



IPM PACKAGE NO. 54



**INTEGRATED
PEST MANAGEMENT
PACKAGE**

FOR

PEACH



Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation
Directorate of Plant Protection, Quarantine & Storage
N. H. IV, Faridabad - 121 001.

IPM PACKAGE FOR PEACH

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Ministry of Agriculture

Department of Agriculture & Cooperation

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FOREWARD

Integrated Pest Management (IPM) approach has been globally accepted for achieving sustainability in agriculture. It has become more relevant due to a number of advantages like safety to environment, pesticide-free food commodities, low input cost based Crop Production Programme etc. Though IPM approach has been taken up since 1981, its impact has not been felt until 1994. Human Resource Development has helped to sensitise extension functionaries and farmers about the usefulness of IPM.

For successful implementation of IPM, the scattered information on various components of this eco-friendly approach forms basic necessity. In this direction, initial attempts were made in 1992 to harmonise the IPM Package of Practices of various crops. Subsequently, concerted efforts were made in 1998, 2001, 2002 and 2003 to update and develop IPM Package of Practices for agricultural and horticultural crops. Presently, IPM Package of Practices for 77 crops have been finalized to help the extension workers and farmers to manage the pests and diseases and to minimize the over use/misuse of chemical pesticides. Efforts have been made to incorporate the relevant available technical input provided by the scientists of ICAR Institutes/ SAUs and State Departments of Agriculture/Horticulture. However, suggestions for further improvement in future publication/ revision will be of immense help. Hopefully, these IPM Package of Practices will be useful for the Researchers, Plant Protection Workers and Farmers alike.


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(P. S. CHANDURKAR)

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P R E F A C E

In order to minimize the indiscriminate and injudicious use of chemical pesticides, INTEGRATED PEST MANAGEMENT (IPM) has been enshrined as cardinal principle of Plant Protection in the overall Crop Protection Programme under the National Agricultural Policy of the Govt. of India. IPM is an eco-friendly approach for managing pest and disease problems encompassing available methods and techniques of pest control such as cultural, mechanical, biological and chemical in a compatible and scientific manner. The greater emphasis has been given on biological control including use of biopesticides.

With a view to provide technical knowledge to the extension functionaries and farmers in the States, first National Workshop on IPM for harmonization of Package of Practices was organized at National Plant Protection Training Institute (NPPTI), Hyderabad during June 29-30, 1992. Subsequently workshops were organized on April 15-17, 1998 and Nov. 5-6, 1998 at the Directorate of Plant Protection, Quarantine & Storage, Faridabad and IPM Package of Practices for 20 crops were finalized on rice, cotton, vegetables, pulses and oilseeds. In this series, two National Workshops on IPM have been conducted at NPPTI, Hyderabad and Dte. of PPQ&S, Faridabad during 14-17, 2001 and Feb. 20-22, 2002 respectively to update 20 available IPM Packages and develop 31 new IPM Packages especially for horticultural crops. Sixth and Seventh National Workshop held at Central Insecticides Laboratory, Faridabad on 4th-5th July, 2002 and 9th-10th January, 2003 respectively for 18 IPM Packages and Eighth National Workshop was held at NPPTI, Hyderabad on 28th-29th May, 2003 for 8 IPM Packages. In these Workshops, 77 IPM Package of Practices for cereal crops (Rice, Wheat, Maize, Sorghum, Millets), commercial crops (Cotton, Sugarcane, Tobacco, Tea, Betelvine, Saffron), pulse crops (Pigeonpea, Gram, Black gram/Green gram, Pea, Rajma), oilseeds (Groundnut, Soybean, Rapeseed/Mustard, Sesame, Olive, Safflower, Castor, Sunflower, Oilpalm), vegetables (Potato, Onion, Tomato, Brinjal, Okra, Chillies, Cruciferous vegetables, Leguminous vegetables, Cucurbitaceous vegetables, Broccoli, Spinach, Lablab bean, Garlic), fruits (Citrus, Banana, Apple, Mango, Guava, Grapes, Jackfruit, Pineapple, Sapota, Pomegranate, Litchi, Papaya, Apricot, Peach, Pear, Cherry, Walnut, Ber, Amla, Loquat, Strawberry, Watermelon, Fig, Phalsa, Persimmon, Custard apple, Raspberry, Kiwi, Passion fruit), spice and plantation crops (Small Cardamom, Large Cardamom, Black Pepper, Ginger, Coriander, Cumin, Fennel, Coconut, Cashew and Arecanut) have been finalized.

IPM technology manages the pest population in such a manner that economic loss is avoided and adverse side effects of chemical pesticides are minimized. The IPM packages encompass various management strategies for containing the pest and disease problems. Pest monitoring is one of the important components of IPM to take proper decision to manage any pest problem. It can be done through Agro-Ecosystem Analysis (AESA), field scouting, light, pheromone, sticky/yellow pan traps. The economic-threshold levels (ETL) of important pests and diseases are also given in the packages to take appropriate control measures when pest population crosses ETL.

These IPM packages developed with the technical inputs from experts from Indian Council of Agricultural Research, State Agricultural Universities, Central Directorate of Plant Protection, Pesticide Industries and State Departments of Agriculture/Horticulture will provide technical backup in the management of pests, diseases, weeds, nematodes and rodents in the agriculture and horticulture. These will also be useful in reducing the pesticide residues in agricultural commodities and would also help in the management of pests/diseases/weeds/nematodes which may get inadvertently introduced in the country.

IPM Package of Practices for agricultural and horticultural crops will be helpful to minimize the ill-effects of chemical pesticides to promote the IPM for sustainable production. These IPM packages will be useful for the researchers, extension workers and farmers alike who are engaged in the agricultural practices.

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- | | | |
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IPM PACKAGE FOR PEACH

I. MAJOR PESTS

A. PESTS OF NATIONAL SIGNIFICANCE:

1. Insect pests:

- | | | |
|-----|---------------------|--|
| 1.1 | Stem borer | (<i>Aeolesthes sarta</i>) |
| 1.2 | Flat headed borer | (<i>Chrysobothris mali</i> & <i>Capnodis</i> sp.) |
| 1.3 | Peach tree borer | (<i>Saninoidea exitiosa</i>) |
| 1.4 | Defoliating beetle | (<i>Protactia neglecta</i> & <i>Adoretus</i> sp.) |
| 1.5 | Hairy caterpillar | (<i>Lymantria obfusate</i>) |
| 1.6 | San-Jose scale | (<i>Quadraspidiotus perniciosus</i>) |
| 1.7 | Apricot brown scale | (<i>Iecaeum corni</i>) |

2. Diseases:

- | | | |
|------|---------------------------|---|
| 2.1 | Frosty mildew | (<i>Cercospora perici</i>) |
| 2.2 | Peach leaf curl | (<i>Taphrina deformans</i>) |
| 2.3 | Leaf spot | (<i>Phyllostica cerasicola</i>) |
| 2.4 | Powdery mildew | (<i>Podosphaera oxycanthae</i>) |
| 2.5 | Coryneum blight/shot hole | (<i>Stigmina corpophylla</i>) |
| 2.6 | Silver leaf and canker | (<i>Chondrostereum purpureum</i>) |
| 2.7 | White root rot | (<i>Dematophora necatrix</i>) |
| 2.8 | Whiskers rot | (<i>Rhizopus stolonifer</i>) |
| 2.9 | Peach rust | (<i>Tranzschelia discolor</i>) |
| 2.10 | Collar rot | (<i>Phytopathora</i> sp. <i>Pythium</i> sp.) |

B. PESTS OF REGIONAL SIGNIFICANCE :

- | | | |
|-----|--------------------------------------|-------------------------------------|
| 1.1 | Green peach aphid | (<i>Myzus persicae</i>) |
| 1.2 | Tent caterpillar | (<i>Melacosoma kashmiriensis</i>) |
| 1.3 | Leaf roller | (<i>Archips subsidiaria</i>) |
| 1.4 | Black peach/Leaf curling aphid | (<i>Anuraphis persicae-niger</i>) |
| 1.5 | Apricot fruit borer/peach twig borer | (<i>Anarsia lineatella</i>) |

- | | | |
|------|---------------------|--------------------------------|
| 1.6 | Root borer | <i>(Lophosternus hugelli)</i> |
| 1.7 | Conspere stink bug | <i>(Euschistis conspersus)</i> |
| 1.8 | Peach fruit fly | <i>(Drosophila moles)</i> |
| 1.9 | Green capsid | <i>(Lygus pabulinus)</i> |
| 1.10 | Blue beetle | <i>(Heltica semipicens)</i> |
| 1.11 | Blossom thrips | <i>(Taeniothrips sp.)</i> |
| 1.12 | Rose chaffer beetle | <i>(Macrodactylus sp.)</i> |
| 1.13 | Oriental fruit moth | <i>(Grapholitha molesta)</i> |

2. Termites

- | | | | |
|----|---------------------|------|---------------------------------|
| 3. | Root knot nematodes | i) | <i>(Meloidogyne incognita)</i> |
| | | ii) | <i>(Pretylenchus pruni)</i> |
| | | iii) | <i>(Macronothemia nematoda)</i> |

II. SEASONAL VARIETIES / CULTIVARS RECOMMENDED FOR CULTIVATION

A. Temperate Areas/Regions:

Early Season	Local Name	Maturity period
i) Saharanpuri	Sahoranpure-1	3 rd week of June
ii) World's Earliest	Sahoranpure-1	3 rd week of Juen
iii) Alton		
iv) Early white giant		
v) Snow queen		
vi) Red haven		

B. Mid season:

i) Peshawari		Ist to 2 nd week of July
ii) July Elberta	Amba Chanun – 1	Ist to 2 nd week of July
iii) Kanto – 5		
iv) Shimizu Hakuto		
v) Sun Haven		

C. Late season:

i) Elberta	Amba Chanun – 2	Last week of July to Ist week of August
ii) Quetta	Quelta	Last week of July to Ist week of August

D. Low Hills / Sub Tropical Regions:

i) Flordasun	Summer set
ii) Shan-i-Punjab	
iii) Florida Red	
iv) Sharbati	

IMPROVEMENT OF FRUIT SET, YIELD & QUALITY (STRUCTURE):

1. In locations where the productivity is low, Biozyme and Protozyme @ 3 ml./lt. water can be sprayed at bud swell and petal fall stage to improve fruit set & yield.
2. Best blossom thinning can be obtained with the spray of 1300 ppm. ethephon (1 ml/ltr water).

III. PEST MONITORING

A. Agro-Eco-System Analysis (AESA):

AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyse field situations with regard to pests, defenders, soil conditions, plant health, the influence of climatic factors and their interrelationship for growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices. The basic components of AESA are:

1. Plant health at different stages.
2. Built-in-compensation abilities of the plants.
3. Pest and defender population dynamics.
4. Soil conditions.
5. Climatic factors.
6. Farmers past experience.

The details of the AESA are given in Annexure-I.

B. Survey/Field scouting:

The objective of surveys through roving surveys is to monitor the initial development of pest and disease in the endemic areas. Therefore, in the beginning of crop season, i.e. from March 1st week survey routes based upon the endemic areas are required to be identified to undertake roving surveys from mid of March i.e. green tip stage/bud swell. Based upon the results of the roving surveys, the state extension functionaries have to concentrate for greater efforts at block and village levels as well as through farmers to initiate field scouting especially to know the proper bud stage for applying the delayed dormant oil spray if required. Therefore, for field scouting farmers should be monitized to observe the pest and disease occurrence at the intervals as stipulated under different fruit developmental stages. The plant protection measures are required to be taken only when pest and diseases cross ETL as per result of field scouting.

1. **Roving survey:**

Undertake roving survey at every 5-10 km. distance or after every 5 orchards depending, on the plantation stretch both in linear and deep horizontal magnitudes, initially at 10 days intervals and thereafter at weekly intervals depending again on pest population intensity. Observe/identify the proper bud/growth stage for applying the dormant oil. Spray after taking the prevailing temperature into consideration which should not be less than 4⁰C for at least 48 hours. Observe 10 plants randomly in zig zag fashion in each orchard for recording the intensity/population of sucking pests and defoliators at the later growth stages i.e. from bud burst/petal fall to harvesting. Record population of potential different biocontrol fauna to arrive at the decision making stage. Record the occurrence and extent of diseases alongwith deficiency related disorders exhibited by the plant during the course of survey.

2. **Field scouting:**

Field scouting for pests and biocontrol fauna by extension agencies and farmers once in a week should be undertaken to work out ETL or pest defender ratio. For sucking pests different methodology is to be adopted. In case of scale infestation, scale count should be taken per unit area after flagging the particular limit of the plant while in case of mite, or other sucking pests count should be taken per leaf after taping the leaves randomly from periphery of the selected trees at chest/head height. The State Departments of Horticulture should make all possible efforts by using different media, mode and publicity to inform the farmers for field scouting in the specific crop area having indication of pest and disease build-up.

3. **Pest monitoring through traps:**

3.1 Through yellow sticky traps: Set up yellow fast coloured sticky traps, for monitoring the aphid, one trap/5 trees. Locally available empty yellow

Palmolive-tin coated with grease/Vaseline/caster oil an outer surface may also be used.

- 3.2 Through pheromone traps: Certain pests like gypsy moths require installation of pheromone traps to monitor initial pest build up and suppression of its increasing population. Sticky pheromone traps may also be used 5-7 traps per ha. for effective monitoring.
- 3.3 Through light traps: Most of the moths of leaf roller caterpillars and a few beetles of root/stem borers get attracted towards light during night. Therefore, installation of light traps in the orchards help in monitoring of initial build-up of pest population.

C. Economic Threshold Level (ETLs) :

Based upon the results of surveys/field scouting etc., the extension functionaries are to determine the ETLs for different pests to advise farmers to initiate pest management practices accordingly. For some fruit pests adequate sampling techniques are not available. This is particularly true for pests with non-uniform distribution such as scale insects, trunk borers, green fruit worms. Economic threshold level for spp. which attack foliage are difficult to establish because of the large number of variables involved, such as fruit to leaf ratio, weather, variety, time of year and tree vigour. However, it seems certain that there is a considerable tolerance for loss of leaves or leaf function in fruit trees.

The determination of economic injury levels and the development of effective survey techniques made possible the treating of portions of the orchard where predator prey ratios are unfavorable for biological control.

E.T.L. : Economic threshold level is the population density of pest at which control measures should be determined to prevent an increasing pest population from reaching the economic injury level (E.I.L.).

E.I.L. : It is the lowest population density of pest that will cause economic damage (E.D.).

E.D. : It is the amount of injury which will justify the cost of artificial control measures. These costs should be measured in the broadest sense possible.

S.No.	Name of pest	Range	Incidence/ Extent	Remarks
1.	San-Jose-scale	a) 1-5 scales/sample b) 6-12 scales/sample c) 13 & above/sample	Low Medium High	
2.	Tortrix moth	Appearance of infestation on the apical shoots exhibiting scorching.	--	Depending on survey observations.
3.	Hairy caterpillars	Appearance of caterpillars on foliage.	--	Depending on survey observations.
4.	Foliar diseases	a) Just appearance of diseases or upto 5% foliage affected. b) 6-15% foliage / twigs/limbs affected. c) > 15% of foliage / twigs / limbs affected	Traces/low Medium High	The level may be influenced by prevailing weather conditions and also vary from disease to disease.

IV. AGRO ECO SYSTEM ANALYSIS (AESAs)

The methodology of AESA is as under :

A. **Field observations** :

- a) Enter the orchard atleast 15 - 20 feet away from road/bund. Select a tree of medium size randomly.

- b) Record the visual observations on the following parameters :
 - i) Flying insects (both pests & defenders).
 - ii) Close observation on pest and defenders which remain on the plant.
 - iii) Observe pests like Mite, Scale insect, Aphid, defoliators, borers and defenders like lady bird beetle (LBB), Green Lace wings, Anthocorids Bugs, Spiders, Predatory Ants and Phytoseiid Mites.
 - iv) Record various diseases and their intensities.
 - v) Record insect damage in percentage or otherwise in case of non uniform pests like San-jose-scale.

- c) Select the trees for sampling. The sampling would depend largely on the size of the orchard. The trees selected for sampling should be representative of the entire orchard in size and cultivar. Preferably cultivars which are sensitive to the pests should be taken for sampling. The predator population is surveyed on the same tree and is accomplished by slowly walking around the periphery of the tree and recording the number of adults and larvae visually. The predator survey should be done before samples are collected/observed for determining the pest populations or extent of damage. For example, sampling scale insects, select two trees with same degree of scale infestation on various limbs. Mark/flag one infested limb on each tree as sampling area say 50 cm to 60 cm length with paint. From the marked area remove a sample approximately of 1.6 cm². Take 1st sample from the area at the lowest point on branch and later ones about 1.3 cm above. Take samples monthly from each limb. Count all live scales from the sample. Process the data

of two selected trees separately to correlate the population density changes over time between the two trees.

- d) Record soil conditions viz dry, wet or water lodged.
- e) Observe rodent live burrows.
- f) Repeat the steps from b to e at least on 5 trees in a diagonal row or criss cross fashion across the orchard to have overall average assessment of the orchard.
- g) Record the climatic factors viz. sunny partially sunny, cloudy, rainy etc. for the proceeding week.

B. Drawing :

First draw the plant with actual number of main limbs in the centre of a chart. Then draw pests on left side and defender on the right side. Indicate the soil condition, Rodent damage, etc. Give natural colours to all the drawings, for instance draw healthy plant with green colour, diseased plant/leaves with yellow colour. While drawing the pests and the defenders on the chart care should be taken to draw them at appropriate part of the plant, where they are seen at the time of observation. The common of the pest and defenders and their population count should also be given alongwith diagram. The weather factor should be reflected in the chart by drawing the diagram of sun just above the plant, if the attribute is sunny. If cloudy the clouds may be drawn in place of sun. In the case of partially sunny, the diagram of sun may be half masked with clouds.

C. Group Discussion and Decision Making :

The observations recorded in the previous and current charts should be discussed among the farmers and apprentice trainees by raising questions relating to change in pest and defender population in relation to crop stages, soil conditions, weather factors, such as rainy cloudy or sunny etc. The group may evolve a strategy based upon weekly AESA, ETL and corresponding change in P:D ratio and take judicious decision for specific pest management practices.

D. Strategy for Decision Making (Example) :

- i) The group members may closely observe the representative fruit trees for the prominent/characteristics symptoms of various diseases and their extent along with prevailing weather conditions and may accordingly suggest for sprays or no sprays.
- ii) In case of scale insects if 50% of scales are parasitized by its parasitoids or 2-3 lady bird beetles are present per infested twig, then there is no need of chemical spray.

AESA BY EXTENSION FUNCTIONARIES :

The extension functionaries during the regular visit to the village should mobilize the farmers, conduct AESA and critically analyse the various factors such as the pest population viz-a-viz defender population and their role in natural suppression of the pest, the influence of prevailing weather condition/soil conditions on the likely build up of defender/pest population. They may also take the decision based on the AESA, for application of neem formulations/safe pesticides for specific pest situation. Such an exercise may be repeated by the extension functionaries during every visit to the village and motivate the farmers to adopt AESA in their orchards.

AESA BY FARMERS :

After a brief exposure during IPM demonstrations/field trainings, farmers can practice AESA in their own fields. Wherever trained farmers are available their experiences could be utilised in training their fellow farmers in their own villages. Thus a large group of farmers could be made efficiently competent in undertaking weekly AESA thereby empowering themselves in decision making on any specific pest situations. Farmers-to-farmers training approach will go a long way in practicing IPM on a large area on sustainable basis.

V. INTEGRATED PEST MANAGEMENT STRATEGIES

A. Cultural practices:

- Proper soil selection be made for raising orchards of respective crops.
- Proper climatic factors / topography be considered for planting of the peach trees.
- Plant material for laying quality fruit orchard should be obtained from registered nursery.
- Avoid planting of saplings infested with scales, borers and diseases.
- Make use of recommended quantum of FYM in the soil for laying of nursery and laying of orchard.
- Make use of balanced dose of chemical fertilizers and avoid excessive use of nitrogen which should be used in split doses only.
- Remove the weeds from the orchards. Mulching of dry grass or hay 10-15 cms in thickness in the tree basins should be done.
- Apply white wash impregnated with glue regularly on the tree trunks to avoid sun burn and winter injury.
- If plants/ trees exhibit the deficiency of micro nutrients go for the application of the same on the basis of soil and leaf analysis.
- Growing of flowering plants especially marigold and maize on the peripheries will help in conservations of both predators and parasites.
- 2-3 Bee colonies/ha should be provided in each orchard at the time of bloom.
- Plant early maturing varieties like world's earliest and early white giant in case of peach fruit fly endemic areas.
- Proper irrigation schedule should be adopted.
- Trees should neither be forced to drought nor water lodging conditions.
- Rogue out infected plants.
- Avoid water lodging in the tree basin and improve the drainage of the orchard.

- Maintain vigour of the tree to keep away shot hole/pin hole borers, bark beetles and other pest infestation.
- Grow marigold, berseem and mustard's in between lines of plantation to check the nematode population.
- Make use of disease free bud wood for raising healthy nursery plants.
- Take proper care in handling the fruits to avoid bruises.
- Don't grow the nursery at the same site every year.
- Use nematode free planting stocks.
- Don't delay harvesting of fruits.
- Keep the trees as free as possible from mechanical wounds, winter injury, crotch separation and cankers.
- Proper pruning of trees be made for obtaining quality fruit and good yield.
- Pruning cuts should be made close to the branches leaving no stubs.
- Cut wounds should be covered with superior white lead paint.
- Solarization of nursery beds be undertaken to destroy soil pests.

B. Mechanical practices:

- Remove and destroy dead and dying fruit trees to ward off borer infestation.
- Prune and destroy the scale and borer infested twigs/branches.
- Collection and destruction of egg masses of hairy caterpillars especially from the barks of shade trees grown in the vicinity of the orchards be made.
- Stapling burlap skirts around tree trunks infested with hairy caterpillars and collection of larvae and pupae from May to end of June and ensure their destruction.
- Clean the stem borer hole with flexible wire and plug the hole with mud/cow dung.
- Cover the exposed part of the stem to sun with dry grass or gunny bags soaked with methyl parathion 0.1% once a month in March till October.

- Install a light trap near the orchard to collect and kill the beetles in kerosenized water.
- Shake non bearing trees over a cloth sheet at dusk and collect and destroy the collected insects.
- Clip off terminal shoots with unshed cluster of dry leaves in winter for the destruction of shoot borers.
- Collect and destroy the fallen fruits.
- Remove the dead bark and frass and apply water proof paint on hard wood to avoid borer attack.
- Add well rotten manure in case of termite infestation.
- Destroy termitaria in the vicinity of the orchards.
- Apply Mashobra paste after cleaning the weeping wounds at the time of dormancy break for the control of bacterial gummosis.
- Cover fresh wounds with Chaubatia paste or copper oxychloride paint.
- Remove the infected roots and apply chaubatia paste on the cut ends.
- Collect and destroy the grubs of root borers while preparing basins.
- Destroy the affected seedlings.
- Complete collection and destruction of foliage and pruned wood in the orchards itself after leaf fall be made.
- Clip off mildewed twigs and destroy them.
- Remove all the mummified fruits, dead fruits and prunings from the orchards.
- Prune off suckers and water sprouts.

C. Biological practices:

1. Soil borne diseases:

Root rot and collar rot control

1.1 Before laying or raising of plant nursery make use of *Trichoderma viride* and *T. harzianum* to control root rot disease and at later stages for control of collar rot also.

1.2 Make use of neem cakes while raising plant nurseries to ward off any soil pest.

2. Conservation:

- 2.1 Conserve the predators like Lace wings, Lady bird beetles, Carabids, Syrphids, Anthocorid bugs, Mirids bugs, Nabid bugs, Capsid bugs, Spiders, Predatory Ants, Phytoseiid mites, Parasitoids like *Encarsia*, *Aphytis*, *Trichogramma*, *Telenomus* etc. in orchard.
- 2.2 Growing of flowering plants, especially Marigold and Maize on the peripheries and legumes as inter cropping help in nematode management and conservation of both predators and parasitoids, especially *Chrysoperla* and *Anthocorids*.
- 2.3 Collection of egg masses of Hairy caterpillars and putting them in a fine meshed cage for emergence of egg parasites (*Anastatus* sp.) protect the parasites from orchard sprays. The larvae hatched may be destroyed.
- 2.4 Collect the different larval instars of hairy caterpillars (suspected parasitized) from orchards and place them in wire meshed cages for emergence of larval parasites like various species of *Exorista*, *Drino*, *Apanteles*, *Sarcophaga*, *Pollenia*, *Helina*, *Anilastus*, *Anthomyia*, *Euplectrus*, etc. to protect them from scheduled spray effects.
- 2.5 Collection of pupae of hairy caterpillar from the orchards and placing them in wire mesh cages for emergence of pupal parasites like various species of *Brachymeria*, *Monodontomerus*, *Hyposoter*, *Exorista* and *Pimpla* etc. to protect the parasitoids from scheduled spray effects.

3. Augmentation:

- 3.1 Monitor the incidence of sucking pests like scale insects, Aphid and make release of:

- A. Predators : Lady bird beetles like *Chilocorus bijugus*, *Pharoscygnus horni*, *Coccinella septumpunctata*, *Chilocorus tristis*, *Adalia bipunctata*, *Synharmonia sp.* *Exochomus quadripustulatus*, *Hippodamia convergens*, *Stethorus sp.* @ 30-50 adults/infested tree.
- (ii) Green lace wings – *Chrysoperla sp* and *Syrphus sp.* 10-20 1st instar larvae/tree.
- B. Parasitoids: *Encarsia perniciosi* and *Aphytis diaspidis* @ 2000/infested tree at least 15 days after insecticidal sprays and 10 days after fungicidal sprays against scale insects. The dosage may vary depending upon the intensity and extent of damage.

D. Chemical control measures:

1. Need based judicious and safe application of pesticides are the most vital tripartite segments of chemical control measures under the ambit of IPM. It involves developing IPM skills to play safe with environment by proper crop health monitoring. Observing ETL and conserving natural biocontrol potential before deciding in favour of use of chemical pesticides as a last resort.
2. Following suggestions have important bearing for success of control measures in the context of IPM strategy:
 - 2.1 The number of fungicidal and insecticidal sprays recommended in Annexure-I/A & I/B can be minimized as per need after proper surveillance and pest intensity considering both biotic and abiotic factors.
 - 2.2 Avoid mixing of two or more insecticides/tank mixing.
 - 2.3 Repeated application of same pesticides should be avoided.
 - 2.4 Avoid use of synthetic pyrethroids which may cause resurgence of sucking pests.
 - 2.5 Use selective insecticides (Endosulfan) during early fruiting phase of crop growth.

2.6 Encourage use of neem based formulations.

2.7 Proper spray equipments should be used e.g.

Tractor mounted sprayers/power sprayers for effective spray coverage.

2.8 Use proper spray volume per unit area.

3. Cautions during spraying:

3.1 If operator feels giddiness, uneasy, he must discontinue spraying/dusting at once.

3.2 An operator should not continue spray/dust more than 4 hours at a stretch in a day.

3.3 An operator should not take up spray/dusting work with empty stomach.

4. Rodent management:

4.1 Adopt orchard sanitation.

4.2 Do not cultivate fodder crops especially oats in orchards.

4.3 Make use of Bromodiolon bait (0.005% a.i.) in two application at an interval of one week.

4.4 Adoption of community approach may be taken.

VI. STAGEWISE IPM PRACTICES

S. No.	Crop stage	Pest	Stage-wise IPM practices	
1.	Bud burst	Aphids, Thrips, Scale insects	Monitoring	Regular monitoring be conducted.
			Biocontrol	Conduct surveys and surveillance for conservation of natural enemies and observe P:D ratio.
			Chemical	Conduct sprays as per the recommendations (Ref. annexure 1-A), only after determining ETL.
		Bark eating & Chaffer beetles	Cultural	Maintain plant vigour by providing sufficient and balanced nutrients and avoid water stressing of the trees.
			Mechanical	Swab the infested branches and trunk with 10.0% carbaryl dust and soil in the ratio of 1.6 mixed with wheat or rice straw.
		Borers	Cultural	Maintain plant vigour by providing balanced dose of nutrients and avoid water stresses. Avoid trunk injury to the plant.
			Mechanical/ Chemical	Clean the holes and remove saw dust with flexible wire insert para dichloro benzene flakes and plug the holes and for more details (ref. annexure-II).
		Canker, Stigmia blight, Shot hole, Leaf curl	Monitoring	Conduct regular monitoring for the build up of diseases to determine the incidence/extent (ETL).
			Chemical	Apply recommended chemicals (ref. Annexure-1B).
2.	Petal Fall	Aphids, Thrips	Monitoring	Regular monitoring be conducted.
			Biocontrol	Conserve the natural enemies. Release <i>Encarsia sp.</i> Aphytis sp. @ 2000 adults/infested tree or L.B.B. 30-50 adults/infested tree or Chrysopa 10-20/1st instar larvae/tree.
		Peach rust, Leaf spot, Leaf curl	Monitoring	Conduct regular monitoring for the build up of diseases for determining incidence/ extent (ETL).
		Canker, P. mildew	Chemical	Apply the recommended chemicals (ref. Annex. I-B)
		P. Mildew	Mechanical	Clip off the mildewed twigs and destroy them.
3.	Fruit set	Thrips, Leaf Rollers, Hairy Caterpillars and Scale insects	Monitoring	Regular monitoring for the build up of pest and conservation of natural enemies.
			Biocontrol	Repeat the practice as mentioned

				under S.No. 2 above.
			Chemical	Apply the recommended chemicals (if needed) (ref. Annex. I – A)/
		Leaf Spot, Blight/Shot hole, Leaf Curl, P. mildew	Monitoring	Conduct monitoring and surveillance for the build up of the disease for determining incidence/extent (ETL).
			Chemical	Apply the recommended chemicals. IF needed (Ref. Annexure-I-B).
4.	Fruit Development	Aphids, Leaf Rollers, Fruit and Bark eating Beetles, Chaffer Beetles, Scale insects and Chalcid	Monitoring	Regular monitoring be conducted for determining ETL.
			Biocontrol	Repeat the practice as mentioned at S. No. 2 above.
			Chemical	Apply the recommended chemicals if needed (Ref. Annex. I-A)
		Hairy caterpillars	Mechanical	Burlapping of tree trunks may be done for the management of the pest.
		Leaf Spot, Blight, Bacterial Gummosis, Brown Rot	Monitoring	Conduct regular monitoring for determining the incidence/ extent (ETL)
			Chemical	Apply the recommended chemicals if needed (Ref. Annexure I-B).
		Chalcids	Mechanical	Collect and destroy all fallen fruits from the orchards.
5.	Preharvest	Aphids, Chalcids, Fruit & Bark eating beetles, Chaffer Beetles & scale insect	Monitoring	Regular monitoring and surveillance for determining the ETL.
			Biocontrol	Conservation of natural enemies be done. Repeat the practices as mentioned under S.No. 2 above.
			Chemical	Apply the recommended chemicals (Need based) only (Ref. Annexure I-A)
		Chalcids	Mechanical	Collect and destroy all the fallen fruits from the orchards.
		Hairy Caterpillars	Mechanical	Burlap skirts around the infested tree trunks for mass trapping of larvae and pupae and ensure their destruction.
6.	Post Harvest	Hairy Caterpillars	Mechanical	Scrap, collect and destroy the egg masses of the pest.
		Aphids, Chaffer beetles, Leaf Rollers, Bark eating beetles, scale insects and borers	Monitoring	Regular monitoring and surveillance be conducted for determining ETL.
			Biocontrol	Repeat the practices as mentioned at S. No. 2 above.
7.	Leaf Fall	Aphids, Chaffer beetles, Bark eating beetles	Monitoring	Regular monitoring be conducted for determining ETL.
			Biocontrol	Repeat the practices as mentioned at

				S.No. 2 above.
		Hairy caterpillars	Mechanical	Scrap, remove and destroy the egg masses of caterpillars.
		Borers	Mechanical	Uproot severely infested plants and their destruction. Pruning of borer infested twigs and their destruction. Repeat the practice as mentioned under S. NO. 1. Treatment of Basin soil with PDB.
		Blight, Shot hole/ Leaf spot, Leaf curl, bacterial gummosis, Canker, Frosty Mildew	Mechanical	Remove diseased branches, twigs and destroy them.
			Chemical	Apply the recommended chemical (Reg. Annexure I-B)
8.	Dormant stage	Scale insect	Mechanical	Pruning and destruction of scale infested branches / twigs. Removal and destruction of heavily infested young trees from the orchard. Removal and destruction of leftover/ culled infested fruits from the orchards. Removal of mummified fruits from the orchards.
			Chemical	In case of severe infestation go for the application of dormant oil (diesel spray) spray.
		Hairy caterpillars	Mechanical	To check the infestation during ensuring season collect and destroy the egg masses of the pest from in and around of the orchards.
		Borers	Cultural	Maintain vigour of the trees through proper fertilization. Avoid mechanical injury to the trees and cover the wounds with chaubatia paste.
			Cultural	Heavily infested trees/ dead/dying wood should be pruned and destroyed by burning to check the infestation for ensuring season. Clip off terminal shoots with unshed cluster of dry leaves in winter for the destruction of shoot borers.
		Water lodging	Cultural	Provide proper drainage in orchards to drain off the surface water.
		Canker, Coryneum blight, Shot hole, Root rot, Leaf curl	Mechanical	Apply wound dresser (lead paint or Bordeaux paste) on cut areas.
			Mechanical	Remove the infected roots and apply

				Chaubatia paste.
			Cultural	Avoid mechanical injury of the trees.
				Disease can be effectively controlled by adoption of judicious pruning of all dead wood and proper orchard management. Maintain vigour of the plants through proper fertilization. Improve the drainage of the orchard.
			Chemical	Apply the recommended fungicides. (Ref. Annexure I-B).

VII. MANAGEMENT PRACTICES FOR ENDEMIC PESTS & DISEASES

A. Borers (Stem, shothole and Bark Eating Borers):

1. Clear the holes with flexible wire and then insert 0.5 gm. of paradichlorobenzene (PDCB) in the hole and plug it with puddling material or insert cotton wick soaked with petrol or methyl parathion (1 ml./lt. water) or dichlorvas (0.15 ml./lt. /water) and plug the hole.
2. Place small quantity of crystals of Para-dichloro-benzene (PDCB) on the surface of the soil around the trucks of the tree during the leaf fall (September – October). The quantity of PDCB to be applied will vary with size of the tree. Apply the crystals in a ring completely encircling the trunk, with 1.0-3.0" distance from the trunk. Cover the crystals with the earth to confine the PDCB gas. Don't apply treatment during summer and late fall.
3. In case of localized infestation, swab the infested part with methyl parathion (0.2%) or spray with fenitrothion (0.05%).
4. Remove webbing and treat the main limbs and trunk of the attacked trees with 0.1% methyl parathion 50 EC and inject into the holes excavated by the caterpillars.
5. Swabbing infested branches and trunk with 10% carbaryl dust and soil in ratio of 1:6 mixed with Rice or Wheat straw.

B. Chaffer beetles:

Applying phorate 10G @ 1.5 kg. a.i./ha in the soil against the grubs of chaffer beetles.

C. Termites:

1. Drench the soil with chlorpyriphos (0.1%).
2. Treat the trunk and main roots of the affected plant with chlorpyriphos (0.1%).

D. Nematodes:

Use carbofuran granules 3 G @ 60 kg. / ha. in nursery beds and 100-300 gms./tree in orchards depending on the size of tree after fruit harvest.

E. Collar rot:

1. Clean the infected collar area with a sharp knife and apply Bordeaux paint.
2. Remove the soil around the collar region and expose the affected portion to sun.
3. Apply *Trichoderma harzianum* and *T. viride*. Irrigate 30 cm. radius around tree trunk with copper oxychloride or mancozeb 400-600 gms/100 lts. of water.

VIII. DO'S & DON'T IN PEACH FRUIT MANAGEMENT

Do's	Don't
A. Agronomical Practices	
1. Grow only recommended cultivars.	Do not grow under script material which vary greatly in fruiting pattern and pest susceptibility.
2. Consider soil profile and texture before establishing an orchard.	Don't establish an orchard in the soils not suited for cultivation of peach.
3. Orchards should be laid on hill sides or elevated areas having air and soil drainage	Don't raise the nurseries in low lying areas, especially where no drainage can be possible.
4. For producing quality fruits, the trees should be pruned properly as specified for each fruit crop.	Don't ignore pruning for getting good yield.
5. Trees should be irrigated whenever needed and wherever irrigation facilities are available.	Don't under/over irrigate the orchards.
6. Under rainfed conditions tree canopy should be weeded and hoed in late spring and basins should be prepared which must be covered with 10-15 cms. Of mulch (decomposed Pine Needles; straw, hay, cut-grasses and FYM etc.)	Under rainfed condition restrict the use of nitrogen into 2 split dose only. Don't over dose the trees with any of the fertilizers.
7. Trees should be supplied with FYM and apply the major and micro nutrients on the basis of soil and leaf analysis.	Thinning should be avoided if drought like conditions prevail and there are no irrigation facilities.

<p>8. Leguminous cover crops be grown in orchards to improve soil fertility, to prevent soil erosion and controlling of weeds.</p> <p>9. Fertilizers should be applied 30.0 cms. Away from the trunk in old trees.</p> <p>10. Orchards must be ploughed thoroughly in autumn for retention of moisture during winter and destruction of live Rodent burrows.</p>	<p>Don't apply the fertilizers and FYM close to the trunks especially in old trees.</p> <p>Don't ignore the white washing of tree trunks.</p>
<p>B. <u>Pest Management</u></p>	
<p>1. Water sprouts/shoots, suckers diseases, insect infested and intermingling branches should be removed as early as possible.</p> <p>2. Cut wounds should be painted thoroughly.</p> <p>3. Complete collection and destruction of foliage during leaf fall by decomposition.</p> <p>4. Conduct sprays during monitoring and evening only.</p> <p>5. Remove completely girdled and canker infested portions with sharp knives only and should be covered with Bordeaux paint.</p>	<p>Don't allow the water shoots, diseased and insect infested pant material to remain in the orchards.</p> <p>Don't leave pruned position un-painted.</p> <p>Don't burn collected foliage, instead use for making compost.</p> <p>Don't conduct spray operations during hot periods of the day.</p>

<p>6. While preparing delay Dormant oil sprays solutions add water to stock solution as per the recommendations only.</p> <p>7. Use recommended pesticides and spray technology only as per need and especially atleast 3-4 weeks prior to harvest.</p>	<p>Don't go for blanket sprays without field roving.</p>
<p>C. <u>Harvesting practices</u></p>	
<p>1. Make use of orchard ladder and skilled persons for fruit picking.</p> <p>2. Fruits should be harvested only after ensuring their proper maturity.</p> <p>3. Care should be taken to avoid any damage to the spurs during harvesting and bruises to the fruits.</p> <p>4. Harvested fruits should be placed gently in cushioned containers to avoid any damage/injury</p> <p>5. Place the harvested fruits on soft bed of grass in a cool dry and shady place.</p>	<p>Don't climb the tree for picking the fruits.</p> <p>Don't harvest premature fruits or delay in harvesting.</p> <p>Don't engage unskilled persons for picking.</p> <p>Make sure that the fruits don't get any would or bruises while harvesting/handling.</p> <p>Don't make use of containers without lining.</p>

PESTICIDES RECOMMENDED FOR PEST MANAGEMENT IN PEACH**A. Insect Pest:**

S.No.	Crop stage	Target Pest	Name of the Pesticides	Dosage (ml/100 lit water)	Remarks
1.	Dormant	San-Jose-Scale Scale, Chalcid, Twig borer, stem borer	Diesel emulsion or tree spray oil	6330 3000	When temperature is above 4.0 ^o c.
2.	Bud swell/Bud burst	Scales, Thrips, Chaffer beetles, Bark eating caterpillars and borers	Chlorpyrifos 20 EC Methyl demeton 25 EC Dimethoate 30 EC Monocrotofos 36 EC	100 80 100 140	Use any one of the chemicals
3.	Petal fall	Aphids, Scales, Thrips, Twig borer and Borers.	Endosulfan 35 EC Phosalone 35 EC Quinofos 25 EC Fentrothion 50 EC	140 140 100 200	Use any one of the chemicals if needed.
4.	Fruit let	Aphids, Scales, Thrips, Hairy caterpillar, Leaf borer, Chaffer beetles	Chlorpyrifos 20 EC Methyl demeton 25 EC Dimethoate 30 EC Malathion 50 EC	100 80 100 200	-do-
5.	Fruit Development stages	Scales, Aphids, Hairy caterpillars, Leaf rollers, Fruit & Bark eating Beetles, Chaffer Beetles and borers	Endosulfan 35 EC Phosalone 35 EC Quinofos 25 EC Fentrothion 50 EC	140 140 100 200	-do-
6.	Preharvest	Cherry fruit fly, Plum moth, Aphids and borers	Endosulfan 35 EC Phosalone 35 EC Quinofos 25 EC Fentrothion 50 EC	140 140 100 200	-do-

FUNGICIDES RECOMMENDED FOR DISEASE MANAGEMENT IN PEACH**B. Diseases:**

S.No.	Crop stage	Target Pest	Name of the Pesticides	Dosage (ml/100 lit water)	Remarks
1.	Dormant	Leaf curl, Canker, Root rot	Copper oxychloride 50 WP Bitertanol 25 WP	300 50	During late dormancy or when temp. becomes warmer above 10°C at least for 48 hours
2.	Bud swell/Bud burst	Stigmina blight/Shot hole, Leaf curl and Canker.	Copper oxychloride 50 WP Captan 50 WP Carberdazim 50 WP Thiophenate Methyl 50 WP	300 300 50 50	Repeat after 7-10 days any one the chemical.
3.	Petal fall	Leaf spot, Leaf curl, P. Mildew & Canker.	Mancozeb 75 WP Captan 75 WP Copper oxychloride 75 WP Carberdazim 50 WP Thiophenate Methyl Wettable Sulfur	300 200 300 50 50 300	Use any one of the chemicals if needed.
4.	Fruit let	Leaf spot, Stigmina blight, shot hole, Leaf curl and P. Mildew	Captan 75 WP Copper oxychloride 50 WP Carberdazim 50 WP Bitertanol 25 WP	200 200 50 50	-do-
5.	Fruit Development stages	Leaf spot, Stigmina blight, Bacterial Gummosis and Brown rot.	Mancozeb 75 WP Captan 75 WP Copper oxychloride 50 WP Carberdazim 50 WP Streptoclyline	250-300 300 300 50 10	-do-
6.	Leaf fall	Stigmina blight/Shot hole, Leaf spot, Frosty mildew, Bac. Gummosis and Canker.	Captan 75 WP Mancozeb 75 WP Copper oxychloride 50 WP Carberdazim 50 WP Streptoclyline	300 250-300 300 50 10	-do-

BASIC PRECAUTIONS IN PESTICIDE USAGE

A. **Purchase:**

1. Purchase only JUST required quantity e.g. 100,250,500 or 1000 g/ml for single application in specified area.
2. Do not purchase leaking containers, loose, unsealed or torn bags.
3. Do not purchase pesticides without proper/ approved LABELS.

B. **Storage:**

1. Avoid storage of pesticides in the house premises.
2. Keep only in original container with intact seal.
3. Do not transfer pesticides to other container.
4. Never keep them together with food or feed/ fodder.
5. Keep away from the reach of children and livestock.
6. Do not expose to sun-light or rain water.
7. Do not store weedicides along with other pesticides.

C. **Handling:**

1. Never carry/ transport pesticides along with food materials.
2. Avoid carrying bulk - pesticides (dusts / granules) on head, shoulders or on the back.

D. **Precautions for Preparing Spray Solution:**

1. Use clean water.
2. Always protect your NOSE, EYES, MOUTH, EARS and HANDS.
3. Use hand gloves, face mask and cover your head with cap.

4. Use polyethylene bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover the head (Do not use polyethylene bag contaminated with pesticides).
5. Read the label on the container before preparing spray solution.
6. Prepare spray solution as per requirement.
7. Do not mix granules with water.
8. Concentrated pesticides must not fall on hands etc. while opening sealed containers. Do not smell the sprayer tank.
9. Avoid spilling of pesticide solution while filling the sprayer tank.
10. Do not eat, drink, smoke or chew while preparing solution.
11. The operator should protect his bare feet and hands with polyethylene bags.

E. **Equipment:**

1. Select right kind of equipment.
2. Do not use leaky, defective equipment.
3. Select right kind of nozzle.
4. Don't blow/clean clogged- nozzle with mouth. Use old tooth- brush tied with the sprayer and clean with water.
5. Do not use same sprayer for weedicide and insecticide.

F. **Precautions for applying pesticides:**

1. Apply only at recommended dose and dilution.
2. Do not apply on hot sunny day or strong windy condition.
3. Do not apply just before the rains and also after the rains.
4. Do not apply against the wind direction.
5. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV sprayer.
6. Wash the sprayer and bucket etc with soap water after spraying.

7. Containers, buckets etc. used for mixing pesticides should not be used for domestic purposes.
8. Avoid entry of animals and workers in the fields immediately after the spraying.

G. **Disposal:**

1. Left over spray solution should not be drained in ponds or water lines etc. Throw it in barren isolated area, if possible.
2. The used/ empty containers should be crushed with a stone / stick and buried deep into soil away from water source.
3. Never re-use empty pesticide container for any purpose.