IPM PACKAGE NO. 55

INTEGRATED PEST MANAGEMENT PACKAGE

FOR

PEAR

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 PEAR

CONTENTS

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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.

Chandurkar. 14/8/03
(P. S. CHANDURKAR)

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PREFACE

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, Cucurbitacious 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.

7th October, 2003

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IPM PACKAGE FOR PEAR

I. MAJOR PESTS

A. PESTS OF NATIONAL SIGNIFICANCE

1. Insect pests:

1.1	San-jose-scale	(*Quadraspidiotus perniciosus)*
1.2	Cock chaffer beetle	(*Melolontha melolontha)*
1.3	Pear psylla	(*Psylla pericola)*
1.4	Green peach aphis	*(Myzus persicae)*
1.5	Chaffer beetle	(*Protactia neglecta)*
1.6	Stem borer	(*Aeolesthis sarta)*
1.7	Root borer	(*Lophosternus hugelli)*

(2) **Diseases:**

2.1	Scab	(*Venturia pirina)*
2.2	Seedling blight	(*Sclerotium rolfssi)*
2.3	Hairy root	(*Agrobacterium rhizogenes)*
2.4	Crown gall	(*Agrobacterium tumefaciens)*
2.5	White root rot	(*Dematophora necatrix)*
2.6	Collar rot	(*Phytophthora cactorum.)*
2.7	Marssonina blotch	(*Marssonina coronaria)*
2.8	Powdery mildew	(*Podosphaera leucotricha))*
2.9	Leaf spot	

i) *Mycosphaerella sp.*
ii) *Alternaria sp.*

B. PESTS OF REGIONAL SIGNIFICANCE

1.	**Insect Pests:**	
1.	Coding moth	*(Cydia pomonella)*
2.	Thrips	*(Taeniothrips sp.)*
3.	Mites	*(Panonychus ulmi) & (Tetranychus urticae)*
4.	Flat headed borer	*(Chrysobothris mali)*
5.	Leopard moth	*(Zeuzera murristrigata)*
6.	Leaf roller	*(Archips argyrospilus*
7.	Green weevil	*(Phyllobuis sp.)*
8.	May, June beetle	*(Adoretus sp.)*
9.	Green capsid	*(Lyguspabulinus)*
10.	Green aphis	*(Aphis pomi)*
11.	Blue beetle	*(Heltica semipicens)*
12.	Stik bug	*(Euschistus conspersus)*
13.	Tent hairy caterpillar	*(Malacosoma indica)*
2.	**Diseases**	
2.1	Canker & Die back diseases	
2.2	Bitter rot	*(Schizothyrium pomi)*
2.3	Virus diseases	
2.4	Mycoplasma diseases	
2.5	Lichen	
3.	**Rodent:**	
3.1	Smaller Bandicoot	*(Bandicota bengalensis)*
3.2	Soft furred field rat	*(Melardia meltada)*
3.3	Vole	*(Alticola sp.)*

II. 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 relationship for growing healthy crop. A critical analysis of the field situations will help or enhance in decision making skill for implementation of 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 -1.

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. 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. Therefore, for field scouting farmers should be mobilized 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 population 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. Observe/identify the proper bud/growth stage for applying dormant oil Spray. 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 biocontrol fauna to arrive at the decision making stage. Record the occurrence and extent of diseases along with deficiency related disorders exhibited by the plant during the course of survey.

2. Pest Monitoring through Traps:

2.1 Through yellow sticky traps: Set up yellow fast coloured sticky traps, for monitoring the aphis (one trap/5 trees). Locally available empty yellow Palmolive-tin coated with grease/Vaseline/caster oil on outer surface may also be used.

2.2 Through pheromone traps: Certain pests like gypsy moth and codling moth require installation of pheromone traps to monitor their initial pest build up and suppression of their increasing population. Sticky pheromone traps may also be used (5-7 traps per ha.) for effective monitoring.

2.3 Through light traps: Most of the moths of leaf roller and hairy 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.

3. Economic Threshold Levels (ETLs):

Based upon the results of survey/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 San-jose-scale, trunk borers and

green fruit worms. Economic threshold levels for insect spp. which attack foliage are difficult to establish because of the large number of variables involved, such as fruit to leaf ration, weather,variety, time of year and tree vigour.

The determination of economic injury levels and the development of effective survey techniques made possible the treating of certain parts orchard where predator prey ratio are unfavourable for biological control.

ETL: Economic threshold level is the population density of pest at which control measures should be applied to prevent an increasing pest population from reaching the economic injury level (EIL).

EIL: It is the lowest population density of pest that will cause economic damage (ED).

ED: 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.

ETLs of a few important pest of Pear are as below:

S.No.	Name of Pest	Range	Intensity	Sample size	Remarks
1.	San-Jose-scale	a) 1-5 scales/sample b) 6-12 scale/sample c) 13 & above/sample	Low Medium High	1.4 cm^2 1.4cm^2 1.4 cm^2	
2.	Mites	a) 1-4 mites/leaf b) 5-8 mites/leaf c) 8 & above/leaf d) 20 & above mites/leaf	Low Medium High High	1leaf 1leaf 1 leaf 1leaf	From petal fall stage to fruit dev. Stage. Post harvest stage

III. INTEGRATED PEST MANAGEMENT STRATEGIES

A. Cultural practices:

- Proper selection of cultivars, having commercial value and suitable for effective cross pollination be made.
- Deep medium textured and well drained soils may be selected for cultivation of pear. However, they can withstand in soils having high water table and poor aeration.
- Plant material for laying quality fruit orchard should be obtained from registered nursery.
- Avoid planting of saplings infested with scales, borers and diseases.
- For raising of nurseries, the soil. Selection be made which is free from pest infestation.
- 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 and phosphorus fertilizers which should be used in split doses only.
- If trees exhibit the deficiency of micro nutrients go for the application of the same on the basis of soil and leaf analysis.
- Adopt close planting on quince rootstocks for higher yields.
- Delay planting until the soil is reasonably dry and plant before the buds begin to burst.
- Leguminous cover crops should be grown in orchards to improve soil fertility, preventing soil erosion and controlling of weeds etc.
- Growing of flowering plants especially marigold and maize on the peripheries will help in conservation of both predators and parasites.
- In rich soils, the fertilizer doses may be halved or regulated on the basis of leaf analysis report.
- Plant two rows of main cultivar like Bartlett and one row of pollinizer or have 1 tree of pollinizer for 8 such trees.
- 3-4 Bee hives should be provided/ha, for better pollination.
- Need based irrigation must be provided to pear trees during the cropping season.

- Under rainfed/drought condtions, tree canopy should be weeded and hoed in late spring and basins should be prepared and covered with 10-15 cms. of mulch (Rotton Pine needles, Straw, Hay, Cut Grasses, FYM etc.)
- 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.
- Large wounds should be covered with superior white leaf paint/Bordeaux paint.
- Proper climatic factors/topography be considered for planting of the trees.
- 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.
- Proper irrigation schedule should be adopted.
- Trees should neither be forced to drought nor water lodging conditions.
- Rouge 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.
- 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 ensured.
- Staple burlap skirts around tree trunks infested with hairy caterpillars and collect the larvae and pupae from May to end of June and ensure their destruction.
- Clean the stem borer hole with flexible wire & apply the recommended chemical..
- Cover the exposed part of the stem to sun with dry grass or gunny bags soaked with methyl parathion (0.1%) once a month from March till October.
- Install a light trap near the orchard to collect and kill the beetles in kerosenized water.
- Shake the non bearing trees over a cloth sheet at dusk and collect and destroy the beetles (defoliating and fruit eating).
- Clip off terminal shots/with unshed cluster of dry leaves in winter for the destruction of shot 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 after leaf fall be made.
- Clip off mildewed twigs and destroy them.
- Remove all the mummified fruits, dead fruits and prunings from the orchards.
- Pruning of suckers and water sprouts be ensured.

C. <u>Biological Practices:</u>

1. <u>Soil borne diseases:</u>

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. <u>Conservation:</u>

2.1 Conserve the predators like Lace wings, Lady bird beetles, Carabids, Syrphids, Anthocorid bugs, Mirids bugs, Nabid bugs, Capsid bugs, Spiders, Predatroy Ants, Phytoseiid mites, Parasitioids 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 parasitioids, 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, Sarcophage, 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 Sanj-jose-scale, Mite, Aphis and make release of:.

A. Predators: Lady bird beetles- *Chilochorus bijugus, Pharoscymnus horni, Coccinella septumpunctata, Chilochorus tristis, Adalia bipunctala, Synharmonia sp. Exochomus quadripustulatus, Hippodamia-convergens, Stethorus sp.* @ 30-50 adults/infested tree.

ii) Gree lace wings-Chrysoperla sp. and Syrphus sp. 10-20 Ist isntar 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. Therefore, it is not necessary to rely upon pesticides.

2. Following suggestions have important bearing for successful of control measures in the context of IPM strategy:

2.1 The number of fungicidal and insecticidal sprays recommended 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.
Discourage using undescriptive inefficient sprayers.

2.8 Use proper spray volume per unit area.

3. <u>Cautions during spraying:</u>

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

3.2 Operator should not spray/dust for more than 4 hours at a stretch in a day.

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

3. <u>Rodent Management:</u>

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.

IV. INTEGRATED CONTROL OF CODDLING MOTH, CYDIA POMONELLA

Codling moth is a seasonal pest of apple confined to Ladakh region (Leh and Kargil District) of the State of J&K. This pest also attacks other fruits like, Pear, Apricots and Walnut.

Life and Seasonal History :

There is one complete generation each year with a larval diapause during late August to mid of May next. There is however, a partial 2nd generation also, adults of which are seen in August. Thus, some times broods overlap and caterpillars of both generations are found between 3rd week of August to late September. The adults of Ist generation are seen from late May or early June depending on earliness or lateness of the season.

Integrated Control Measures :

The integrated control of codling moth is affected by adopting the following methods :

A 1. All loose bark of trees should be scraped off to remove overwintering sites for the caterpillars. Vicinity of trees should be kept clean of packing cases and all other debris which are likely to shelter the overwintering caterpillars during August to mid October,

2. Bands of sacking (gunny bags) or corrugated cardboard about 150 mm. to 240mm. wide, can be tied round the tree trunks by late July till end of October to provide alternative over wintering sites for the caterpillars. These bands should be removed during the first week of November and either burnt or immersed in a pail of boiling water or kerosenised water.

3. Fallen fruits should be collected throughout the season and buried deep in the soil.

B. **Biological :**

1. Release of exotic egg parasites. *Trichogramma embryophagum* Htg. and *Trichogramma cacoeciae pallidum* Meir *Trichogramma chilonis* (*minutum*)

at the rate of 20,000 adults per 50 apple trees per/week should be undertaken from first fortnight of June to end of August.

2. Birds, especially tits feedling on overwintering caterpillars play an important role in pest suppression.

Sex Pheromone Traps :

Use sticky traps (Delta traps) baited with the synthetic Codling moth phermone/lure to monitor the flight of male moth as :

i) An aid to the timing of chemical sprays. If fewer than five moths are caught per trap per week, it is not necessary to spray. Thus it can improve spray timings and leads to judicious use of spray.

ii) For suppression of codling moth by male removal through mass trapping.

Chemical :

Well timed sprays of relatively safer insecticides are effective in controlling Codling moth. Spray timings should be related to moth catches in sex pheromone traps or as per surveillance data.

Apply two sprays - one in the 2nd half of June coinciding with hatching of Ist generation larvae and another two to three weeks later where regular infestation by Codling moth occur depending on altitude.

The pesticides that can be used for chemical control are Chlorphyriphos and Fenitrothion, (0.02%), Ethion (0.05%), Diazinion (0.045), Malathion (0.05%).

The methodology of AESA is an under :

A. **Field Observations :**

a) Enter the orchard atleast 10 - 15 feet away from road / bund. Select a tree of medium size randonly.

b) Record the visual observations on the following parameters :
   i) Flying insects (both pest and defenders).
   ii) Close observations on pest and defenders which remain on the plant.
   iii) Observe the pest like scale insects, Mites, Aphids, Defoliators, Borers and defenders like LBB, Green Lace Wings, Authocorids, Bugs, Spiders, Phytoseiid, Mites, Syrphids and other bioagents.
   iv) Record various diseases and their intensities.
   v) Record insect damage in percentage or otherwise in case of non-uniform pests like scale insects.

c) Record parameters like number of mites / leaf randomly only around the tree canopy on the periphery at chest and head height. Secondly regular counts of motile mite and predator (LLB) population on a 7 - 10 day interval are needed. The mite population is sampled by determining the number of motile stages on at least 10 leaves collected around the tree and from five or more trees per selected orchard. The number of trees selected for 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 pest attack should be taken for sampling. The predator population is surveyed on the same tree where pest sampled / observations have been taken. The predators / bioagents count is accomplished by slowly walking around the periphery of

the sampling tree and recording the number of adults and larvae / grubs visually. This predator / parasitoid survey should be done before leaves are collected / disturbed / observed for sampling the pest population. Similarly for scale count, the main limbs of the representative/sampling tree infested with scale insects are observed, where number of scales / unit area (say 1.42 cm^2 at a marked position) should be painted or flagged for making observations in the following weeks.

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 cris 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 name of the pest and defender 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 it is sunny. If cloudy the clouds may be drawn in place of sun. In 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) :**

a) When number of mites is 8 or more the group may advocate for any recommended pesticides especially when the whether is hot and likely to prevail during petal fall stage.

b) When number of mites is 8 or more at later stages but there is enough population of LBB's, Spiders and Green lace wings and phytoceiid mites especially during the period from June to mid of September, the group may advocate for monitoring and surveillance only to see the impact of defenders.

c) The group members may closely observe the representative fruit trees for the prominent / characteristic disease symptoms of leaf curl, blight and leaf spot and their intensities along with prevailing weather conditions and may accordingly suggest for sprays or no sprays.

d) In case of San-jose-scale if 50% of scales are parasitised by its parasitoids or 2-3 Lady Bird Beetles (LBB) are present per infested twig then there is no need of chemical spray.

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AESA BY EXTENSION FUNCTIONARIES :

The extension functionaries during the regular visit to the village should mobolize the orchardists to 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, like release of defenders, application of neem formulations / safe pesticides are to be used for specific pest situation. Such an exercise may be repeated by the extension functionaries during every visit to the village and motivate the orchardists to adopt AESA in their fields.

AESA BY FARMERS :

After a brief exposure during IPM demonstrations / field trainings, orchardist can practice AESA in their own orchards. Trained farmers can train their own fellow farmers in villages. Thus a large group of orchardist 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.

ANNEXURE -II

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 burried deep into soil away from water source.
3. Never re-use empty pesticide container for any purpose.