# *Bacillus thuringiensis* (ICAR-NBAIR BT25) for effective management of fall armyworm in maize

Field view of maize treated with *B. thuringiensis* NBAIR BT25 showing mortality of FAW

## Technology Description

At ICAR-NBAIR, research has succeeded in identifying an effective indigenous Bt isolate, NBAIR-BT25, and further developing it into a formulation for FAW management. This isolate has been submitted to GenBank as MN327970 (AICRP-BC 2020). In a replicated trial in Orissa, a combination of *Trichogramma* sp. releases to target the egg stage followed by NBAIR-BT25 sprays to target the larval stage resulted in a green cob yield of 16.05 t/ha, significantly higher than that of the untreated control (8.14 t/ha) and comparable to that obtained with emamectin benzoate (17.54 t/ha) (AICRP-BC 2019). (Green cob yield includes the wet weight of cob + kernels + husks sold as "sweet corn" for human consumption, which would be higher than typical yields of dried corn used for grain.) The percentages of plant damage in these three treatments followed the expected trend, i.e., more damage was associated with lower yield. Additional testing will be required to confirm these effects.

## Background

*Bacillus thuringiensis* Berliner (Bt) is a bacterium that forms insecticidal proteins and other toxins, and is used as a biopesticidal spray. Most Bt crystal (Cry) toxins are specific to lepidopteran insects, and Bt strains with activity against FAW can be found all over the world. For example, Bt aizawai HD 68 and Bt thuringiensis 4412 have shown 80% and 80.4% mortality, respectively, against FAW in laboratory studies (Polanczyk et al. 2000). de Souza et al. (2009) identified Bt (israelensis type) showing toxicity to FAW ($LC_{50}$ of 76.58 µg cm−2). Similarly, Cerqueira et al. (2016) isolated four indigenous isolates from Brazilian soils having $LC_{50}$ of 44-108 ng cm−2 against FAW. Extensive surveys conducted in the southern states of Karnataka, Tamil Nadu and Andhra Pradesh to collect FAW larvae. Initially, there were no *Bt* infected larvae present as farmers used pesticides. However subsequent collections yielded few infections and isolated *Bt* was purified as per protocols of Travers *et al.* (1987) and Santana *et al.* (2008). The *Bt* isolate was identified as NBAIR-BT25 (GenBank MN327970) the culture was also certified by NBAIM, Mau (MN203620.1).

## Benefits /Utility

Field tests have shown 83-85% reduction in pest and 19-35% increase in yield.

## Scalability

It can be scaled up to large quantities using large-scale fermentors of 500-1000 litres capacity depending on the need.


A) Liquid formulation of *B. thuringiensis* NBAIR BT25 B) Preparation of BT25 biopesticides for spraying maize crops C) Spraying BT25 in maize field.

## Business and commercial potential

This technology has a wide scope of commercialization and there is a high demand for biocontrol agents for management of FAW. At present, very small quantities of microbial BCAs are produced in the country against very high demand. There is scope for label expansion of this technology for management of other lepidopteran pests like *Spodoptera litura* etc in other crops.

## Financial requirement

The cost of production of this product may around 150/- per litre and it can be sold at Rs. 500/L. An investment of 15-20 lakhs for equipment, other infrastructure etc. is required to produce 100 tonnes/ annum.

## Target Market/Customer

Though maize is emerging as an important industrial crop in India, its productivity (3.1 tonne/ha) is much lower than the world average (5.62 tonne/ha). The fall armyworm, a polyphagous insect, is an invasive pest of maize posing a serious threat to maize cultivation in India. FAW can cause up to 33% yield loss. This technology will be highly useful to maize growers in the country especially for farmers in Tamil Nadu, Andhra Pradesh, Telangana, Orissa, Karnataka, Maharashtra, Uttar Pradesh etc.

## Social Impact of the Technology

- This ICAR-NBAIR technology is an ecofriendly strategy for obtaining healthy and robust maize crop resulting in the reduced usage of chemical insecticides against FAW and thereby minimize the risks associated with insecticides on environment and non-target organisms including human beings.

## Toxicology data

- Toxicology data for primary culture and liquid formulation of *Bacillus thuringiensis* ICAR-NBAIR BT25 is proposed generated as per CIBRC guidelines in future.