Technical Bulletin-45

MANUAL FOR

Pest Surveillance for Major Horticultural Crops in Haryana

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CONTENTS

1. INTRODUCTION

Haryana is one of the fast and rapidly emerging Horticultural states in the country with an area of 3.37 lakh ha and production of 5.86 and 1.2 million tons of vegetables and fruits, respectively. Tomato, cucurbits, crucifers (cabbage/cauliflower), brinjal, chillies, okra and kinnow are popular and widely grown throughout the State due to their nutritive value and rising market demand. In recent years, area under these crops have witnessed sharp increase and expected to rise further in near future. Area under horticultural crops has increased during last one and a half decade from a mere 3.1% to 8.2% of the cropped area during 2020-21. Karnal, Kurukshetra, Sonepat, Gurugram, Panipat, Ambala, Palwal, Bhiwani and Mewat are the major vegetable growing districts while Hisar, Fatehabad and Sirsa are known kinnow growing regions.

In recent years, pest status/scenario of many crops has changed due to altered cropping pattern, agronomic practices, susceptible cultivars and climate change. Sap feeders and lepidopterans in tomato, chilli, okra, brinjal and cabbage/cauliflower, fruit fly in cucurbits and citrus psylla in kinnow among insect pests and begomovirus in cucurbits, chilli, okra and tomato, early and late blight in tomato, anthracnose in chilli, downy mildew in cucumber, *Fusarium* wilt in chilli, *Phomopsis* blight in brinjal, black rot in cauliflower/cabbage, gummy/collar rot and greening in kinnow among diseases cause severe crop loss in the years of epidemic. Faster communication for identification of pests through mobile applications have made the crop protection to be applied in real time and is becoming popular through ICT based pest surveillance. Establishment of an intensive pest monitoring mechanism and advisory system, if put in place, would help in overcoming unmanageable pest situations.

Pest surveillance or monitoring is the cornerstone of Integrated Pest Management (IPM) implementation compared to calendar-based treatments. IPM stresses monitoring of pests and determines the time of appropriate action to be taken. The basic purpose of surveillance is to determine whether pests are present in the field at a level to initiate pest management interventions or not. Through regular and systematic pest surveillance, epidemic situations can be avoided by detecting damage before the establishment of a pest in an area. Manual on “Pest surveillance for major Horticultural crops” has been prepared to assist all the stake holders including scouts for identification of pests,

collection and compilation of data on occurrence and severity of insect pests and diseases. It is a ready reckoner and guide for identifying the pests. Manual also includes the plan and schedule of pest surveillance. Contents of the manual describe the pests of importance and their sampling procedures followed by finalized data sheet formats.

2. SURVEILLANCE PLAN AND PROCEDURES

Fixed fields are selected in the beginning of the season and shall be monitored till harvest on weekly basis for the insect pests and diseases using specified data sheet formats/mobile application. In addition, a random field survey in the selected villages should be conducted during each week. The schedule of surveillance is outlined in Annexure-1.

2.1 Nursery surveillance

- Nursery in selected village where fixed and random fields are to be monitored would be used for surveillance.
- Observations on insect pests and diseases are to be made on weekly basis at least thrice in nursery.
- Use separate sheet for each nursery, during each time of observation.

General information for nursery

One time collection of general information relating to each nursery should be done as in Proforma 1 (Annexure II)

2.2 Selection of main fields for surveillance

Fixed fields

In each selected village, four farmer fields (Fixed 1-4) of near to one acre, must be selected for surveillance at the beginning of the season and maintained till end of the season.

Suggest farmers to grow the recommended and popular cultivars for the region. The latitude, longitude and altitude of the selected fields should be recorded using GPS.

Random fields

In each selected village, four farmer fields (Random 1-4) of near to one

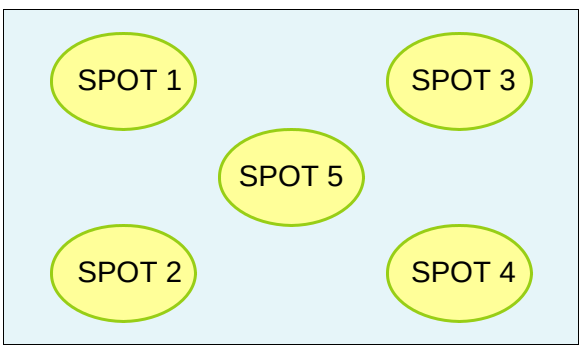
acre, must be selected for each surveillance during the season. These fields shall be selected randomly every week.

General information for fields (Proforma 2, Annexure III)

Geographical, cropping system, agronomical and cultural details relating to the crop must be collected at the beginning of the season from fixed fields in the selected villages. The exact date of planting, growing conditions and cultivar details are important and to be noted with great care.

2.3 Specific guidelines for observations in Fixed/Random fields

- Observations in all the designated fixed fields should be taken on weekly basis.
- Surveillance on pest occurrence should commence soon after crop establishment after transplanting and at weekly intervals thereafter.
- Note date of observation and tick mark the general crop health as Excellent/Good/ Poor and the stage of the crop i.e. vegetative/first flowering/ 50% flowering/fruit set & development/ripening.
- In each of the fields, select five spots randomly as shown (four in the corners, at least 5 feet inside field borders and one at the centre).
- Select five random plants or as directed at each spot for recording counts of insects/disease as per procedure finalized for individual insect/disease.
- In kinnow, one randomly selected plant is considered as single spot.



3. PESTS AND THEIR OBSERVATIONS

3.1 Vegetables

3.1.1 Tomato

Nursery

Insect pests

Whitefly (*Bemisia tabaci*)

Identification

Whitefly adults are yellowish covered with milky white waxy coating on wings. Adults are often clustered on the under surface of leaves and fly when disturbed.

Whitefly adults

Procedure for observation

Count and record number of whitefly adults per seedling. Data to be recorded from 10 randomly selected seedlings.

Aphids (*Myzus persicae* and *Aphis gossypii*)

Identification

Aphids are tiny, soft-bodied, pale yellowish, green coloured insects with three dark lines on the back of the abdomen. They are found in great numbers on the leaves, petioles and stem. Winged and wingless aphids are common. Aphids are normally associated with ants and develop sooty mold at advanced stage.

Aphid nymphs and adults

Procedure for observation

Count and record number of aphids per seedling. Data to be recorded from 10 randomly selected seedlings.

Diseases

Damping off (*Pythium* spp.)

Symptoms

In pre-emergence damping off, seeds become soft, turn brown and decompose. In post-emergence damping-off, roots, hypocotyls and the crown of the seedlings turn pale brown, soft, water soaked and thinner. Infected seedlings topple and collapse. Disease is noticed mostly in patches.

Toppling of seedlings

Procedure for observation

Count and record number of infected seedlings out of 50 seedlings selected in five groups (10 seedlings each).

- Data sheet for nursery pest observation (Annexure-IV)

Main Field

Insect pests

Whitefly (*Bemisia tabaci*)

Identification

Adults are yellowish, covered with a milky white waxy coating. They fly when disturbed. Adults are clustered together on the undersurface of leaves.

Nymphs and adults

Procedure for observation

Count and record number of whitefly adults in five randomly selected leaves per plant. Record number of whitefly on five plants per spot.

Aphids (*Myzus persicae* and *Aphis gossypii*)

Identification

Aphids are tiny insects that are pale yellowish, green in colour with three dark lines on the back of the abdomen and are found in great numbers on the leaves. Both wingless and winged forms are found in colonies. Ants are associated with aphids and sooty mold develops in advance stage of infestation

Nymphs and adult

Procedure for observation

Record aphid numbers (both nymphs and adults) on five randomly selected young leaves per plant.

Thrips (*Thrips tabaci* and *Frankliniella* sp.)

Identification

Thrips are tiny, slender and free moving insects. Adults are yellowish to yellowish brown and have a pair of fringed wings with long hairs when observed under magnifying lens. The immature stages have the same body shape as adults but are lighter in colour and are wingless.

Adult thrips

Thrips damaged fruit

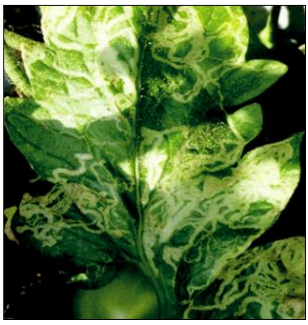
Procedure for observation

Count and record number of nymphs and adults in five terminal leaves per plant (Tapping method can be used to count). Record data on five plants per spot.

Leaf miner (*Liriomyza trifolii*)

Identification

Maggot mines into the leaf between the upper and lower surface and feeds on the mesophyll tissues making serpentine mines. Young leaves have small and thin mines. In old leaves, white long circular mines are seen.

Leaf miner damaged leaves

Procedure for observation

Record numbers of live mines on five randomly selected leaves per plant. Record such data on five plants per spot.

Fruit borer *(Helicoverpa armigera)*

Symptoms

Larvae show color variations ranging from greenish to brown. Fully grown caterpillars are apple green with whitish and dark grey broken longitudinal stripes. Larvae feed on leaves and fruits. Advanced stage larvae make clear cut circular holes and eat the contents with rear part

Larva on fruit

Damaged fruit

of their body seen outside the fruit.

Procedure for observation

Count number of fruits damaged by borer out of 50 fruits observed in a spot of five plants.

Diseases

Early blight (*Alternaria solani*)

Symptoms

Lower leaves are more susceptible than the upper ones and generally serious in older than younger plants. Small, dark, circular lesions develop on leaves which later turn distinctly zonate. Spots rapidly enlarge, coalesce and turn into complete blight, resulting in death of the leaves. Small, dark, slightly sunken lesions form on the main stem and side branches which enlarge and form dark brown elongated spots.

Concentric ring

Infected branches

Severely infected plant

Symptoms on fruit

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Late blight

Symptoms

Cool nights, warm days and extended wet conditions from rain and fog can result in late blight epidemics. Grey green/yellowish to brownish-black lesions on leaves and stems that are small at first and appear indefinite; water-soaked spots enlarge rapidly and become necrotic; destroy the entire plants & fruits.

Symptoms on leaf

Symptoms on stem

Symptoms on fruit

Procedure for observation

Visually observe and record severity scale (0-6) in five randomly selected plants in each spot.

Disease rating	Late blight	Disease rating	Early blight
0	No symptoms	0	No symptoms
1	Up to 10 lesions per plant with severity of up to 5%	1	1-4% area of a plant infected
2	Lesions easily seen at closer distance. Maximum foliage area affected up to 20 leaflets with severity of 5 to 25%	2	5-10% area of a plant infected
3	Lower leaves are dead. About half the foliage area is destroyed with severity of 26 to 55%	3	11-25% area of a plant infected
4	56 to 85% area of plant infected	4	26-50% area of a plant infected
5	All plants in a spot are brown-coloured. A few top leaves still have some green areas. Most stems have lesions with severity of 86 to <100 %	5	More than 50% area of a plant infected
6	All leaves and stems dead plants in each spot.		

Leaf curl (Tomato Leaf Curl Virus)

Symptoms

Symptoms include mosaic, intervenal yellowing, vine clearing, crinkling and puckering accompanied more often by inward rolling of leaf margins. Older leaves become leathery and brittle. The disease also induces severe stunting, bushy growth and partial or complete sterility depending on the stage of the crop. Infected plants bear few or no fruits.

Twig infected with leaf curl virus

Leaf curl infected field

Procedure for observation

Count and record number of leaf curl infected plants out of 10 randomly selected plants in a spot.

Wilt (*Fusarium* spp.)

Symptoms

Lower leaves turn yellow. Yellowing often begins on one side of the plant and progresses upwards. Infected leaves curl downward, followed by browning and drying. Vascular browning is evident in stems and leaf petioles. Young plants when infected are severely stunted.

Procedure for observation

Count and record number of wilt infected plants out of 10 randomly selected plants in a spot.

Yellowing of lower leaves and wilting upwards

Severe wilting

- Data sheet for pest observation in field (Annexure-V)

3.1.2 Cole crops (Cabbage & Cauliflower)

Nursery

Insect pests

Cabbage borer/Head borer (*Hellula undalis*)

Identification

Larvae feed on the growing leaves in the heart of cabbage plants. Once the heart is destroyed, larvae move out to the leaf tips and feed on older leaves. No Head formation and only multiple shoot formation.

Damaged Plant

Procedure for observation

Count and record number of borers per seedling and data from 10 such randomly selected seedlings to be recorded.

Diseases

Damping off (*Pythium* spp)

Symptoms

Major symptoms are the failure of the seedlings to emerge as a result of seed or seedling decay or sudden death of the emerged seedlings. Affected region is relatively thinner than the stems of the healthy plants.

Damping off

Procedure for observation

Count and record number of infected seedlings out of 50 seedlings selected in five groups (10 seedlings each).

Downy mildew

Symptoms

Purplish brown spots appear on the under surface of leaves with upper surface of the lesion turning tan to yellow. Downy growth usually appears on the under surface of leaves.

Symptoms on leaf

Infected leaves

Procedure for observation

Count and record number of infected seedlings out of 50 seedlings selected in five groups (10 seedlings each).

- Data sheet for nursery pest observation (Annexure-VI)

Main Field

Insect pests

Diamond back moth (*Plutella xylostella*)

Identification

A patch of three diamond shaped yellowish white spots is visible by joining both the forewings, hence the name 'diamond back'. Young larvae feed by scrapping epidermal leaf tissues causing typical whitish patches. Advance stage larvae make holes in the leaves.


Larva


Pupa


Adult


DBM damage

Procedure for observation

Count and record number of larvae per plant in five randomly selected plants in a spot.

Tobacco caterpillar (*Spodoptera litura*)

Identification

Larvae are blackish gray to dark green with dark longitudinal bands on the side of the body. Adult moth is stout brown coloured with wavy white markings on the forewings. Neonate larvae are gregarious, scrap the green matter in the leaf. Late instars feed voraciously on tender leaves leaving the epidermis giving a white papery appearance.

Larvae

Damaged leaves

Procedure for observation

Count and record number of larvae per plant in five randomly selected plants in a spot.

Aphid (*Brevicoryne brassicae*)

Identification

As a result of sucking of vital sap from the tissues, plants remain stunted resulting in poor head formation. Aphids produce honey dew which makes the plant sticky and favour the growth of sooty mold with black coating.

Nymphs and adults

Procedure for observation

Count and record number of aphids per leaf per plant in five randomly selected plants per spot.

Head borer (*Hellula undalis*)

Identification

Caterpillars are pale whitish brown, which infect the crop immediately after transplant. Eggs are laid singly, young larvae bore into stem and multiple shoots are formed. It is a serious pest during summer/rainy months.

Head borer damage

Procedure for observation

Count and record number of borers per plant in five randomly selected plants per spot.

Diseases

Black rot (*Xanthomonas campestris* pv. *campestris*)

Symptoms

Infection occurs at margins and infected tissue turns yellow and the chlorosis advances towards the centre of the leaf forming a wilted 'V' shape notch.

Symptoms on leaf

Black rot infected leaves

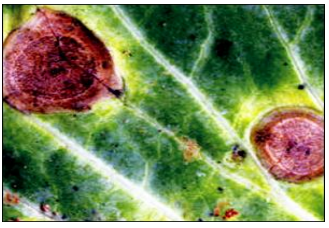
Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot. Severity scale based on the ratings given ahead should be used.

Alternaria* leaf spot (*Alternaria* spp.*)

Symptoms

On leaves, spots appear as small, dark coloured areas expanding rapidly upto one cm in diameter, with further enlargement leading to formation of concentric circles. In humid weather, fungus may cause bluish growth in the centre of the spots.



Symptoms on leaves

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot. Severity scale based on the ratings given below should be used.

Disease rating	Black rot	*Alternaria* leaf spot
0	No disease	Healthy
1	Plants with up to 15% with one or two small lesions/leaf	Plants with up to 10% leaf area covered
2	Plant with 15 to 30% with three to five medium lesions/leaf	Plants with 10-25% leaf area covered
3	Plant with 30 to 50% with five or more large lesions (>4.0 cm in diameter)	Plants with 26-50% leaf area covered
4	Plant with 50 to 75% with coalesced lesions and leaf blight	Plants with 51-75% leaf area covered
5	Plant with 75 to 100% leaf area infected with dead plant.	Plants with > 75% leaf area covered

- Data sheet for pest observation in field (Annexure-VII)

3.1.3 Cucurbitaceous crop

3.1.3.1 Cucumber

Insect pests

Red Pumpkin Beetle (*Aulacophora foveicollis*)

Identification

Adult beetles attack leaves, flowers and fruits and make holes causing death or retardation of growth. Larvae live in the soil and feed on the roots and stem of the plant.

Red pumpkin beetle

Procedure for observation

Count and record number of beetles in each of the five randomly selected plants separately in a spot.

Whitefly (*Bemisia tabaci*)

Identification

Both the nymphs and adults suck the plant sap mainly from underside of the leaves and secrete honeydew on which black sooty-mould develops which in turn reduces photosynthetic activity of the plants.

Whitefly adults

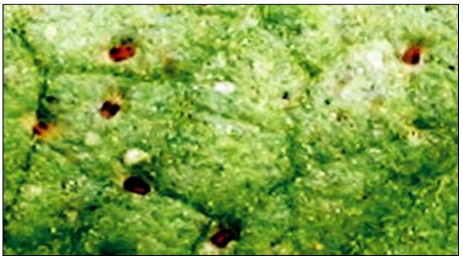
Procedure for observation

Count and record number of white flies in five leaves per vine and data in five such randomly selected vines in each spot to be recorded.

Mites (*Tetranychus urticae*)

Identification

Infestation usually begins on lower leaves and progresses upwards. Inspect lowest leaves for stippling and webbing with high population of mites seen during humid months.



Mite infestation on leaves

Procedure for observation

Count and record number of mites in five leaves per vine and data in five such randomly selected vines in each spot to be recorded.

Thrips (*Thrips palmi*)

Identification

Adult and nymphal stages feed by piercing the plant surface with mouthparts and suck the contents of plant cells causing white or brown rough corky spots on the leaves and fruits.

Thrips on vineshoot

Damaged fruits

Procedure for observation

Count and record number of thrips on 10 cm shoot top of vine and data in five such randomly selected vines in each spot to be recorded.

Diseases

Downy mildew (*Pseudoperonospora cubensis*)

Symptoms

It is one of the serious diseases which initiates as water soaked angular lesions under conditions of high humidity and moderate temperature, soon turning chlorotic and finally on the corresponding lower surface purplish growth is seen.

Upper surface of leaf

Lower surface of leaf

Procedure for observation

Visually assign rating to each of two square feet area (leaves) according to severity scale (0-5). Record data in five randomly selected areas in each spot. Severity scale based on the ratings given ahead should be used.

Virus complex/Cucumber mosaic virus

Symptoms

Various symptoms, yellow mosaic crinkling, mottling and stunting under severe conditions are noticed. In cucumber mosaic, typical mosaic symptoms develop on young leaves which mottle with alternating light green and dark green patches.

Infected leaves

Infected vine

Procedure for observation

Count and record number of virus infected shoots in 10 randomly selected shoots in each spot.

3.1.3.2 Bottle gourd

Insect pests

Red pumpkin beetle (*Aulacophora foveicollis*)

Identification

Adult beetles attack leaves, flowers and fruits and make holes causing death or retardation of growth. Larvae live in the soil and feed on the roots and stem of the plant.

Red pumpkin beetle damage

Red pumpkin beetle

Procedure for observation

Count and record number of beetles in each of the five randomly selected plants separately in a spot.

Fruit fly (*Bactrocera cucurbitae*)

Identification

Gravid female inserts the eggs 2 to 4 mm deep in the soft, tender fruit tissues and maggots feed inside the fruit tissues making galleries. Fruits subsequently rot or become distorted/mummified.

Adult

Damaged fruit

Procedure for observation

Count number of fruits damaged out of total number of fruits observed in a spot.

Mirid bug (*Nesidiocoris cruentatus*)

Feeds both tender leaves and young fruits of bottle gourd. On tender leaves, a minute puncture spot with yellow hallow is observed. Damage is more prominent in young fruits. Brown puncture spots on the rind with sap oozing is the characteristic symptom. Affected fruits often fail to fetch a good market price.

Mirid bug nymphs and adult

Procedure for observation

Count and record number of mirid bugs in each of twenty randomly selected fruits separately in a spot.

Diseases

Gummy stem blight

Symptoms

Spots on stems often elongate into streaks usually start at the internode and exudate amber coloured gummy substance leading to withering of affected vines and death of plants at advance stage.

Infected stem

Wilted plant

Infected vine

Procedure for observation

Count and record number of infected plants with gummosis in 10 randomly selected plants in each spot.

Viral disease

Symptoms

Chlorotic, mottling, mild curling and serious stunting of plants are common symptoms of begomo virus. Vine usually appear bushy under severe condition with no flowering buds.

Infected leaves

Infected vine

Procedure for observation

Count and record number of infected young shoots in 10 randomly selected young shoots in each spot.

Anthracnose (*Colletotrichum lagenarium*)

Symptoms

Yellowish water soaked spots appear which enlarge and turn dry brownish black with centre giving shot hole appearance. On fruits, spots are circular sunken with dark borders containing numerous pin head size fruiting bodies.

Infected fruit

Symptoms on leaf

Procedure for observation

Visually assign rating to each of two square feet area (Leaves) according to severity scale (0-5). Record data in five randomly selected

area in each spot. Severity scale based on the ratings given ahead should be used.

Cercospora leaf spot (_Cercospora citrullina_)

Symptoms

The disease occurs on all cucurbits but is more common on cucumber, bitter gourd and bottle gourd and is usually found on foliage. Small black circular spots with grey centre appear on leaves. Severely infected leaves fall off.

Symptoms on leaf

Procedure for observation

Visually assign rating to each of two square feet area (leaves) according to severity scale (0-5). Record data in five randomly selected area in each spot. Severity scale based on the ratings given ahead should be used.

3.1.3.3 Bitter gourd

Insect pests

Whitefly (_Bemisia tabaci_)

Identification

Both the nymphs and adults suck the plant sap mainly from underside of the leaves and secrete honeydew on which black sooty-mould develops which in turn reduces photosynthetic activity of the plants.

Whitefly adults

Procedure for observation

Count and record number of white flies in five leaves per vine and data in five such randomly selected vines in each spot to be recorded.

Thrips (*Thrips palmi*)

Identification

Adult and larval stages feed by piercing the plant surface/growing shoot with mouthparts and suck the contents of plant cells causing white or brown spots on the leaves/growing shoots.

Thrips on leaf

Procedure for observation

Count and record number of thrips on 10 cm shoot top of vine and data in five such randomly selected shoots in each spot to be recorded.

Fruit fly (*Bactrocera cucurbitae*)

Identification

Gravid female inserts the eggs 2 to 4 mm deep in the soft, tender, fruit tissues and maggots feed inside the fruit tissues making galleries. Fruits subsequently rot or become distorted/mummified.

Fruit damage

Procedure for observation

Count number of fruits damaged out of 10 fruits observed in a spot.

Diseases

Cercospora leaf spot (*Cercospora citrullina*)

Symptoms

Small black circular spots with grey centre appear on leaves. Severely infected leaves fall off.

Symptoms on leaf

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Procedure for observation

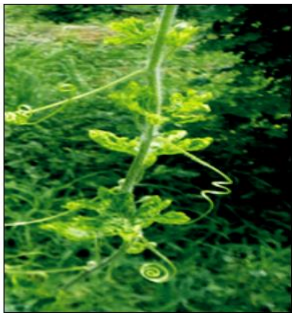
Visually assign rating to each of two square feet area (leaves) according to severity scale (0-5). Record data in five randomly selected area in each spot. Severity scale based on the ratings given ahead should be used.

Viral disease

Symptoms

Severe mosaic with upward leaf curling, crinkling, mottling with severe stunting of vines in advanced stage is the characteristic symptom of yellow mosaic virus. Yellowness of leaf is also observed.

Infected Plant



Infected leaves

Procedure for observation

Count and record number of infected young shoots in 10 randomly selected young shoots in each spot.

Disease rating	Anthracnose/*Cercospora* leaf spot	Downy mildew
0	No infection	
1	Upto 10% leaf area covered	Upto 10% leaf area covered
2	11 to15% leaf area covered	11 to15% leaf area covered
3	16 to 25% leaf area covered	16 to 25% leaf area covered
4	26 to 50% leaf area covered	26 to 50% leaf area covered
5	More than 50% of leaf area covered	More than 50% of leaf area covered with mildew growth

- Data sheet for pest observation (Annexure-VIII)

3.1.4 Chilli

Nursery

Insect pests

Whitefly (*Bemisia tabaci*)

Identification

Whitefly adults are white tiny scale like covered with a white waxy bloom. Nymphs and adults suck the sap on the ventral surface of leaves.

Whitefly adults

Procedure for observation

Count and record number of whitefly nymphs and adults per seedling. Data to be recorded from 10 randomly selected seedlings.

Diseases

Damping off (*Pythium aphanidermatum*)

Symptoms

It is serious in warm and moist heavy soils having poor drainage. Seed may rot before emergence or the seedlings may be toppled before they emerge from the soil. Young seedlings die in patches due to decay of tissues in the collar region.

Toppling of seedlings

Procedure for observation

Count and record number of infected seedlings out of 50 seedlings selected in five groups (10 seedlings each).

- Data sheet for nursery pest observation (Annexure-X)

Main Field

Insect pests

Thrips (*Scirtothrips dorsalis*)

Identification

Thrips are slender, minute and pale in colour, move briskly on leaves and flowers. Appear in nursery as well as main field. Both adults, nymphs lacerate the leaf tissue and as a result, young tender shoots, buds and flowers become twisted, deformed with leaves curled upwards like a boat. Thrips population tends to increase during dry and hot period of the crop season.

Infected leaves

Procedure for observation

Count and record number of nymphs and adults in three terminal leaves per plant. Record data on five plants per spot.

Broad mite (*Polyphagotarsonemus latus*)

Identification

Nymphs and adults suck sap from leaves which curl downward along the margins of the leaf and attain an inverted boat shape. Leaf petioles get elongated and small leaves are serrated giving bunchy appearance. In severe cases, fruit wall becomes hard and white stripes appear on the fruit.

Infected leaves

Procedure for observation

Count and record number of mites in 2 cm2 area of leaf in three randomly selected leaves per plant. Record number of mite on five plants per spot.

Whitefly (*Bemisia tabaci*)

Identification

Adults are white tiny scale like covered with a white waxy bloom. Nymphs and adults suck the sap on the ventral surface of leaves. Feeding by high population often result in stunting, poor growth, defoliation and reduced yields.

Whitefly adults

Procedure for observation

Count and record number of whitefly adults in three randomly selected leaves per plant. Record number of whitefly on five plants per spot.

Gall midge (*Asphondylia capsici*)

Identification

Adults are light yellowish brown, mosquito like. Full grown maggot legless, light yellow, very small of about 3 mm length and pointed at both ends.

Maggots feed on ovary of flower buds, flowers and tender fruits. Affected buds remain unopened and infested flowers and fruits drop severely. Flower buds and young pods turn into galls and do not attain proper size. Infestation declines during summer months.

Gall midge Adult

Infested fruits

Procedure for observation

Count number of fruits damaged by gall midge out of 50 fruits observed in a spot of five plants.

Tobacco caterpillar (*Spodoptera litura*)

Identification

The adult moth is stout, brown coloured, with wavy white markings on the forewings. Eggs are laid on leaves in masses and are covered with brown hairs. Larvae of second and third instar enter pods by making a hole near calyx and feed on seed. Affected pods drop off or develop white colour on drying. It is mostly nocturnal but can be seen during day time as well.

Larvae on leaves

Infestation on leaves

Procedure for observation

Count and record number of larvae per plant in five randomly selected plants in each spot.

Fruit borer (*Helicoverpa armigera*)

Identification

Eggs are yellowish-white, ribbed and dome shaped. Full grown caterpillars are apple green with whitish and dark grey broken longitudinal stripes. It is particularly active during post-rainy season (October to March). Larva damages by boring into fruits and feeds on inner contents of the pods. The entry hole is large and typically circular.

Larvae **Damaged fruit**

Procedure for observation

Count number of fruits damaged by *H. armigera* out of 50 fruits observed in a spot of five plants.

Diseases

Powdery mildew (*Levillula taurica*)

Symptoms

Initially, chlorotic blotches or spots appear on the upper leaf surface with white to gray powdery growth on the corresponding lower surface. It proceeds from the older to younger leaves and shedding of foliage is very prominent.

Infected leaf

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Leaf curl (begomo virus)

Symptoms

Leaves are greatly reduced in size and plant gives stunted look. In advanced stages, the whole plant appears bushy, with stunted growth and fewer flowers. Small sized fruits are produced with deformed seeds. In case of severe infection, complete crop failure is not uncommon.

Leaf curl infected plant

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

***Fusarium* wilt (*Fusarium solani*)**

Symptoms

It is characterized by typical wilting of the plant with upward and inward rolling of the leaves. Initially wilt appears in patches in water stagnating/low lying areas and quickly spreads through irrigation along the water channel. By the time symptoms are evident, the vascular bundle turns brown, discoloured particularly at the lower stem and roots.

Wilt infected field

Root infected with wilt

Procedure for observation

Count and record number of wilt infected plants out of 10 randomly selected plants in a spot.

Die-back and anthracnose (*Colletotrichum capsici*)

Symptoms

It is one of the most serious diseases of chilli occur almost throughout the country. Spots on ripened fruits appear as circular, water-soaked, sunken patches with black margins and numerous small pinhead sized acervuli at the centre. The fruits with many spots drop off prematurely resulting in heavy loss to crop yield. Fungus may also attack the fruit stalk and spread along the stem causing dieback symptoms.

Infected fruit

Die-back infected field

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Cercospora **leaf spot (***Cercospora capsici***)**

Symptoms

It appears as brown, circular spots with small light grey centres and dark brown margins. Severely infected leaves may drop off prematurely resulting in reduced yield.

Infected leaf

Procedure for observation

Visually observe and record severity scale (0-9) in five randomly selected plants in each spot.

Disease rating	*Cercospora* leaf spot	Disease rating	Die back
0	No infection	0	No infection
1	Upto 10% canopy showing symptoms	1	Upto 5% area of plant infected
3	11 to25% canopy	2	6 to 10 % area
5	26 to 50% canopy	3	11 to 25 % area
7	51 to 75% canopy	4	26 to 50 % area
9	More than 76% canopy	5	More than 51% area

Disease rating	Powdery mildew	Leaf curl
0	No infection	No infection
1	Upto 10% leaf area covered	Upto 5% curling and clearing of upper leaves
2	11 to25% leaf area	6 to 25% curling, clearing of leaves and swelling of veins
3	26 to 50% leaf area	26 to 50% curling and stunted of plant growth
4	51 to 75% leaf area	51 to 75% curling and stunted of plant growth
5	More than 76% of leaf area	More than 76% curling and deformed small leaves

- Data sheet for pest observation in field (Annexure- XI)

3.1.5 Brinjal

Nursery

Diseases

Damping off (*Pythium* spp.)

Symptoms

It appears in two stages as pre-emergence and post emergence. In pre-emergence, seeds rot before emergence while in post emergence, seedlings topple down at the soil surface.

Procedure for observation

Count and record number of infected seedlings out of 50 seedlings selected in five groups (10 seedlings each).

- Data sheet for nursery pest observation (Annexure-XII)

Main Field

Insect pests

Hadda beetle (*Epilachna vigintioctopunctata, E. dodecastigma*)

Identification

Beetles are 8 to 9 mm in length and 5 to 6 mm in width. *E. vigintioctopunctata* are deep red with 7-14 black spots on each elytron whose tip is somewhat pointed. *E. dodecastigma* are deep copper coloured & have six black spots on each elytron whose tip is more rounded. Grubs and adults scrap chlorophyll and totally skeletonise the leaves leaving veins and veinlets forming ladder-like windows.

Adult beetles

Damaged leaves

Procedure for observation

Count and record number of grubs/adults in three randomly selected leaves per plant. Record number of grubs/adults on five plants per spot.

Aphids (*Aphis gossypii*)

Identification

Found in large colonies on underside of leaves or tender shoots. They are tiny soft-bodied yellowish insects, 1.0 - 1.5 mm in length, with two tubes projecting from abdomens. Aphids pierce through the leaf surface and suck the plant's juice. They secrete a sugary substance, on which a sooty black mold fungus grows. Older aphids sometimes develop wings.

Aphids on leaf

Procedure for observation

Count and record number of aphids in three (top, middle and bottom) leaves per plant. Record number of aphids on five plants per spot.

White fly (*Bemisia tabaci*)

Identification

Nymphs are pale yellow while adults are yellowish with white coating on the body. Nymphs and adults are sluggish, clustered together on the under surface of the leaves. Feeding cause chlorotic spots on leaves which coalesce and turn leaf yellow with green veins. Nymphs secrete a sticky honeydew substance which covers leaf surfaces and flowers. Plant growth is stunted.

Whitefly adults

Procedure for observation

Count and record number of whitefly adults in three (top, middle and bottom) leaves per plant. Record number of whitefly on five plants per spot.

Shoot and fruit borer (*Leucinodes orbonalis*)

Identification

Fully grown larvae are 15-18 mm long, dull white, turn to light pink when matures. Moth which is active at night hides under plant canopy during day time. Moth is white with a pink or bluish tinge and brownish marking

on its wings. In younger plants, caterpillars bore into young tender shoots which wilt and droop. Later larvae bore into fruits which become unfit for consumption.

Damaged fruit

Infested shoots

Larvae on fruit

Procedure for observation for infected shoots

Count number of shoots damaged per plant in five randomly selected plants in each spot.

Procedure for observation for infected fruits

Count number of fruits damaged by fruit borer out of 25 fruits observed in a spot of five plants.

Mites (*Tetranychus neocaledonicus*, *T. cinnabarinus***)**

Identification

Mites have eight legs, oval in shape. Cause damage similar to many tiny insects such as thrips and whiteflies. They are very tiny red in colour and barely seen by the naked eye. Mite feeding results in large chlorotic patches on leaves. Damaged leaves often curl when infestation is on middle part of lower leaf surface. Severe infestation causes extensive yellowing and browning of entire leaves which eventually drop of.

Mite infestation on leaves

Procedure for observation

Count and record number of mites in 2 cm^2 area of leaf in top three leaves per plant. Record number of mite on five plants per spot.

Leafhopper/Jassid (*Amrasca biguttula biguttula*)

Identification

They are usually 1.3 mm long, greenish yellow with slender, tapered bodies, with two distinct black spots on the posterior end of the wings. Legs have rows of sharp spines. Infested leaves curl upwards along the margins which may turn yellowish, crinkle and show burnt up patches. Plants become stunted and may be killed in severe cases. Fruit set is also adversely affected.

Leafhopper nymph

Procedure for observation

Count and record number of hopper nymphs in three randomly selected leaves per plant. Record number of jassids on five plants per spot.

Leaf roller (*Eublemma olivacea*)

Identification

Caterpillars are purple-brown with many cream coloured hollow bumps and long hairs on the back and sides. Adult is an olive green moth that is active at night. Young leaves are rolled lengthwise from tip downwards and feed within by scrapping the green matter. Rolled leaves wither and eventually dry up. In heavy infestations, entire portions of plants appear brown and leaf drop occurs.

Infected leaf

Procedure for observation

Count and record number of rolled leaves per plant in five randomly selected plants per spot.

Diseases

Phomopsis blight and fruit rot (*Phomopsis vexans*)

Symptoms

Leaf spots appear as small gray to brown lesions with light centers which become numerous and cover large areas of leaves. Lesions may also develop on petiole and stem with numerous pin head sized pycnidia, causing blighting of affected portion. Symptoms on the infected fruits appear as minute, sunken dull and dusky spots. Fruit lesions are sunken, discoloured with margin of black fruit bodies.

Infected fruit

Infected stem

Procedure for observation (Rating)

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Procedure for observation for infected fruits

Count number of infected fruits out of 25 fruits observed in a spot of five plants.

Little leaf (MLO)

Symptoms

Characteristic symptom is the appearance of small or little leaves. Petioles are short as though the leaves stick to the stem with internodes of the stem shortened giving the plant a bushy appearance. Flowering and fruiting is rare. It is transmitted by the plant hopper, *Hishimonas phycitis*.

Little leaf infected plant

Procedure for observation

Count and record number of little leaf infected plants out of 10 randomly selected plants in a spot.

Cercospora leaf spot (*Cercospora melongenae*)

Symptoms

Symptoms generally appear on the older, lowest leaves which move upwards and infect young leaves and stems. Symptoms appear on the leaves, petioles, and stems which are small, circular to oval chlorotic spots with light to dark tan centers which may develop angular or irregular shapes.

Infected leaf

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Fusarium wilt (*Fusarium oxysporum*)

Symptoms

Initial symptom appear as clearing of veinlets, with main veins remaining green followed by yellowing of younger leaves and wilting of old leaves which progresses to main stem and whole plant. Xylem vessels show brown discoloration.

Infected field

Procedure for observation

Count and record number of wilt infected plants out of 10 randomly selected plants in a spot.

Alternaria leaf spot (*Alternaria* sp)

Symptoms

Initially small, circular, brown, necrotic spots develop which uniformly distribute on leaves which gradually enlarge and develop concentric rings. Eventually, the spots coalesce and cause extensive leaf senescence.

Infected leaves

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Disease rating scale	*Alternaria/Cercospora* leaf spot
0	No infection
1	Upto 10% area of plant infected
2	11 to25% area of plant infected
3	26 to 50% area of plant infected
4	51 to 75% area of plant infected
5	More than 76% area of plant infected

- Data sheet for pest observation in field (Annexure- XIII)

3.1.6 Okra

Insect pests

Leafhopper (*Amrasca devastans*)

Identification

Nymphs and adults are pale greenish, wedge shaped with a pair of black spots on vertex and a black spot on posterior portion of each of the forewings which move diagonally. Both nymphs and adult suck cell sap from the under surface of leaves and inject toxins. The affected leaves turn yellowish and curl upwards along the margins. In case of heavy infestation the leaves turn dark brick red 'hopper burn''

Leafhopper adult

Nymphs and adults

Procedure for observation

Count and record number of nymphs in three (top, middle and bottom) leaves of the plant. Record number of jassids on five plants per spot.

Shoot and fruit borer: (*Earias vittella*); fruit borer (*Helicoverpa armigera*)

Identification

E. vitella Larva bores into terminal shoots of young plants leading to death of the shoots. With the formation of the buds, flowers and fruits, the caterpillars of both *E. vitella* and *H. armigera* bore inside these and feed on inner tissues.

Infected buds & flowers will shed. Entrance hole is plugged with excreta. Fruits become deformed in shape with no market value.

For identification of *H. armigera* larva and adults please refer under chilli *E. vitella* adults are small measuring 1.25 cm across the forewing. Forewings are pale white with a wedge shaped horizontal green patch in the middle. Larvae brownish with white streaks dorsally and pale yellow ventrally.

H. armigera larvae

E. vitella larvae

Procedure for observation

Count separately number of fruits damaged by fruit borers (*E. vitella* and *H. armigera*) out of 50 fruits observed in a spot of five plants.

Red spider mite (*Tetranychus telarius*)

Symptoms

Larvae & nymphs are greenish red while adults are oval, reddish brown in colour. Mites feed on the under surface of leaves and the affected leaves gradually start curling and get wrinkled and crumpled.

Mite infestation on leaf

Procedure for observation

Count and record number of mites in 2 cm^2 area of leaf in three (top, middle and bottom) leaves of the plant. Record number of mite on five plants per spot.

Whitefly (*Bemicia tabaci*)

Identification

Female lays stalked yellow spindle shaped eggs singly on the lower surface of the leaf. Nymphs are oval, scale like and remain attached to the leaf surface. Adults are tiny, with yellowish body and wings coated with milky white waxy powder. Nymphs and adults suck the sap usually from the under surface of the leaves and excrete honeydew. Plant shows stunted growth. It also transmits the vein mosaic virus.

Whitefly

Procedure for observation

Count and record number of whitefly adults in three (top, middle and bottom) leaves of the plant. Record number of whitefly on five plants per spot.

Aphid (*Aphis gossypii*)

Identification

Nymphs are light yellowish black or brownish. Adults are mostly wingless but few winged forms also seen.

Colonies of nymphs and adults are found often on tender shoots and as a result of sucking of vital sap from the tissues, crinkling and curling of leaves takes place. Leaves appear shiny and sticky due to honeydew excreted by the aphids. Later sooty mould grows on honeydew and leaves have a black coating.

Procedure for observation

Count and record number of aphids in three (top, middle and bottom) leaves of the plant. Record number of aphids on five plants per spot.

Diseases

Yellow vein mosaic (begomo virus)

Symptoms

Characteristic symptom is the interwoven network of yellow veins encompassing with islands of green tissues on leaves which later turns yellow. The plants remain stunted or yellowish green in colour. Infection restricts flowering and fruits, if formed, may be smaller, yellowish and harder. It is transmitted by white fly.

Infested leaf

Procedure for observation

Visually observe and record severity scale (0-6) in five randomly selected plants in each spot.

Powdery mildew (*Erysiphe cichoracearum*)

Symptoms

Initially white superficial spots appear on leaves, but entire surface may be covered with powdery mass. Severely affected leaves turn yellow and shrivelled. Severe infection will cause the leaves to roll upward and scorch which may result in heavy leaf shed.

Symptoms on leaf

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Cercospora **leaf spot** *Cercospora malayensis* **and** *C. abelmoschi*

Symptoms

Initially, brown irregular spots surrounded by red or pink coloration appear generally on the lower leaves and progress with newer lesions appearing on the younger, upper leaves. As the disease advances, the leaf spots enlarge and eventually merge to cover the entire leaf, which then turns necrotic and often rolls as it dries, but remains attached to the stem.

Symptoms on leaf

Procedure for observation

Visually observe and record severity scale (0-5) in five randomly selected plants in each spot.

Alternaria leaf spot (*Alternaria alternata / A. chlamydospora*)

Symptoms

Appear as minute yellow specks in older leaves and stems which darken and enlarge into circular, tan to dark brown spots sometimes with concentric rings. A yellow halo may surround the lesion. As the disease progresses, it spreads to all aerial parts of the plant.

Procedure for observation

Visually observe and record severity scale (0-9) in five randomly selected plants in each spot.

Disease rating	*Alternaria* leaf blight	Disease rating	*Cercospora* leaf spot
0	No symptoms on leaves	0	No infection
1	Upto 1% leaf area covering with small brown spots	1	1 to 5% of total foliage affecting
3	2 to 10% leaf area covering with concentric ring small brown to black spots covering	2	6 to 10 % of total foliage affecting with dark brown lesions
5	11 to 25% leaf area affected	3	11 to 35 % of total foliage affecting with more severe on lower leaves
7	26 to 50% leaf area affected with lesions enlarging	4	36 to 70 % of total foliage affecting with slight defoliation
9	More than 51% leaf area affected with lesions enlarging up to 10 mm	5	More than 71% of total foliage affecting with numerous lesions and defoliation advancing

Disease rating	Yellow vein mosaic	Disease rating	Powdery mildew
0	No disease	0	No symptoms
1	1 to 10 % of vein clearing	1	Up to 10% area of leaves/plant parts covered
2	11 to 25% of vein of small leaves become yellowing	2	11 to 25% area
3	26 to 50% yellow network of some leaves	3	26 to 50 % area
4	51 to 60% yellow network on all leaves	4	51 to 75 % area
5	61 to 70% of complete leaves turn yellow or cream colour	5	More than 76% area of leaves/plant parts covered with drying and defoliation
6	More than 71% yellow network and plant stunted, deformed whole plants become colourless		

- Data sheet for pest observation in field (Annexure-XIV)

3.2 Fruits

3.2.1 Kinnow

Insect pests

Citrus psylla (*Diaphorina citri*)

Identification

Psylla is 3-4 mm long, mottled brown with transparent wings. Nymphs are orange yellow in colour. Damage is caused by both nymphs and adults by sucking the cell sap from the leaves, tender shoots and flowers causing curling of leaves, defoliation and drying of twigs. Insect also transmits citrus greening disease. In case of severe attack, the leaf buds, flower buds and leaves may wilt and die. Peak period of infestation is from March to mid-October.

Infected young shoot

Procedure for observation

Count and record number of psylla on 10 cm shoot top in each direction. (east/west/north/south) per tree.

Leaf miner *(Phyllocnistis citrella)*

Identification

Adults is a tiny silvery-white moth about 2 mm long with fringed wings. Forewings have brown stripes and a prominent black spot near the apical margin while hind wings pure white with a wing spread of 4-5 mm. Characteristic symptom of leaf miner is the presence of silvery serpentine mines usually on the under surface of the leaf. Each leaf has

mostly a single mine, but during heavy infestation several mines per leaf are noticed.

Mines by leaf miner

Fruit mined by leaf

Procedure for observation

Count and record number of mined leaves in five randomly selected leaves in each direction (east/west/north/south) per tree. Record such data on 5 plants (tree) per field.

Whitefly (*Dialeurodes citri*)

Identification

Adult is about 1.5 mm long with white or greyish wings, pale yellow body and red constricted eyes. Nymphs are stationary, oval, scale like, blackish with marginal bristle like fringes. Both nymphs and adults suck the plant sap and secrete honeydew which lead to sooty mould on leaves.

Whitefly on leaves

Procedure for observation

Count and record number of whitefly in five randomly selected leaves in each direction (east/west/north/south) per tree and 5 plants per field.

Aphid (*Toxoptera aurantii*, *Aphis gossypii* and *Myzus persicae*)

Identification

Aphid is soft bodied, tiny sucking insects, measuring less than 2 mm in length and are pale yellowish green to black in colour. Nymphs and adults suck sap from tender leaves and shoots. Affected leaves turn yellow, get curled, deformed and dry up.

Affected plant

Procedure for observation

Count and record the number of aphids in five randomly selected leaves in each direction (east/west/north/south) per tree. Record such data on 5 plants (tree) per field.

Diseases

Citrus canker (*Xanthomonas axonopodis*)

Symptoms

Canker lesions start as pinpoint spots and attain a diameter of 2 - 10 mm. Characteristic symptom on leaves is the yellow halo that surrounds lesion. Lesions on fruit and stems extend 1-3 mm depth and are superficially similar to those on leaves.

Canker on leaves

Fruit rind blemishing

Procedure for observation

Visually assign rating to each of one square feet area (leaves) according to severity scale (0-5) and record rating in three such randomly selected area in each direction. Average the rating of the three randomly selected area / direction and record.

Disease rating	Description
0	No disease
1	1-20% leaf area covered
2	21-40% leaf area covered
3	41-60% leaf area covered
4	61-80% leaf area covered
5	81-100% leaf area covered

Citrus gummosis/Foot rot (*Phytophthora* spp.)

Symptoms

Profuse gumming on the surface of the bark on tree trunk from which gummy substance oozes out. Affected bark turns dark brown and develops longitudinal cracks. Affected plants show stunted growth with pale green foliage

Symptoms of gummosis

Procedure for observation

Count and record number of infected plants in 25 randomly selected plants per field.

Citrus greening *(Candidatus liberibacter)*

Symptoms

Greening infected leaves are generally small, upright and frequently have green veins and chlorotic interveinal areas. Pre-mature defoliation, dieback of broken and greening of fruit are additional symptoms. However, confirmation through molecular diagnosis is important.

Procedure for observation

Count and record number of infected plants in 25 randomly selected plants per field.

- Data sheet for pest observation (Annexure-IX)

Annexure - I

Schedule for surveillance

Day	Schedule for pest scouts	No. of fields
Monday	Village 1	4 fixed field and 4 random fields
Tuesday	Village 2	4 fixed field and 4 random fields
Wednesday	Village 3	4 fixed field and 4 random fields
Thursday	Village 4	4 fixed field and 4 random fields
Friday	Village 5	4 fixed field and 4 random fields
Saturday	Checking data/Uploading of pest data and survey in high pest incidence village	–

Annexure - II

Proforma - 1

Data sheet for general information in nursery

Nursery survey

S. No.	Name of Village	Name of cultivar/ Hybrid	Sowing during the season (Early/mid/ late)	Date of sowing	Seed treatment
1					
2					
3					
4					
5					

Annexure – III

Proforma - 2

General information of fixed fields in main crop field
(to be filled only once in the beginning of the season)

(Use separate sheet for each field)

Field no.	Farmer name	Previous crop	Date of transplant-ing	Seedling treatment	Type of crop	Stacking	Spacing (cm)	Approx. area (acre)	Crop in adjacent field

Annexure - IV

Data sheet for nursery pests in Tomato

Plant no.	Whitefly (Per seedling)	Aphids (Per seedling)	Damping off (Infected seedlings out of 50 seedlings in 5 spots)	*Alternaria* blight (Infected seedlings out of 50 seedlings in 5 spots)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Data sheet for pest observation in Tomato fields

Spot no.	Plant number	Insect pests			Disease				
		Whitefly (Numbers per five leaves)	Aphids (Numbers per five leaves)	Fruit borer No. of infected fruits out of 50 fruits	Early blight (Rating)	Late blight (Rating)	Wilt (Rating)	Leaf curl (Infected plants out of 10 plants)	Any other
1	1								
	2								
	3								
	4								
	5								
2	1								
	2								
	3								
	4								
	5								
3	1								
	2								
	3								
	4								
	5								
4	1								
	2								
	3								
	4								
	5								
5	1								
	2								
	3								
	4								
	5								
	5								

Annexure - VI

Data sheet for nursery pests of Cole crops (Cabbage/Cauliflower)

Plant no.	Cabbage borer/ Head borer (No. per seedling)	Damping off (Infected seedlings out of 50 seedlings in 5 spots)	Downy mildew (Infected seedlings out of 50 seedlings in 5 spots)	*Alternaria* blight (Infected seedlings out of 50 seedlings in 5 spots)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Data sheet for pest observation in fields of Cole crops (Cauliflower/Cabbage)

Spot no.	Plant no.	Insect pests			Disease		
		Diamond back moth (Larvae per Plant)	Tobacco caterpillar (Larvae per plant)	Aphids (Per leaf per plant)	Black Rot (Rating)	*Alternaria* leaf spot/Blight (Rating)	Any other
1	1						
	2						
	3						
	4						
	5						
2	1						
	2						
	3						
	4						
	5						
3	1						
	2						
	3						
	4						
	5						
4	1						
	2						
	3						
	4						
	5						
5	1						
	2						
	3						
	4						
	5						
	5						

Annexure-VIII

Data sheet for pest observation in Cucurbitaceous fields

Spot no.	Plant no.	Insect pests					Disease					Any other
		Red pumpkin beetle/ plant	Whitefly adults (Numbers per five leaves)	Mite (Per five leaves)	Thrips (On top 10 cm shoot per vine)	Mirid bug (Numbers on 20 fruits per spot)	Downy Mildew (Rating)	*Cercospora* leaf spot (Rating)	*Anthracnose* (Rating)	Gummy/Collar rot (Infected plants out of 10 plants)	Viral disease (Infected shoot out of 10 shoots)	
		Bottle gourd/ Cucumber	Bitter gourd/ Cucumber	Cucumber	Bitter gourd/ Cucumber	Bottle gourd	Cucumber	Bottle gourd/ Bitter gourd	Bottle gourd	Bottle gourd	Bottle gourd/ Bitter gourd/ Cucumber	
1	1											
	2											
	3											
	4											
	5											
2	1											
	2											
	3											
	4											
	5											
3	1											
	2											
	3											
	4											
	5											
4	1											
	2											
	3											
	4											
	5											
5	1											
	2											
	3											
	4											
	5											

Annexure - X

Data sheet for nursery pests of Chilli

Plants group of 10 plants	Damping off (Infected seedlings out of 50 seedlings)	Whitefly (Per seedling)
1		
2		
3		
4		
5		

Annexure-XI

Data sheet for pest observation in Chilli fields

Spot no.	Plant no.	Insect pests						Disease						
		Thrips (Numbers per top 3 young leaves)	Yellow mite or broad mite (Numbers/ top 3 young leaves)	Whitefly (Numbers per three leaves)	Gall midge Infected fruits out of 50 fruits (No.)	Tobacco caterpillar (*Spodopteralitura*) (Larvae per plant)	Fruit borer (*Helicovera armigera*) Infected fruits out of 50 fruits (No.)	*Cercospora* leaf spot (Rating)	Die back/*Anthracnose* (Rating)	Powdery mildew (Rating)	Wilt (Infected plants out of 10 plants)	Leaf curl (rating)	*Anthracnose* fruit rot Infected fruit out of 50 fruits (No.)	Any other
1	1													
	2													
	3													
	4													
	5													
2	1													
	2													
	3													
	4													
	5													
3	1													
	2													
	3													
	4													
	5													
4	1													
	2													
	3													
	4													
	5													
5	1													
	2													
	3													
	4													
	5													
	5													

Annexure - XII

Data sheet for nursery pests of Brinjal

Plants group of 10 plants	Damping off (Infected seedlings out of 50 seedlings)
1	
2	
3	
4	
5	

Data sheet for pest observation in Brinjal fields

Spot no.	Plant no.	Insect pests								Disease						
		White fly (Numbers per three leaves)	Aphids (Numbers per three leaves)	Red spider mite (Numbers per three leaves)	Jassid nymphs (Numbers per three leaves)	Hadda beetle Grubs and adults (Numbers per three leaves)	Shoot borer (Number of infected shoots/ plant)	Leaf roller (Number Of rolled leaves/ plant)	Fruit borer No. of Infected fruits out of 25 fruits	*Cercospora* leaf spot (Rating)	*Fusarium* wilt (Infected plants out of 10 plants)	Little leaf (Infect plants out of 10 plants)	*Phomopsis* fruit rot No. of Infected fruits out of 25 fruits	*Alternaria* leaf spot (Rating)	*Phomopsis* blight (Rating)	Any other
1	1															
	2															
	3															
	4															
	5															
2	1															
	2															
	3															
	4															
	5															
3	1															
	2															
	3															
	4															
	5															
4	1															
	2															
	3															
	4															
	5															
5	1															
	2															
	3															
	4															
	5															

Annexure-XIV

Data sheet for pest observation in Okra fields

Spot no.	Plant number	Insect pests						Disease				
		Whitefly (Numbers per three leaves)	Aphids (Numbers per three leaves)	Red spider mite (Numbers per three leaves)	Jassid nymphs (Numbers per three leaves)	Fruit borer (*E. vittella*) No. of infected fruits out of 50 fruits	Fruit borer (*H. armigera*) No. of infected fruits out of 50 fruits	*Cercospora* leaf spot (Rating)	Powdery mildew (Rating)	Yellow vein mosaic (Rating)	*Alternaria* leaf spot/ blight (Rating)	Any other
1	1											
	2											
	3											
	4											
	5											
2	1											
	2											
	3											
	4											
	5											
3	1											
	2											
	3											
	4											
	5											
4	1											
	2											
	3											
	4											
	5											
5	1											
	2											
	3											
	4											
	5											

Annexure-IX

Data sheet for pest observations in kinnow

Plant no.	Plant side	Insect pests			Disease			
		Citrus psylla population/ 10cm shoot	Leaf miner (Mined leaves/5 leaves)	Whitefly adults (Per five leaves)	Citrus canker (Rating)	Citrus gummosis/ Foot rot (Infected plants out of 25 plants)	Citrus greening (Infected plants out of 25 plants)	Any other
1	East							
	North							
	West							
	South							
2	East							
	North							
	West							
	South							
3	East							
	North							
	West							
	South							
4	East							
	North							
	West							
	South							
5	East							
	North							
	West							
	South							

Notes

Notes