
WELCOME

COURSE SEMINAR (ENT – 699)
ON
"Fall armyworm, *Spodoptera frugiperda*, J.E.Smith : A threat for local farmers in *Kharif* season."

Submitted By

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CONTENTS

- Introduction
- Host range of fall armyworm in India
- Life history
- Nature of damage
- How to differentiated between damage by stem borer and fall armyworm
- FAW management List of natural enemies *Spodoptera frugiperda* in the maize field in India
- Integrated pest management
- Conclusion
- Refrences

INTRODUCTION

- Till 2015, the Fall Armyworm remained confined to America.
- FAW was first reported in West Africa in January 2016 (Goergen *et. al.*, 2016) and has spread to more than 40 countries across Africa (Prasanna *et. al.*, 2018).
- In May 2018, this highly invasive insect pest was noticed for the first time in India on the maize crop in the Shivamogga and Davanagere districts of Karnataka state (Sharanabasappa *et. al.*, 2018) and subsequently reported by Ganiger *et. al.*, (2018) and Shylesha *et. al.*, (2018)

Conti....

- The ICAR-National Bureau of Agricultural Insect Resources, Bengaluru has reported the damage intensity of FAW as 9 to 62% with the yield loss of 34% in Karnataka.
- Fall armyworm is highly migratory in nature and has high fecundity, wide range of host plants, and voracious feeding behaviour, without diapause.
- These characteristics make the fall armyworm a major destructive crop insect pest.

- Common Name: - Fall Armyworm
- Scientific Name: - *Spodoptera frugiperda* (J.E.Smith)
- Family- Noctuidae
- Order- Lepidoptera
- Host plant- Mainly grows on Maize but eats on additional 186 plant species like Rice, Sorghum, Sugarcane and many vegetables.
- Native to- Tropical and subtropical regions of America.

HOST RANGE OF FALL ARMYWORM IN INDIA

S.No.	Common Name	Scientific Name	Family
1.	Maize	*Zea mays*, L.	Poaceae
2.	Fodder maize	*Zea mays*, L.	Poaceae
3.	Sorghum	*Sorghum bicolor*, L.	Poaceae
4.	Finger millet	*Eleusine coracana*, L.	Poaceae
5.	Pearl millet	*Pennisetum glaucum*, L.	Poaceae
6.	Barnyard millet	*Echinochloa frumentacea*, Link	Poaceae
7.	Sugarcane	*Saccharum officinarum*, L.	Poaceae
8.	Para grass	*Brachiaria mutica*, Forssk.	Poaceae
9.	Guinea grass	*Megathyrsus maximus*, Jacq.	Poaceae
10.	Green amaranth	*Amaranthus viridis*, L.	Amaranthaceae
11	Sugar beet	*Beta vulgaris*, L.	Amaranthaceae

Source: Deshmukh *et. al.*, 2021

LIFE HISTORY

Fall armyworm takes about 30 days to complete its life cycle on maize in warm summer months; however, in cooler temperatures, it may extend up to 60–90 days (**Prasanna *et. al.*, 2018**).

Egg-

- The female adult lays about 1000 eggs (fig. a) in clusters on below or above the leaf surface of the maize plant**.**
- The eggs are ventrally flattened.
- Immediately after laying, the eggs are of light green in colour for a day and then turn to golden yellowish and finally to black colour before hatching.
- Egg hatching may take from 2 to 3 days.

(a)

Larva-

- There are six larval instars with 14–19 days of larval duration, and colour changes from instar to instar.
- First instars are green with a black head but it turns greenish brown during second instar (fig. b).
- From third instar onward, larvae turn brown with three dorsal and lateral white lines (**Prasanna *et. al*., 2018; Sharanabasappa *et. al*., 2019,)**

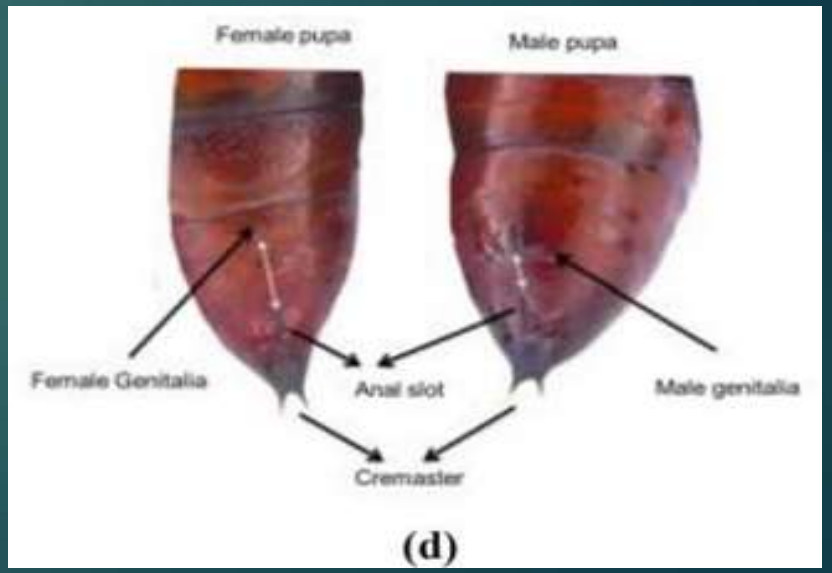
(b)

Pupa-

- Pre-pupa stops feeding and turns bright brown during pupal stages (fig. c) .
- Pupation takes place in the soil, and pupal period ranges from 9 to 12 days.
- Pupal sexing can be done by looking at the genital opening.
- The distance from the genital opening to the anal slot can be used to distinguish the female and male pupa(fig. d).

The distance from the genital opening to the anal slot is more in female pupa than in the male pupa .

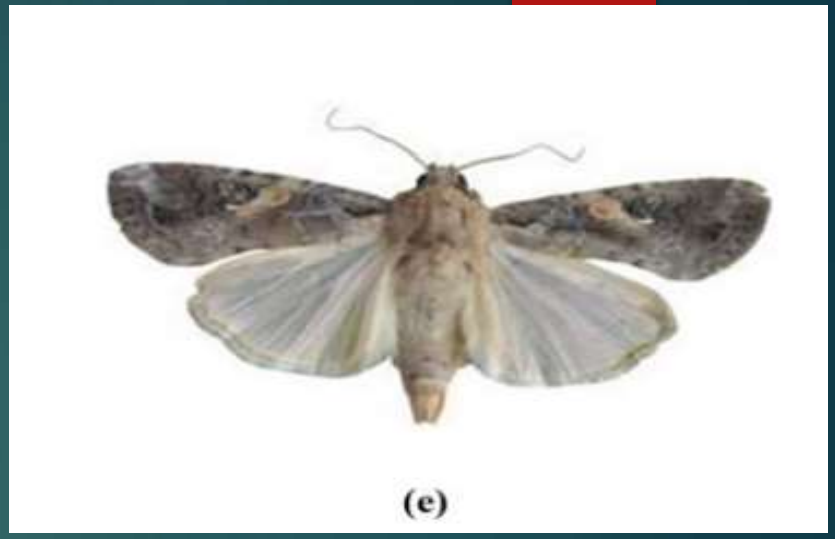
(c)



(d)

Adult-

- The adult longevity includes preoviposition, oviposition and post-oviposition periods ranged from 3 to 4, 2 to 3, and 4 to 5 days, respectively.
- The total life cycle of male and female fall armyworm ranges from 32 to 43 and 34 to 46 days, respectively .
- The average wingspan of female is 3.20 cm with a range of 3.00 to 3.4 cm, while it is 3.25 cm with a range of 3.00 to 3.50 cm in male (**Sharanabasappa *et. al.*, 2018**).



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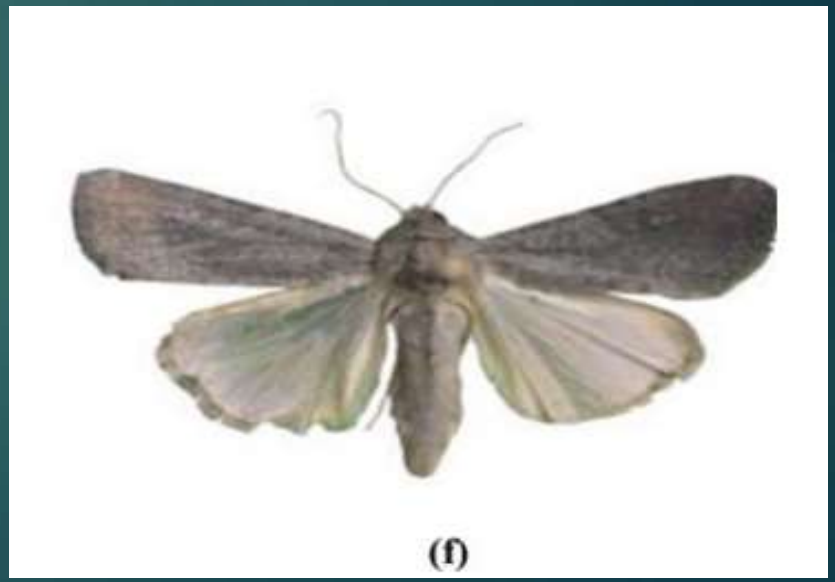


(f)

NATURE OF DAMAGE

- Early instars (1–3 instar stages) feed on the leaves, causing whitish patches appearing as “scratches” on the leaf surface
- Grown-up caterpillars feed on leaf tissues resulting in ragged and elongated holes on leaves leading to sickly appearance.
- A very diagnosable symptom of attack is the presence of lumps of faecal matter in the whorls.
- When two larvae are found in a single whorl, their feeding sites are different because in fall armyworm cannibalism is noticed.

Fig. (a) *Fall armyworm feeding on cob).* ***(b)*** *Maize.* ***(c)*** *Sorghum.* ***(d)*** *Pearl millet (Photo: Jaba J).* ***(e)*** *Sugarcane*

How to differentiate between damage by stem borer and fall armyworm ?

Stem borer damage	Fall armyworm damage
• Big holes on leaves are not present .	• FAW's larvae usually leaves big holes.
• Dead heart formation with a stinky smell.	• No stinky smell.
• Old larvae are usually found on maize stem rather than whorl, leaving hole in stem and visible frass.	• Old larval stages remains in whorl itself.

FAW MANAGEMENT

Preventive Methods

❖Monitoring-

Installation of pheromone traps @ 5/acre in the current and potential area of spread in crop season and off-season.

❖Scouting-

➢At Seedling to early whorl stage (3-4 Weeks after emergence)- Action can be taken if 5 % plants are damaged.

➢At Mid whorl to late whorl stage (5-7 weeks after emergence) –Action can be taken if 10 % whorls are freshly damaged in mid whorl stage and 20% whorl damage in late whorl stage

❖Cultural control

- Summer ploughing in deep to expose pupae of FAW to predatory birds, heat *etc*.
- Control is largely achieved in the northern and central India through a winter kill by exposing larvae and pupae within the upper soil surface. Freezing temperatures cause high larval mortality.
- Dig trench around the field and fill with water and insecticide to avoid migration of FAW larvae from one to another field.

❖**Mechanical control-**

➢Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosine water.

➢Application of Sand + lime in 9:1 ration in whorls in first thirty days of sowing.

➢Install FAW pheromone trap @ 5 numbers/ac and light trap @ 1number/ha at early stage of crop

➢Biological control-

➢*In situ* protection of natural enemies by habitat management: Increase the plant diversity by intercropping with pulses, oil seeds and ornamental flowering plants which help in build-up of natural enemies.

➢Augmentative release of egg parasitoid *Trichogramma pretiosum* or *Telenomus remus* @ 50,000 per acre at weekly intervals or based on trap catch of 3 moths/trap.

➢Bio-pesticides: If infestation level is at 5% damage in seedling to early whorl stage and 10% ear damage, then use following entomopathogenic fungi and bacteria: *Metarhizium anisopliae*, *Nomuraea rileyi*, *Beauveria bassiana*, *Verticilium lecani* (1 × 108cfu/g) @ 5g/litre whorl application. Repeat after 10 days if required.

List of natural enemies recorded on *Spodoptera frugiperda* in the maize fields in India

S. No.	Scientific name	Order: family	Nature of natural enemy
1	*Trichogramma sp.*	Hymenoptera: Trichogrammatidae	Egg parasitoid
2	*Telenomus remus Nixon*	Hymenoptera: Platygastridae	Egg parasitoid
3	*Chelonus formosanus Sonan*	Hymenoptera: Braconidae	Egg-larval parasitoid
4	*Coccygidium melleum (Roman)*	Hymenoptera: Braconidae	Endo-larval parasitoid
5	*Coccygidium luteum (Roman)*	Hymenoptera: Braconidae	Endo-larval parasitoid
6	*Coccygidium transcaspicum (Kokujev)*	Hymenoptera: Braconidae	Endo-larval parasitoid
7	*Campoletis chlorideae Uchida*	Hymenoptera: Ichneumonidae	Endo-larval parasitoid
8	*Eriborus sp.*	Hymenoptera: Ichneumonidae	Endo-larval parasitoid
9	*Exorista sorbillans (Wiedemann)*	Diptera: Tachinidae	Endo-larval parasitoid
10	*Odontepyris sp.*	Hymenoptera: Bethylidae	Larval parasitoid
11	*Cotesia ruficrus (Haliday)*	Hymenoptera: Ichneumonidae	Larval-pupal parasitoid
12	*Forficula sp.*	Dermaptera: Forficulidae	Predator
13	*Harmonia octomaculata (Fabricius)*	Coleoptera: Coccinellidae	Predator

14	*Coccinella transversalis Fabricius*	Coleoptera: Coccinellidae	**Predator**
15	*Eocanthecona furcellata Wolff.*	Hemiptera: Pentatomidae	**Predator**
16	*Andrallus spinidens (Fabr.)*	Hemiptera: Pentatomidae	**Predator**
17	*Spodoptera frugiperda Nucleopolyhedrovirus*	Baculoviridae	**Entomopathogen**
18	*Metarhizium rileyi (Farlow) Samson*	Ascomycota: Clavicipitaceae	**Entomopathogen**
19	*Bacillus thuringiensis*	Bacillales: Bacillaceae	**Entomopathogen**
20	*Beauveria bassiana*	Hypocreales: Cordycipitaceae	**Entomopathogen**
21	*Beauveria felina (DC.) J.W. Carmich.*	Hypocreales: Cordycipitaceae	**Entomopathogen**
22	*Heterorhabditis indica , Poinar, Karunakar, David*	Rhabditida: Heterorhabditidae	**Entomopathogenic nematode**

Source: Deshmukh *et. al.*, 2021

❖Chemical control-

➢Seed treatment: Cyantraniliprole 19.8% + Thiamethoxam 19.8% FS @ 6 ml/kg of seed will be effective for 15-20 days.

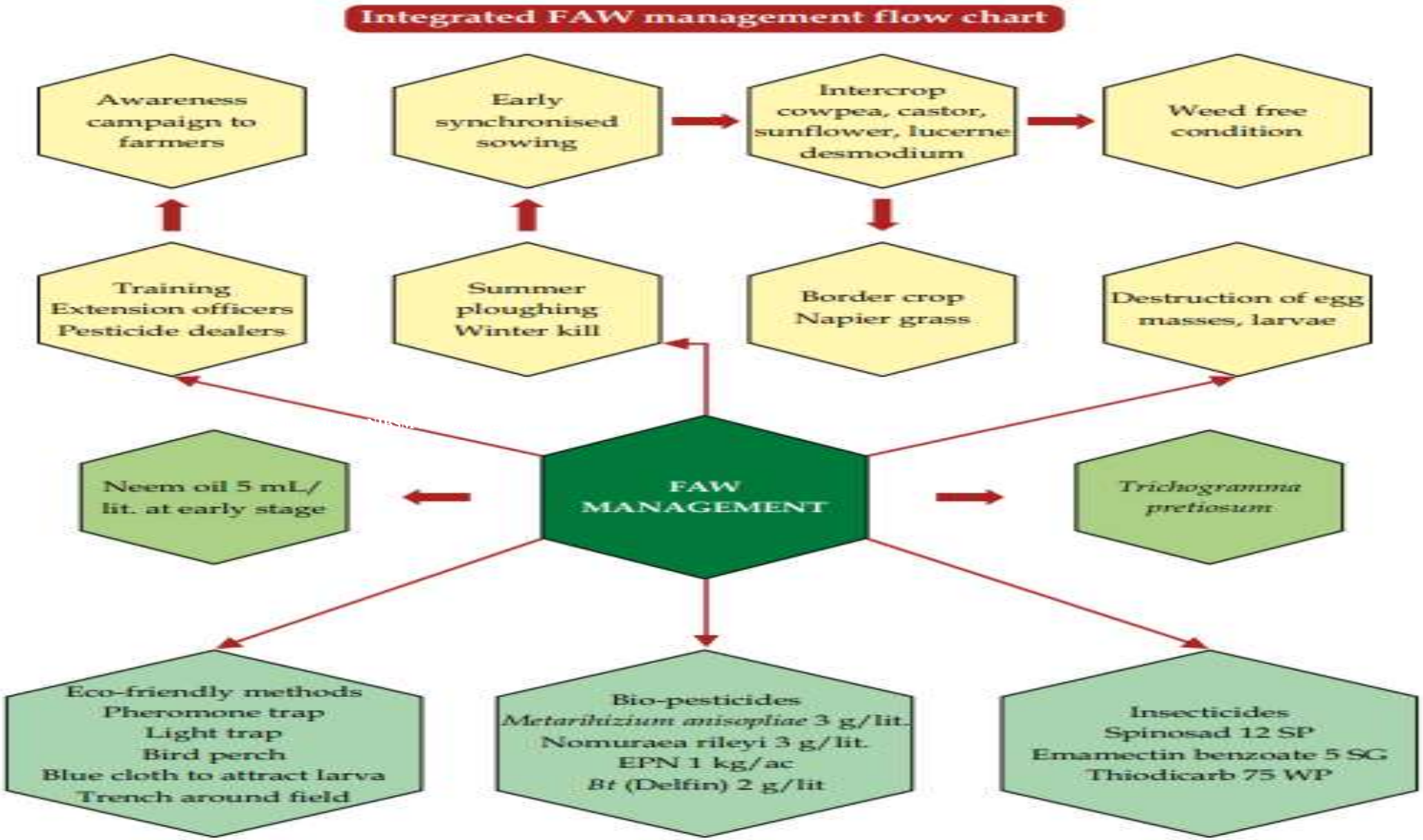
➢To control FAW larvae at 5% damage to reduce hatchability of freshly laid eggs, spray 5% NSKE /Azadirachtin 1500ppm / neem oil @ 5ml/l of water.

➢ To manage 2nd and 3rd instars larvae having more than 10% foliar damage the following chemicals may be used up to early tasselling stage: Spinetoram 11.7% SC or Chlorantraniliprole 18.5% SC or Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC.

Source: ICAR, NIBSM New Delhi (2019)

INTEGRATED PEST MANAGEMENT (IPM)

- The aim of IPM is to economically reduce the pest populations using suitable techniques and methods that minimize hazard to the environment, including people. IPM requires the farmers or farm advisors to have significant knowledge of agronomic and pest management approaches to implement an effective program based on local farming conditions (**Prasanna *et. al.*, 2018**).
- An effective IPM strategy for control of FAW will employ a toolbox approach, with different tools used in combination based on the cropping system, availability of technologies, and socioeconomic conditions of the farming communities.



Source: ICAR, NIBSM New Delhi (2019)

CONCLUSION

- Within a short span of 3–4 years, fall armyworm has spread to several countries across Africa and the Asia-Pacific, causing huge damage to the crops, especially maize, sorghum, and pearl millet in particular affecting the food surety, income, and subsistence of million farmers.
- In summary, fall armyworm poses a complex challenge and needs to be managed through well-coordinated, inter-institutional, and multidisciplinary efforts.

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Thank You