Bal Krishna, Rakesh Kumar, Jaipal Singh Choudhary, Ram Kumar and Hansraj Hans*

Insect pests in okra agro-ecosystem and their integrated management

Okra (*Abelmoschus esculentus*) is a high fibre vegetable with many valuable nutrients and medicinal properties. Okra crop is attacked by several insect pests, among them, shoot and fruit borer, whitefly, jassid, red cotton bug, red spider mite are common, and causes severe economic losses. Therefore, it is noteworthy to describe the damage symptoms, mark of identification and management practices of these major insect pests of okra.

OKRA (*Abelmoschus esculentus* L. Moench) belonging to the family Malvaceae, is an important vegetable crop grown throughout India. West Bengal has the maximum area under okra followed by Bihar. Okra is high fibre food, with many valuable nutrients. Nutrient contents of okra are 0.2 g fat, 7.5 g carbohydrate, 3.2 g fibre, 1.9 g protein, 1.5 g sugar, 82 mg Ca, 57 mg Mg, 299 mg K, 7 mg Na, 23 mg vitamin C, 0.2 mg thiamine, 0.2 mg vitamin B_6, 60 µg folate, 716 IU vitamin A and 31.3 mg vitamin K, respectively. Most abundant vitamin in okra is vitamin K which helps in blood clotting. Iodine content of okra provides protection from goitre. Okra fruit is mainly used as green vegetable; however, roots and stems are used for clearing cane juice in preparation of gur/jaggery. Like other crops, okra is prone to wide array of biotic and abiotic factors. Among biotic factors, insect pests are of utmost importance. Okra is attacked by more than 72 insect pests, in which shoot and fruit borer (*Earias vittella* and *Esrias insulana*), jassids (*Amrasca biguttula biguttula*), aphid (*Aphis gossypii*), whitefly (*Bemisia tabaci*), fruit borer (*Helicoverpa armigera*), red spider mite (*Tetranychus cinnabarinus*) and thrips (*Thrips palmi*) are the most dangerous pests.

Shoot and fruit borer, *Earias vittella* (Fabricius) (Lepidoptera: Noctuidae)

Adult moths are ~ 1 cm in length. Wings have light greenish band with white margin. Female moth lays 2 or 3 sky blue round eggs either on buds, petals, flowers, fruits or anywhere on tender plant parts. Larva of *E. vittella* is light brown with white patches on dorsal portion. Pupa is covered inside a cream-coloured cottony cocoon, becomes full grown within 7-8 days. Infestation starts at 45-50 days, after sowing of crop. Before fruiting, the larva bores inside tender shoot and tunnel downwards, the infested shoots finally dry. During reproductive stage of crop plant, larvae feed on developing buds, flowers, and tender fruits. Fruits become distorted and are rendered unfit for human consumption.

Management

To prevent the crop from shoot and fruit borer infestation, following preventive measures should be applied:

- Use of resistant varieties such as AE 57, PMS 8, Parkins Long Green, PKX 9275, Karnul special.
- Clean cultivation and destruction of alternative weed host plant of *E. vittella* i.e *Chrozophore rottlari*.

Shoot damage by *E. vittella* caterpillar

Distorted fruit

Larvae of *Earias vittella*

Adult of *Earias vittella*

- Release of egg parasitoid, *Trichogramma chilonis*, *Trichogramma brasiliensis* and pupal parasitoid *Brachymeria nephantidis* is very useful in reducing pest incidence.
- Use of *Bacillus thuringiensis* var *kurstaki* @ 500 g a.i./ha at 10 days interval showed effective control on okra shoot and fruit borer.
- Use neem extract @ 1500 ppm, if pest population is very severe.
- Intercropping of soybean, maize, sorghum, cowpea with okra reduces pest infestation.
- After 15 days of okra planting, install sex pheromone trap (Funnel trap/sticky trap/water pan trap etc.) @ 100/ha (10m × 10m) just above the crop canopy.
- When pest population crosses economic threshold level, the crop should be sprayed immediately and thereafter at 10 days interval with any of the following insecticides in 500-600 litres of water per ha: 1.5 litres of profenophos 50 EC, 2.5 kg carbaryl 50 WP, 200 ml cypermethrin 25 EC, 400 ml deltamethrin 2.8 EC, 250 ml fenvalerate 20 EC, 150 ml spinosad 48 SC. To control the pest effectively, 5–6 application of insecticides is required. Insecticide belonging to the same group should not be repeated to avoid development of pesticide resistance and resurgence problem.

Aphids, *Aphis gossypii* Glover (Hemiptera: Aphididae)

Aphids are small and greenish brown insect pest found in tender part of plant and adaxial surface of leaves. The dry condition is most favourable condition for growth and development of aphid. Both adult and nymph suck the cell sap of plant. During sucking processes, aphid secretes honey dew on which black sooty molds develops which decreases the photosynthesis process of plant. In severe infestation, curling of leaves takes place and may lead to severe yield loss.

Management

- Collection and destruction of aphid infested twigs.
- Clipping the tips of the seedling up to 2 inches prior to flowering to remove the egg masses of aphids if any.
- Growing castor along the borders and irrigation bunds as trap crop for aphids.
- Spray NSKE (5%) or neem oil (3%) alternatively.
- Apply neem cake @ 250 kg/ha as a basal dosage.
- Spray fish oil resin soap 25 kg/ha @ 1 kg in 40 litres of water.
- Release of *Chrysoperla* spp. (Green lace wing) 5000-10000 eggs/ha after starting of first sign of aphid presence 3-4 times in 15 days.
- Application of *Verticillium lecanii* (0.5-1.0%) affects all growth stages of aphid.
- Use of light tarp @ 12/ha to monitor and trap the aphids.
- Set up the yellow sticky traps @ 25/ha to monitor the activity of pest and to synchronize the botanical pesticide application, if need be, at the maximum activity stage.

The insect infestation can be managed by spraying the crop with 625 ml of dimethoate 30EC or 100 ml of imidacloprid 17.5 SL in 500 litres of water per ha.

Whitefly, *Bemisia tabaci* Ishida (Hemiptera: Aleyrodidae)

Pale yellow nymphs are sluggish in nature that congregate on the undersides of leaves to suck the sap. Adults are small (1-1.5 mm long), winged, and have a pale-yellow body with a white waxy powder coating. Both nymphs and adults feed on the sap of leaves, especially the undersides of leaves and other tender plant parts. The affected leaves curl inward and eventually become dry because of this, and they are also responsible for the transmission of yellow vein mosaic virus (YVMV), a catastrophic okra disease. The potential of whiteflies to spread viruses adds more to their destructive potential. The virus is spread by whiteflies on a persistent manner.

Management

- Removal and destruction of alternative weed host plant of white fly like *Chrozophore rottlari, Abutilon indicum, Solanum nigrum* and *Hibiscus ficulneus* from

Whitefly infestation

the fields and neighbouring areas and maintaining field sanitation.

- Collection and destruction of leaves infested with white fly.
- Release of *Chrysoperla* spp. (Green lace wing) 5000-10000 eggs /ha, 3-4 times in 15 days after first sign of whitefly presence.
- Spray fish oil resin soap (25 g/litre) and add teepol as wetting agent.

Whitefly population can be managed below economic threshold level (ETL) by adopting several integrated pest management tools i.e., use of resistant varieties, using trap, botanicals and at last, chemical insecticides. Insecticides used against whitefly should be systemic in action, as it is a sucking pest. Application of 750 ml of oxydemeton methyl 25 EC or 625 ml of dimethoate 30EC per hectare is effective.

Okra fruit borer, *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae)

The adult insect is 20 mm long in length, has brown forewing which have dark cross band in outer margin and dark spot in coastal margin. The eggs of this insect are yellowish and spherical in shape. The larva is around 35-45 mm long, has darker broken lines along the side of the body and fine hair on the body. The adult moths can lay 300-500 eggs and their incubation period is 3-6 days. The larval period duration is about 13-18 days. It pupates inside the soil and pupation period is around 8-15 days. The larvae of this insect bore the fruit and during feeding the half portion of larva remain inside the fruit while the remaining half is outside the fruit.

Management

Collect and destroy the infected plant part and larva. Spray the field with *Bacillus thuringiensis* @ 2 g/lit or Ha NPV 250-500 larval equivalent/ha or carbaryl 50 WP 2 g/lit.

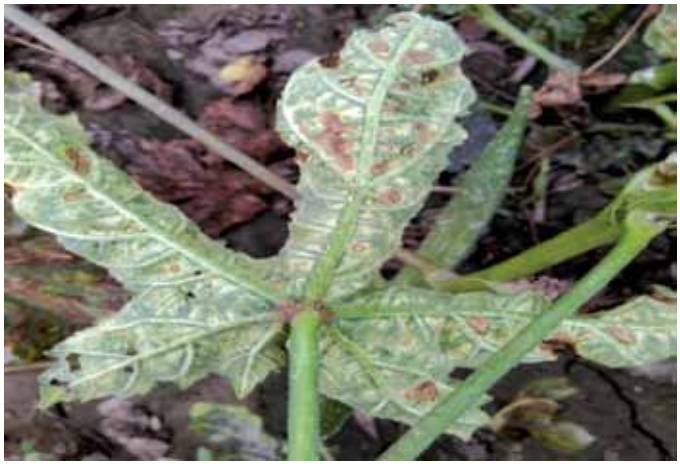
Jassids, *Amrasca biguttula biguttula* Ishida (Hemiptera: Cicadellidae)

Adults are~3 mm long and colour varies with temperature (during summer, it is greenish yellow, while during winter, it becomes reddish tinge). Jassids move briskly forward and sidewise. By slight disturbances, the winged adult flies jump and are phototropic also. Adult breed throughout the year on different hosts but during spring, they especially migrate to okra and start breeding. Female laiy egg on the underside of the leaves. Both nymph and adult suck the cell sap from leaves, prominently from underside and probably also introduce toxins to the plant cell. Initially injured leaves turn pale and later rust red. Sap sucking from the leaves causes inward curling, drying of leaves and fall of leaves to the ground. During severe infestation, plants becomes stunted and fail to achieve reproductive stage.

Management

At the time of sowing, seed should be treated with imidacloprid 70 WS @ 5 g/kg seed. Insecticide should be applied only when pest reach economic threshold level (ETL). The insecticides can be used to control this pest when it crosses ETL at their respective doses: 100 ml imidacloprid 200 SL, 250 ml fenvalerate 20 EC and 100 g thiomethoxam 25 WG in 250 – 300 litres of water. For seed crop, apply 20 kg of phorate 10 G at time of sowing in furrows or spray twice starting at 15 days after sowing with 50 g acetamiprid 20 SP or 625 ml dimethoate 30 EC in 250 – 300 litres of water/ha.

Jassid infestation



Curling of leaf due to jassids infestation

Red cotton bug, *Dysdercus koenigii* F. (Hemiptera: Pyrrhocoridae)

Bugs are elongated slender insects, crimson red with white or pale bands across the abdomen. Insect is active throughout the year and passes winter in the adult stage. Both nymph and adult insects suck cell-sap from leaves stem and fruits of okra. Sap sucking from leaves and stem, initially causes yellowing of leaves and stunted growth of plant. However, during severe infestation, the plant may lose their vigour and fail to reach the reproductive potential.

Management

The insect infestation can be managed by adopting the following practices:

- Use of resistant varieties
- Clean cultivation and destruction of alternative host plant
- By using predacious hemipteran bugs like *Antilochus cocqueberti* Fabricius (Pyrrhocoridae) and *Harpactor costalis* Stal (Reduvidae) which feeds on nymph and adults
- If pest population exceed above the economic threshold level, then pesticide with systemic mode of action same as on jassids should be applied at their recommended dose.

Red spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae)

Mites are oval-shaped, extremely small creatures that can be less than 100 microns long. Some specimens lack the two dark spots on the sides of the body that have given this species its common name. The egg, larva, and two nymphal stages make up the life cycle (protonymph and deutonymph). The time it takes from egg to adult depends a lot on the temperature. Spider mites grow in 5 to 20 days under optimal conditions (around 80 degrees Fahrenheit). Every year, there are several generations that overlap. Adult females live for 2 to 4 weeks and can lay hundreds of eggs during that period.

They use their cheliceral stylets to suck cellular materials, resulting in characteristic white blotches on leaves and plant devitalization. The presence of mite on fruits makes them unfit for consumption, resulting in financial loss.

Management

It can be controlled by commercially available

Table 1. Recommended pesticides for okra insect pests

Pest/Pesticide	Dosage			Waiting period (days)
	in g	Formulation (g/ml)	Dilution (litre)	
Shoot and fruit borer				
Deltamethrin 2.8% EC	10-15	400-600	400-600	1
Fenpropathrin 30% EC	75-100	250-340	750-1000	7
Whitefly				
Azadirachtin 0.03% (300 ppm)	-	2500-5000	500-1000	7
Fenpropathrin 30% EC	75-100	250-340	750-1000	7
Red spider mites				
Dicofol 18.5% EC	250-500	1350-2700	500-1000	15-20
Fenazaquin 10% EC	125	1250	500	7
Fenpropathrin 30% EC	75-100	250-340	750-1000	7
Quinalphos 25% EC	250	1000	500-1000	-
Okra fruit borer				
Azadirachtin 0.03% (300 ppm)	-	2500-5000	500-1000	7
Chlorantraniliprole 18.5% SC	25	125	500	5
Quinalphos 25% EC	200	800	500-1000	-
Leaf hopper				
Azadirachtin 0.03% (300 ppm)	-	2500-5000	500-1000	7
Quinalphos 25% EC	250	1000	500-1000	-
Dimethoate 30% EC	600	1980	500-1000	-
Aphids				
Acetamiprid 20% SP	15	75	500-600	3
Imidacloprid 17.8% SL	20	100	500	3
Dimethoate 30% EC	700	2310	500-1000	-

Source: Directorate of Plant Protection, Quarantine and Storage.

predator mite species such as *Phytoseiulus persimilis*, *Mesoseiulus longipes*, *Neoseiulus californicus*, *Galendromus occidentalis*, and *Amblyseius fallicus*. The most widespread predator, *Phytoseiulus persimilis*, feeds on all stages of mites. Spider mites are also preyed upon by lady beetles (*Stethorus*), minute pirate bugs (*Orius*), thrips (*Leptothrips*), and lacewing larvae (*Chrysopa*). Mites can be controlled by adding sulphur dust at a rate of 25 kg/ha or spraying 1 kg in 225 litres of water. Phosalone, dicofol, and other synthetic acaricides are also used to control mites.

Bio-intensive eco-friendly pest management strategies

- Select resistant/less susceptible region-specific varieties for cultivation.
- Resistant varieties should be sown specially during *kharif* season.
- Grow maize/sorghum on borders as a barrier crop for the entry of shoot and fruit borer adults.
- Grow African marigold along the borders and irrigation bunds as a trap crop to attract the adults of *H. armigera*.
- The alternate weed plant host of insect pest should be removed and destroyed at regular interval.
- About 30-35 days after sowing of crop, egg parasitoid *Trichogramma chilonis* @ 1-1.5 lakh/ha should be release to control shoot and fruit borer.
- At regular intervals, remove and destroy the borer affected fruits and shoots.
- Install pheromone traps @ 2/acre for monitoring of *E. vittella* moth emergence and should replace the lures at every 20-30 day interval.
- Install yellow sticky and delta traps for whitefly and other sucking pests.
- For control of leaf hoppers, aphids, whiteflies, borers, and mites, use biopesticides such as *Verticillium lecanii* (0.5-1.0%), *Beauveria bessiana* @ 1.6×10^4 conidia/ml, NSKE 5%, Azadirachtin @ 0.5%, *Bacillus thuringiensis* @ 2 g/lit, NPV 250-500 larval equivalent/ha recommended as need based.

SUMMARY

Among vegetable crops, okra has its own importance due to nutritional and medicinal value. In India, West Bengal is the largest producer of okra, followed by Bihar. However, okra production suffers from many biotic and abiotic factors. Among all biotic factors, insect pests are most important as it causes heavy infestation and reduces economic yield. Therefore, it is essential to study about the insect pest life cycle, damage symptom and management practices to control the pest below economic threshold level.

For further interaction, please write to:

Hansraj Hans (Senior Research Fellow), Division of Croping Research, ICAR-Research Complex for Eastern Region, Patna, Bihar, India. *Corresponding author email: hrhans13@gmail.com

Management of sucking pests in okra: In search of new alternatives to neonicotinoid insecticides against sucking insect pests of okra, Flupyridifurone 200 SL @ 2.5 ml/l was observed most promising with lowest whiteflies (4.38/3 leaves), leafhoppers (4.86/3 leaves) and gave maximum fruit yield (10.94 tonnes/ha) and maximum B:C ratio of 1:3.22 under Raipur condition.

Pest management in okra through organic sources: To promote organic pest management in okra, seed treatment with Bacillus pumilus 1% A.S (10 ml/kg seed) and application of 20 tonnes of FYM enriched with B. pumilus (5 litre/ha) recorded the maximum decrease in M. incognita population (67.57%) accompanied by highest yield (30.83% over control) with B:C ratio (1:1.93). It was at par with seed treatment with P. putida 1% A.S @ 10 ml/kg seed and application of 20 tonnes of FYM enriched with P. putida (5 litre/ha) in reducing the final nematode population (66.51%) and increasing the yield (29.44% over control) and B:C ratio (1:1.91) under Bengaluru conditions.

Source: ICAR Annual Report 2021-22

Okra: Okra genotype VRO 146 is resistant to YVMV and OELCV virus. More yield potential (170–175 q/ha), semi-dwarf (100–106 cm), dark green fruit colour, free from ring formation and easy to harvest.

Okra genotype VRO 208 is resistant to YVMV and OELCV virus. More yield potential (160–170 q/ha), medium tall (120–130 cm), dark green fruit free from ring formation and easy to harvest.

VRO 210 is resistant to YVMV and OELCV virus. More yield potential (160–165 q/ha), semi-dwarf (100–110 cm), dark green fruit colour free from ring formation and easy to harvest.

Source: ICAR Annual Report 2021-22