.

- **Early shoot borer (*Chilo infuscatellus*)**: It is a pest of hot and dry weather during pre monsoon period and is active from April to June only. Eggs are laid in clusters on the underside of leaves at early stage of growth. The larva enters the plant near soil level and kills the growing point resulting in dead hearts, which can be easily pulled out. These dead hearts also give offensive smell.
- **Top borer (*Scirpophaga excerptalis*)**: It remains active from March to October and has four distinct broods during the season. The 3rd brood which is most destructive occurs during July-August. Eggs are laid on undersides of leaves in clusters covered with brownish hairs. Young larva enters the mid-rib and mines toward base to reach the leaf spindle and feed on central growing leaf causing dead heart with small holes. The white streak formed in the mid rib later turns to red. As a result of feeding on growing point, buds from side sprout and bunchy tops are formed at later stage.
- **Stalk borer (*Chilo auricilius*)**: It is the most notorious pest of sugarcane which remains active throughout the year. In early stage, it causes dead hearts resembling those of early shoot borer. At later stage, the larvae make holes and migrate from one cane to another damaging several of them in due course. The attack of this pest is low in April, May and June but it increases in July and is maximum during October-November. There are no outward symptoms of its attack and entrance or exit holes are visible only after stripping of the canes. One larva can damage up to 3 nodes and a single cane may be attacked at several places.

Maize:

- **Maize stem borer (*Chilo partellus*)**: It is a key pest of maize and fodder maize which causes damage from June to September. Its larvae first scrape the leaves and then bore into the stem through the whorl or leaf sheath. The central leaves of the attacked whorl get perforated. In a young plant, the growing point is killed resulting in dead heart. The damage is critical when the growing points of young plants are completely damaged.

Organic rice: Stem borers and leaf folder are the most important insect pests of rice crop.

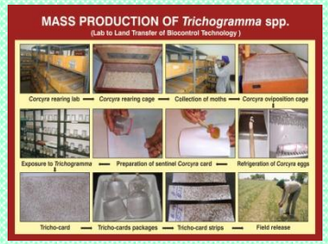
- **Yellow stem borer (*Scirpophaga incertulas*)**: It is predominant and reckoned amongst the most deleterious pests of rice in Punjab, causing significant losses in yield. The larvae bore into the stem and feed inside resulting in drying of central leaf-whorl or 'dead hearts' during vegetative stage which can be pulled out easily and formation of sterile panicles or `white ears' during reproductive stage.
- **Leaf folder (*Cnaphalocrocis medinalis*)**: The younger larvae of leaf folder feed on tender leaves without folding them. The older larvae fold the longitudinal margins of the leaf and feed inside the fold by scrapping the green matter. As a result, leaves become membranous, turn white and finally wither.

BIO-INTENSIVE MANAGEMENT

The trichogrammatids are an important group of hymenopterous parasitoids which parasitize the eggs of many insect pests especially belonging to order Lepidoptera. The adult female wasp uses chemical and visual clues to locate eggs for parasitization. It lays its eggs inside the host egg and completes its development within the host. The larva of this parasitoid feeds internally on host egg contents and finally kills the host. The parasitized eggs become black in colour and adult *Trichogramma* emerges out of these parasitized eggs. The species of *Trichogramma* have played a key role in regulating insect pest population in nature and therefore are potentially important in augmentative biological control programs against insect pests of various crops. The Punjab Agricultural University, Ludhiana has identified *Trichogramma chilonis* and *T. japonicum* for augmentative releases against various lepidopteran in sugarcane, maize, fodder maize and organic rice.

Mass Production of *Trichogramma*

The eggs of rice moth, *Corcyra cephalonica* are utilized as laboratory host for mass production of *Trichogramma* spp. The cards containing parasitized host (*C. cephalonica*) are termed as 'Tricho-cards'. The eggs of *C. Cephalonica* are treated with UV rays for 45 minutes to



prevent hatching. The white sheets are cut into cards of size 15 x 12 cm. These cards are pre-punched to facilitate cutting of pieces/ strips later on. The eggs are glued on an area of 15 x 10 cm to prepare sentinel *Corcyra* cards leaving margin of 1 cm on both sides to facilitate stapling to the leaves/ plant parts. The eggs are exposed to adult female of *Trichogramma* in the ratio of 8:1 for 24 hrs in glass jars. Each tricho-card contains about 20,000 parasitized eggs. After parasitism, 6-day old parasitized egg cards are ready for field release. These cards can also be stored in refrigerator for up to one month before field release.

Utilization of *Trichogramma*

For the eco-friendly management of lepidopteran borers, augmentative releases of egg parasitoids were validated (dose, time and frequency of releases) in sugarcane, maize, fodder maize and organic rice. These egg parasitoids can be released at farmers' fields through laboratory prepared tricho-cards.

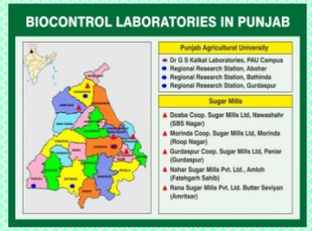
Crop	Insect pests	Bioagent(s)	Dose/ acre	Number and time of release
Sugar-cane	Early shoot borer	*Trichogramma chilonis*	20,000	Eight releases at 10 days interval from mid-April to end-June
	Top borer	*Trichogramma japonicum*	20,000	Eight releases at 10 days interval from mid-April to end-June
	Stalk borer	*Trichogramma chilonis*	20,000	10-12 releases at 10 days interval from July to October
Organic rice	Stem borer Leaf folder	*Trichogramma chilonis* *Trichogramma japonicum*	40,000 40,000	5-6 releases at 7 days interval starting from 30 days after transplanting
Maize	Stem borer	*Trichogramma chilonis*	40,000	Two releases – on 10 and 17 days old crop
Fodder maize	Stem borer	*Trichogramma chilonis*	50,000	Two releases – on 10 and 17 days old crop

Field releases

- **Sugarcane**: Cut one tricho-card having 20,000 parasitized eggs into 40 small pieces / strips (5 x 0.75 cm size), each having approximately 500 parasitized eggs. Staple these strips on underside of sugarcane leaves uniformly at 40 spots per acre.
- **Organic rice**: Cut two tricho-cards each of *T. chilonis* and *T. japonicum* into 40 small pieces / strips of 5 x 1.5 cm size, each having approximately 1000 parasitized eggs and then stapling these strips on underside of the leaves uniformly at 40 spots per acre.
- **Maize:** Cut two tricho-cards into 40 small pieces/ strips of 5 x 1.5 cm size, each having approximately 1000 parasitized eggs. Staple these strips on the underside of the central whorl leaves uniformly at 40 spots per acre.
- **Fodder maize:** Cut two and half tricho-cards into 50 small pieces/ strips of 5 x 1.5 cm size, each having approximately 1000 parasitized eggs. Place these strips in the central whorl uniformly at 50 spots per acre.

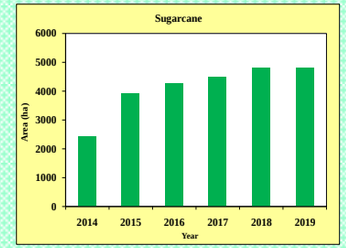
TRANSFER OF TECHNOLOGY AND IMPACT

The Department of Entomology has a well established biocontrol laboratory at PAU, Ludhiana under the aegis of AICRP (Biocontrol). Besides, PAU has also established 3 biocontrol labs at Regional stations (Abohar, Bathinda and Gurdaspur) for covering larger area under biocontrol programs. The technology regarding mass production of *Corcyra* eggs and tricho-cards has also been transferred to five sugar mills namely Nawanshahr Cooperative Sugar Mills Ltd, Nawanshahr (SBS Nagar), Morinda Cooperative Sugar Mills Ltd, Morinda (Ropar), Gurdaspur Cooperative Sugar Mills Ltd, Paniar (Gurdaspur), Nahar Sugar Mills Pvt. Ltd., Amloh (Fatehgarh Sahib) and Rana Sugar Mills Pvt. Ltd. Buttar Seviyan (Amritsar), which are successfully running biocontrol laboratories and supplying tricho-cards to sugarcane farmers in their respective areas. PAU is acting as nodal agency for the transfer of technical expertise as well as point organization for resources like nucleus cultures of bioagents and training to staff of biocontrol laboratories in the state.



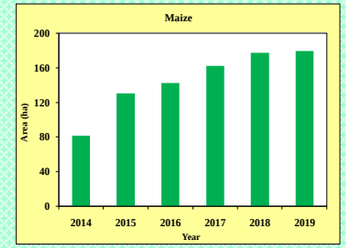
Field day on Adoption of Biocontrol Technologies

Sugarcane: Every year, BIPM practices in sugarcane are being demonstrated on large scale at farmers' fields in collaboration with Sugar Mills, Krishi Vigyan Kendras (KVKs) and Farm Advisory Service Centres (FASC). During last six years, the area covered under biocontrol in sugarcane has been increased from 2446 ha in 2014 to 4823 ha in 2019. The adoption of biocontrol based IPM technology against sugarcane borers has resulted in significant impact w.r.t 97.2 per cent increase in area, reduction in incidence of sugarcane borers (54.0 to 58.0 %) and higher yield. On an average, additional economic benefits to sugarcane farmer's in biocontrol package for early shoot borer and top borer was Rs. 18655/- and 19113/- per ha over untreated control, respectively. Against stalk borer, there are no chemical control measures; hence biocontrol is the only viable option available with sugarcane farmers' for this pest.



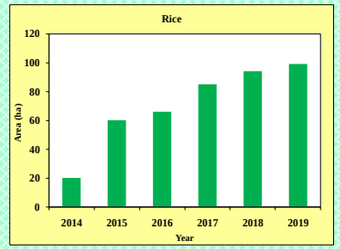
Area covered in Sugarcane (in collaboration with sugar mills)

Maize: Large scale dissemination of biocontrol technology in maize at farmers' fields has been increased 2.2 times from 81 ha in 2014 to 179 ha in 2019 resulting in 55.3 per cent reduction in the incidence of maize stem borer and gave higher grain yield and more net returns (Rs.7742/- per ha) over untreated control.



Area covered in Maize

Organic Rice: The dissemination of biocontrol based IPM technology in organic *basmati* rice involving augmentative releases of egg parasitoids, *T. chilonis* and *T. japonicum* has been increased 5.0 times from 20 ha in 2014 to 99 ha in 2019. The adoption of biocontrol technology on organic *basmati* rice has resulted in lowering the incidence of stem borer (53.8%) and leaf folder (58.6%) and higher grain yield with an additional benefit of Rs. 9468/- per ha over untreated control



Area covered in Rice

For technical guidance, tricho-cards and nucleus culture of *Corcyra* eggs & *Trichogramma*

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