Biointensive Management of FAW: Indian perspective

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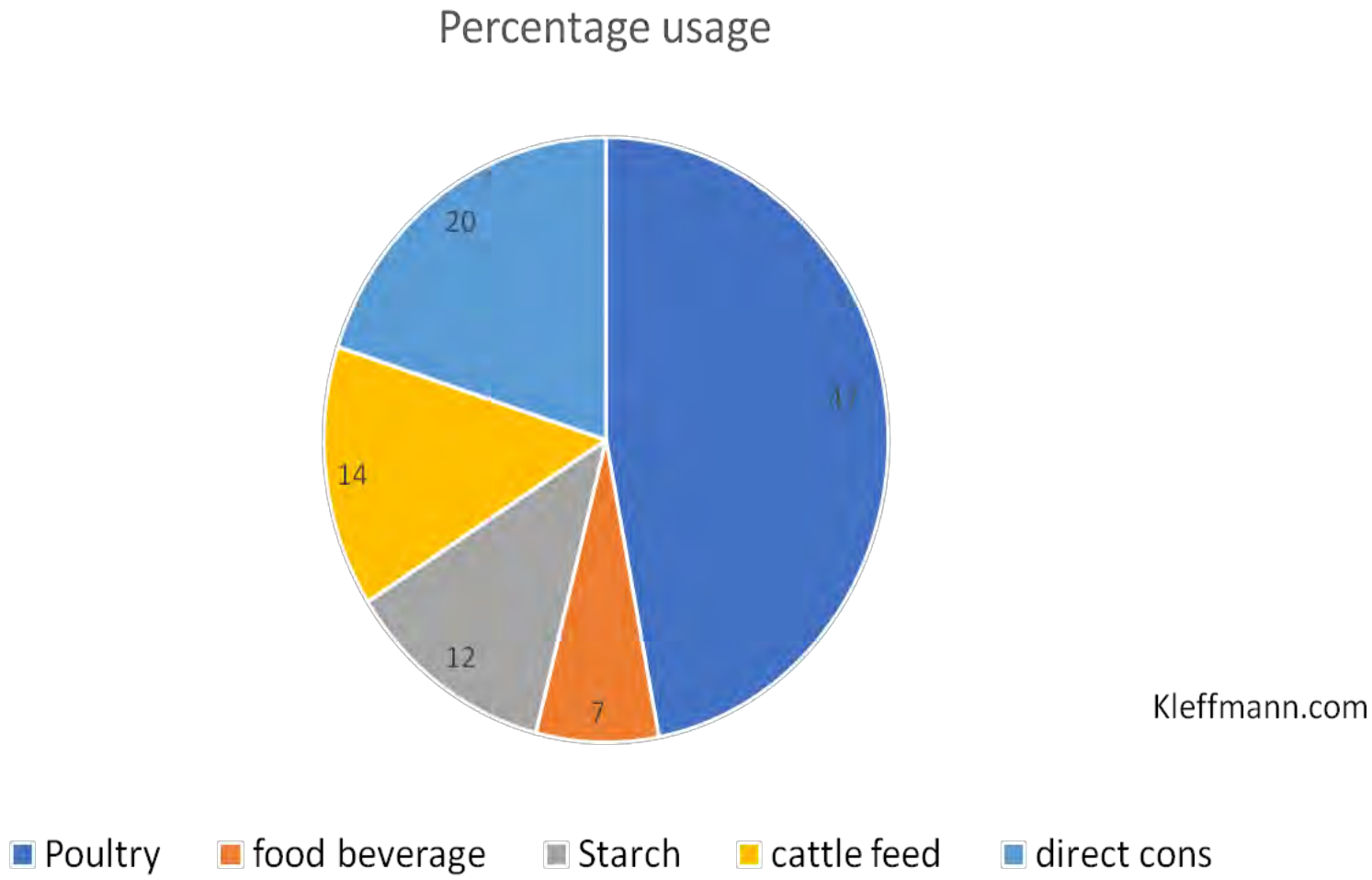
India and Corn (maize)

- Area 9.47 million Ha(2017-18) production 27.5 million metric tonnes,
- Productivity 3.121 t/ha,
- Third major cereal after rice and wheat
- Grown throughout the year

  Kharif (sowing in June- July)

  Rabi (sowing in October to November)
- Summer (after February)
- kharif yield is 2.3t/ ha Rabi yield 4.0 t/ha

Consumption pattern of maize in India



First recorded in 2018 in India in southern most part (see arrow)

At present spread to all the states except Jammu and Kashmir States
First recorded on maize

Later on sorghum,

Occasionally on sugarcane
Reports on cotton and rice

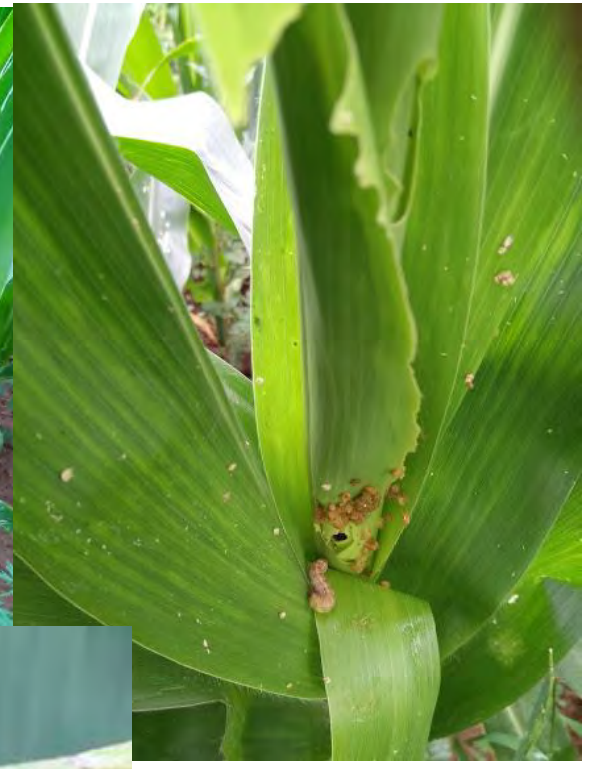
Cobs also damaged occasionally

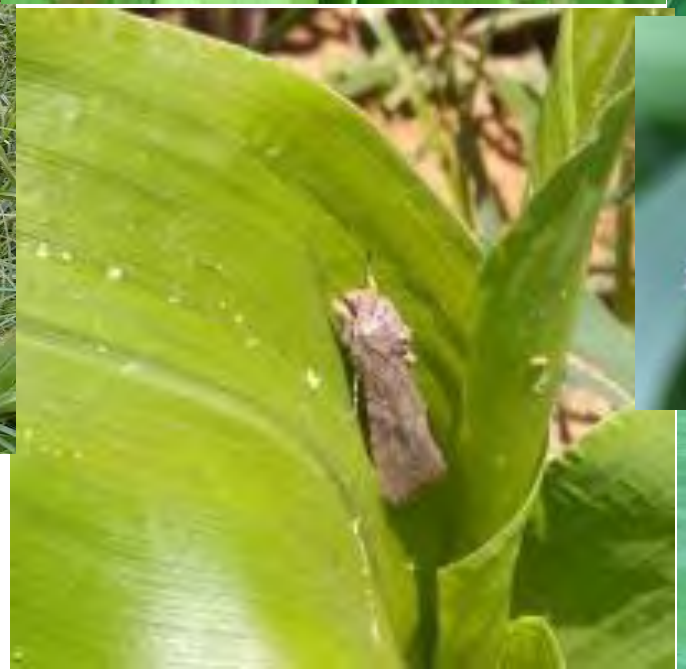
The incidence was earlier (2018) upto 70% plant damage.

In 2019 damage was considerably low (20-30%).

Fall armyworm






FAW on sorghum

Natural enemies recorded on fall armyworm (FAW) in India

Telenomus remus

Trichogramma chilonis

S.No	Scientific name	Taxonomic position	Biological attribute	Collection locality	Reference
1	*Telenomus* sp.#	Hymenoptera: [illegible]	Egg parasitoid	Karnataka and Tamil Nadu	Shylesha et al. 2018
2	*Trichogram[illegible]*	[illegible]mmatida e	Egg parasitoid	Karnataka	Shylesha et al. 2018
3	*Chelonus* sp.	Hymenoptera: Braconidae	Egg-larval parasitoid	Karnataka and Telangana	Present report
4	*Chelonus formosanus* Sonan	Hymenoptera: Braconidae	Egg-larval parasitoid	Karnataka and Telangana	Gupta et al. 2020
5	*Coccygidium transcaspicum*	Hymenoptera: Braconidae	Larval parasitoid	Karnataka and Telangana	Gupta et al. 2020
6	*Cotesia ruficrus* (Haliday)	Hymenoptera: Braconidae	Larval parasitoid	Karnataka, Tamil Nadu, Rajasthan, Uttar Pradesh, Punjab, Meghalaya	Gupta et al. 2019

7	***Glyptapanteles creatonoti* (Viereck)**	**Hymenoptera: Braconidae**	**Larval parasitoid**	**Karnataka**	**Shylesha et al. 2018**
8	*Campoletis chlorideae* Uchida	Hymenoptera: Ichneumonidae	Larval parasitoid	Karnataka	Shylesha et al. 2018 and Sharanabasappa et al. 2019
9	*Eriborus* sp.	Hymenoptera: Ichneumonidae	Larval parasitoid	Karnataka	Sharanabasappa et al. 2019
10	*Odontepyris* sp.	Hymenoptera: Bethylidae	Larval parasitoid	Tamil Nadu	Sharanabasappa et al. 2019
11	*Phanerotoma* sp.	Hymenoptera: Braconidae	Larval parasitoid	Karnataka	Present report
12	*Exorista sorbillans* (Wiedemann)	Diptera: Tachinidae	Larval parasitoid	Karnataka	Sharanabasappa et al. 2019
13	*Trichomalopsis* sp.	Hymenoptera: Pteromalidae	Pupal parasitoid	Karnataka	Present report
14	*Forficula* sp.	Dermaptera: Forficulidae	Predator	Karnataka	Shylesha et al. 2018 and Sharanabasappa et al. 2019
15	*Harmonia octomaculata* (Fabricius):	Coleoptera: Coccinellidae	Predator	Karnataka	Sharanabasappa et al. 2019
16	*Coccinella transversalis* Fabricius	Coleoptera: Coccinellidae	Predator	Karnataka	Sharanabasappa et al. 2019

Survey in Anantapur (14° **56′ N, 77° 03′ E)**

Natural Percent parasitism (Southern India)

Parasitoid	Percent parasitization	Percent parasitization
	2018-19	2019-20
Trichogramma chilonis	3.7-12.43	10.23-14.56
Telenomus remus	1.8-9.4	8.0-11.6
Chelonus spp.	0.2-1.4	18-20

ICAR-NBAIR Report

In North-East, a total of 56.6% to 73.1% of larvae were found to be either parasitized or infected with naturally occurring entomopathogens.

Firake and Behere, 2020

Egg parasitoids

Trichogramma chilonis

Trichogramma pretiosum

Telenomus remuns

Rearing of egg parasitoids

- *Trichogramma chilonis & T. pretiosum*
- *T. pretiosum –introduced in 1964 from USA*
  - Reared on the *Corcyra cephalonica* eggs which in turn are produced on the broken sorghum grains – 50 trichocards per day-depending on the indent
  - Prepared in cards with around 16000 nos, cut into 16 pieces and strappled on the underside of the leaf at the time of emergence

  - *Telenomus remus* :
    - Exotic parasitoid- introduced in India in 1963 for the management of *Spodoptera litura*- a sporadic pest on crops-especially on castor and tobacco nurseries
    - Mass reared on eggs of *S. litura* –capacity less 6000- 8000 perday

Ex situ conservation of Natural enemies adapted to FAW in India

Trichogramma chilonis

Indigenous

Trichogramma pretiosum

Exotic

Telenomus remus

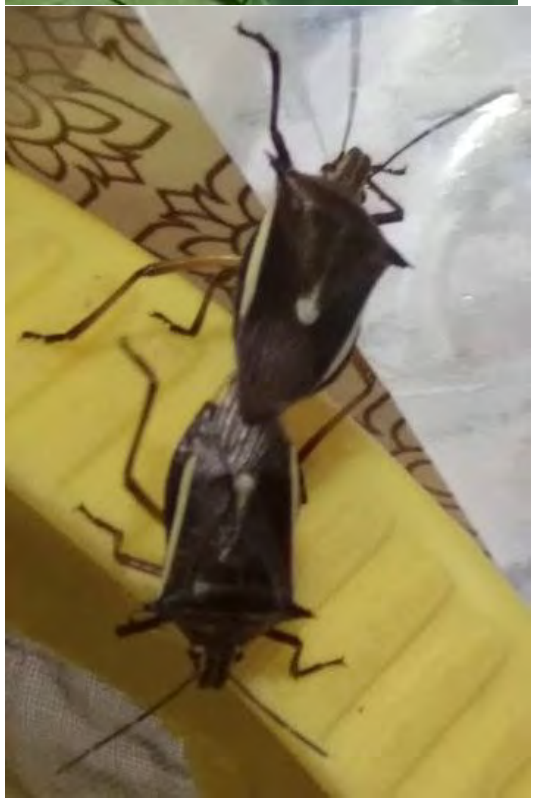
Exotic

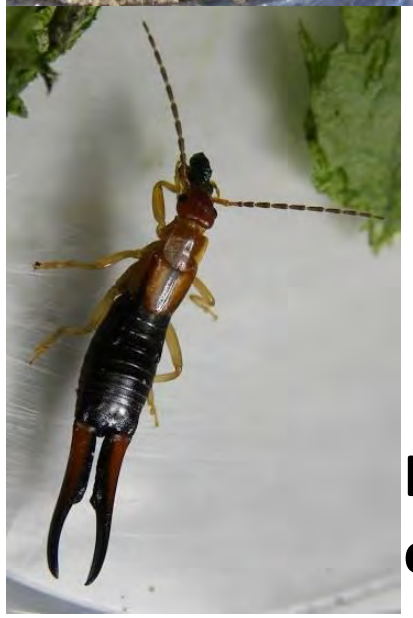
Chelonus formosanus

Indigenous

Egg larval parasitoid *Chelonus formosanus*

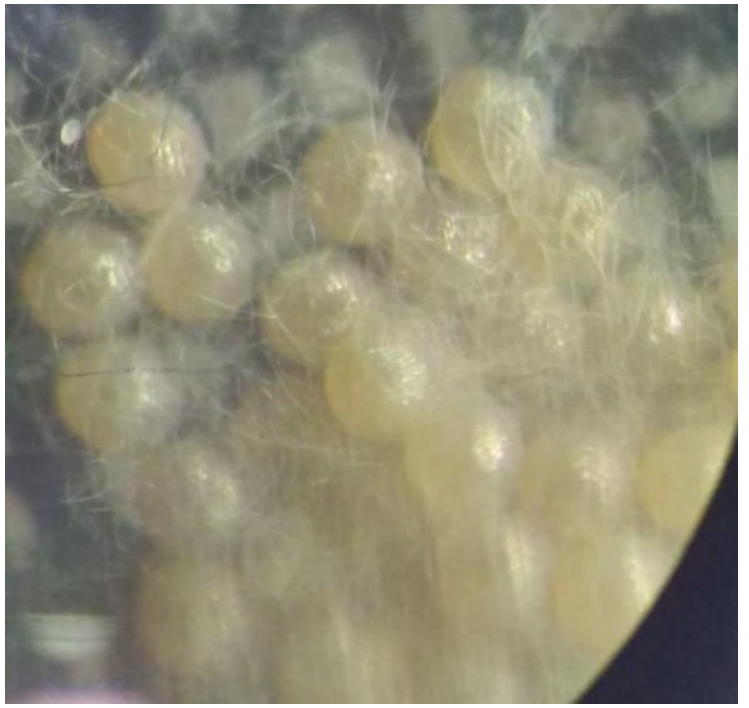
Predators *Andrallus spinidens* and *Eocanthecona* sp.





Ear wig a good predator on early stage larvae

Pseudogaurax anchora (Loew)



Beauveria felina















Quantification of Natural occurrence of microbial pathogens of FAW at Chikkaballapura district

Fungal pathogens : 74.07 %
Bacterial pathogens : 9.87%
NPV : 13.58%
Others : 3.70%

NPV infected Sf larvae Collected from maize fields



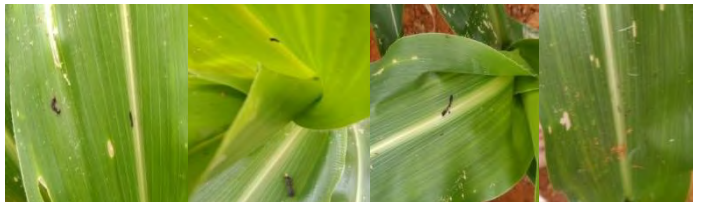

NPV infected Sf larvae Collected from sugarcane fields




Bacillus thuringiensis (NBAIR-BT25) identified for *Spodoptera frugiperda* (FAW) management

Liquid formulation developed and evaluated in field

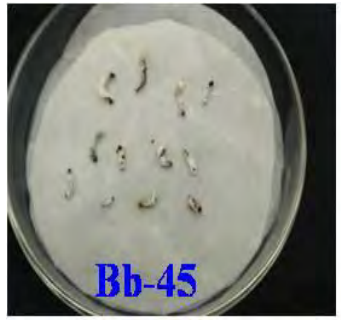
1. **Field trial in Maize (*Rabi*) – at farmer's field Chikkaballapura, showed 85% decrease in pest incidence over control**
2. **At NBAIR research farm 88% decrease in pest incidence over control.**
3. NBAIR-BT25 was able to reduce (76% in Karnataka (Bommanahalli) and 70% in (Hindupur, A.P.) larval population during *Kharif* season.



Entomopathogenic fungi against Fall army worm

Lab Bioassay: Ten EPF isolates of *B. bassiana, M. anisopliae & N. rileyi*

Isolate	% Mortality
NBAIR Ma-35	67.8
NBAIR Bb-45	64.3
NBAIR Bb-11	57.1

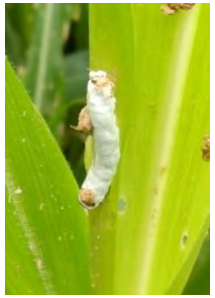


Field trials with Bb-45 & Ma-35 against FAW in Maize

Three foliar sprays @ 5g/litre ($1x10^8$ spores/g) at 15days interval

- **Yelahanka attur farm: 79-80% of pest reduction**
- **Dodaballapur : 55-65% of pest reduction**
- **Gowribidanur : 69-79% of pest reduction.**

Beauveria felinae

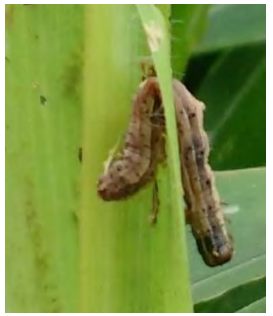










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NPV infected Sf larvae from sugarcane fields




NPV infected *Sf* larvae Collected from maize fields






SpfrNPV evaluation trials

During Kharif 2019
68.96 % pest reduction was observed when SpfrNPV was sprayed @ 1.5×10^{12} POBs/ha

During Rabi 2019
82.85 % pest reduction was observed when SpfrNPV was sprayed @ 1.5×10^{12} POBs/ha

Entomopathogenic nematodes for the management of *S.fruigperda*

Entompathogenic nematodes *Heterorhabditis indica*
NBAIR strain NBAII101
4-6 kg per ha

WP-EPN damage 4-6 leaves Plant recovery 92%

WG-EPN damage 6-8 leaves Plant recovery 90%

Emamectin benzoate damage 4-6 leaves , plant recovery 94%

IPM trial to manage fall armyworm at Manchanahalli, Gauribidnaur, Karnataka covering 1.5 acre area.

Following IPM interventions were made:

•Pheromone traps: 20 days after transplanting @ 10 traps/acre

•Release of egg parasitoids: *Trichogramma pretiosum* (60,000 to 1,00,000 adults/acre):

total 4 releases at weekly interval from 20 days old crop onwards

• Neem oil (3 ml/litre) : 1 spray after 1 week of first release of egg parasitoids and other

spray at 60 DAS.

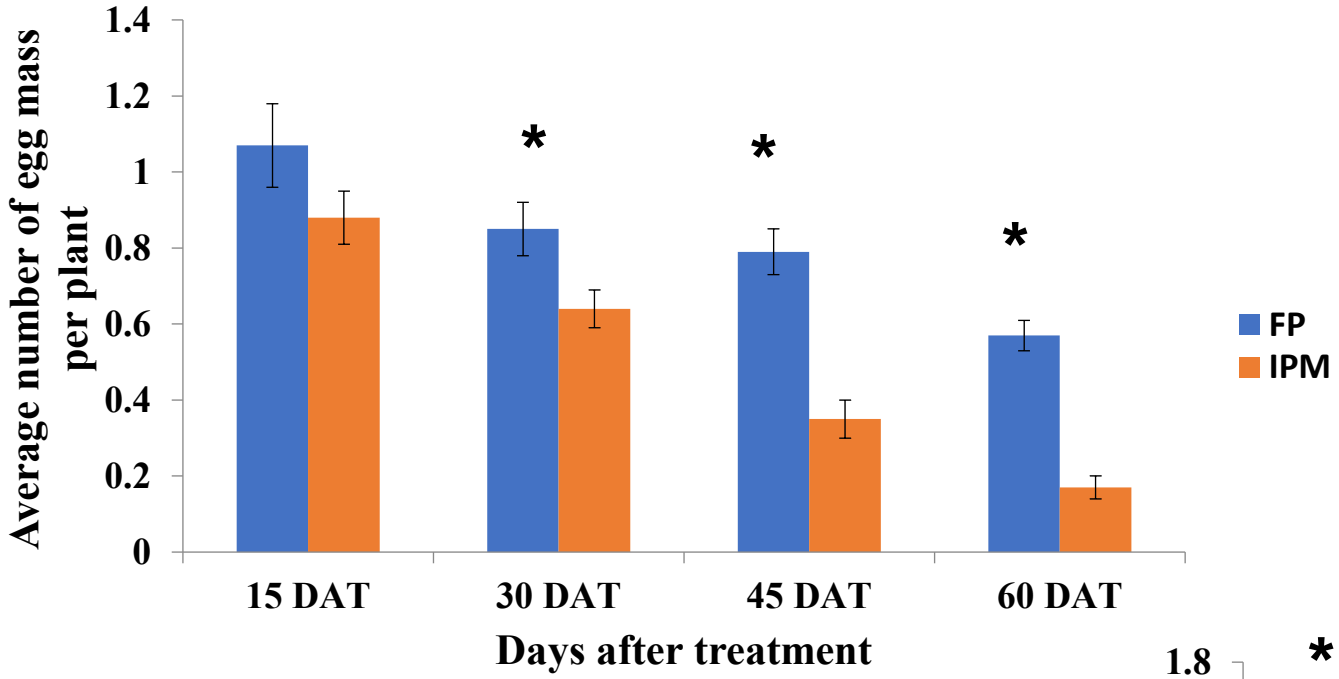
•Bt spray (2%) : only 1 spray after 15 days of first neem oil spray

•*Metarhizium anisopliae* (Ma-35) (5gm/litre) : only 1 spray after 10 days of Bt

Control plot

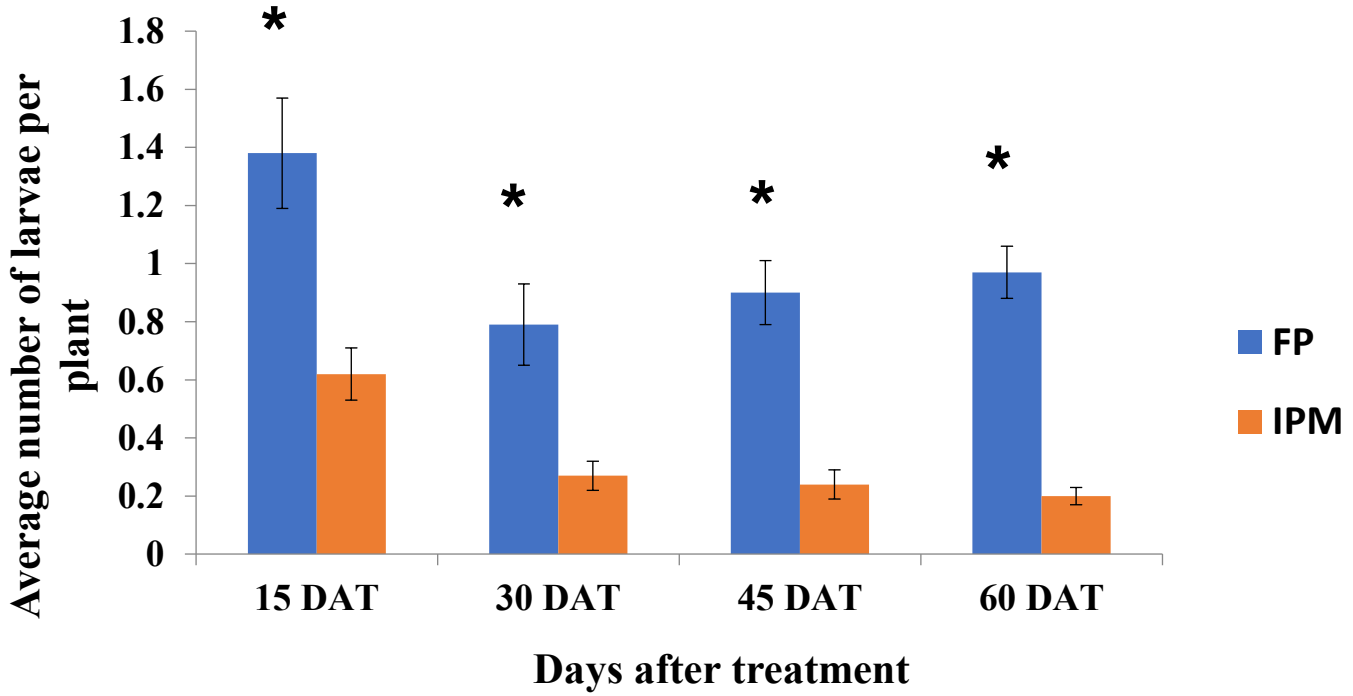
IPM field

Manchenahalli, Gauribidanur (1.5 acre area) (13° **28′ N, 77° 72′ E)**



Effect of biocontrol based IPM practices and farmer's practice on average number of egg mass per plant in both the treatments at 15, 30, 45 and 60 DAT during kharif (2019). Data represent mean ±SE, statistical differences are based on independent *t* test (*P*<0.05; *n*= 20)

Effect of biocontrol based IPM practices and farmer's practice on average number of larvae per plant in both the treatments at 15, 30, 45 and 60 DAT during kharif (2019). Data represent mean ±SE, statistical differences are based on independent *t* test (*P*<0.05; *n*= 20)



Large plot trial

Large plot trial for around 70 acres in two villages with above treatments is under way
The results are encouraging

Conclusion

- The natural enemy complex in India on *S. frugiperda* is very good. Search for native natural enemies
- Natural parasitization on the eggs and larvae are very high
- *Metarhizium rileyi* infection in certain pockets is very high
- Integrated management involving the natural enemies along with one or two sprays of neem proved very effective
- Do not abandon the crop
- Do not use overdose of synthetic insecticides
- Adequate mass production units needed to be developed for covering larger areas under biological control


THANK YOU
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