



IPM PACKAGE NO. 33



INTEGRATED PEST MANAGEMENT PACKAGE

FOR

APPLE



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 APPLE

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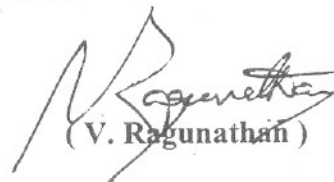
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FOR E W A R D

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 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 and 2002 to update and develop IPM package of practices for agricultural and horticultural crops. Presently, IPM package of practices for 51 crops have been finalised to help the extension workers and farmers to manage the pests/ diseases and to minimise 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. 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.

April 1, 2002


(V. Raguathan)

P R E F A C E

In order to minimise 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 harmonisation of Package of Practices was organized at National Plant Protection Training Institute (NPPTI), Hyderabad during June 29-30, 1992. Subsequently workshops were organized from April 15-17, 1998 and Nov. 5-6, 1998 at Directorate of Plant Protection, Quarantine & Storage, Faridabad and IPM package of practices for 20 crops were evolved 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 May 14-17, 2001 and Feb. 20-22, 2002 respectively to update 20 available IPM Packages and develop 31 new IPM Packages specially for Horticultural crops. In these workshops, 51 IPM Package of Practices for cereal crops (Rice, Wheat, Maize, Sorghum, Millets), commercial crops (Cotton, Sugarcane, Tobacco, Tea), pulse crops (Pigeonpea, Gram, Black gram/Green gram, Pea, Rajma), oilseeds (Groundnut, Soybean, Rapeseed/Mustard, Sesame, Safflower, Castor, Sunflower, Oilpalm), vegetables (Potato, Onion, Tomato, Brinjal, Okra, Chillies, Cruciferous vegetables, Leguminous vegetables, Cucurbitaceous vegetables), fruit crops (Citrus, Banana, Apple, Mango, Guava, Grapes, Pineapple, Sapota, Pomegranate, Litchi), spice and plantation crops (Small Cardamom, Large Cardamom, Black Pepper, Ginger, Coriander, Cumin, Fennel, Coconut, Cashew and Arecanut) have been finalised.

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 encompasses various management strategies for containing the pest and disease problems. Pest monitoring is also one of the important component 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 Agriculture 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 Indian Agriculture and Horticulture. These will also be useful in reducing the pesticide residues in exportable 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 packages will be useful for the researchers, extension workers and farmers alike who are engaged in the agricultural practices.

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IPM PACKAGE FOR APPLE

I. MAJOR PESTS

A. Pests of National Significance:

1. Insect Pests:

- | | | |
|-----|----------------------|--|
| 1.1 | San-Jose-scale | (<i>Quadraspidiotus perniciosus</i>) |
| 1.2 | Woolly aphid | (<i>Eriosoma lanigerum</i>) |
| 1.3 | European red mite | (<i>Panonychus ulmi</i>) |
| 1.4 | Two spotted mite | (<i>Tetranychus urticae</i>) |
| 1.5 | Stem borer | (<i>Aeolesthis sarta</i>) |
| 1.6 | Shot hole bore/borer | (<i>Scolytoplatypus sp.</i>) |
| 1.7 | Gypsy moth | (<i>Lymentria sp.</i>) |
| 1.8 | Leaf rollers | (<i>Archips argyrospilus</i>) |
| 1.9 | Blossom thrips | (<i>Taeniothrips sp.</i>) |

2. Diseases:

- | | | |
|-----|----------------------------|---|
| 2.1 | Apple scab | (<i>Venturia inaequalis</i>) |
| 2.2 | Leaf spots | (<i>Alternaria alterna</i>) (<i>Alternaria male</i>) |
| 2.3 | Crown gall | (<i>Agrobacterium sp.</i>) |
| 2.4 | White root rot | (<i>Dematophora necatrix</i>) |
| 2.5 | Collar rot | (<i>Phytophthora cactorum</i>) |
| 2.6 | Black rot and canker | (<i>Botryo basidium sp.</i>) |
| 2.7 | Powdery mildew | (<i>Podosphaera leucotricha</i>) |
| 2.8 | Sooty blotch and fly speck | (<i>Gloeodes pomigena, Schizo thyrium pomi</i>) |
| 2.9 | Apple mosaic | (Virus) |

B. Pests of Regional Significance:

1. Insect Pests:

- | | | | |
|------|------------------------|---|-------------------------|
| 1.1 | Codling moth | (<i>Cydia pomonella</i>) | Laddak Division of J&K. |
| 1.2 | Aphis | (<i>Aphis pomi</i>) | |
| 1.3 | Leaf miner | (<i>Phyllocnistis sp.</i>) | |
| 1.4 | Leaf skeletonizer | (<i>Cacoecia subsidaria</i>) | |
| 1.5 | Chaffer beetles | (<i>Protactia neglecta</i>) | |
| 1.6 | Cock chaffer beetle | (<i>Melolontha sp.</i>) | |
| 1.7 | May & June beetles | (<i>Adoretus Ladakans</i>) (<i>Adoretus sp.</i>) | |
| 1.8 | Fruit moth | (<i>Argyrestha conjulla</i>) | |
| 1.9 | Bark beetle | (<i>Scolytis nitidus</i>) | |
| 1.10 | Flat headed tree borer | (<i>Chrysobothris sp.</i>) | |
| 1.11 | Shoot borers | | |

2. Diseases :

- | | | |
|-----|----------------|---------------------------------|
| 2.1 | Stem brown | (<i>Botryosphaeria ribis</i>) |
| 2.2 | Fruit rots | |
| | i) Blue mould | (<i>Pencilium expansum</i>) |
| | ii) Bitter rot | (<i>Glomerella cingulata</i>) |
| | iii) Brown rot | (<i>Monilinia spp.</i>) |

- 2.3 Pre-mature leaf fall (*Marsonina coronaria*)
- 2.4 Seedling blight (*Seclerotium sp.*)
- 2.5 Hairy root (*Agrobacterium sp.*)

3. **Physiological disorders :**

- 3.1 Corky core of apple
- 3.2 Water core of apple
- 3.3 Drought syndrome
- 3.4 Bitter pit
- 3.5 Storage scald.

4. **rodents :**

- 4.1 Smaller Bandicoot (*Bandicota bengalensis*)
- 4.2 Soft furred field rat (*Melardia meltdada*)
- 4.3 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 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 routs based upon the endemic areas are required to be identified to undertake roving surveys from mid of March i.e. green tip state. 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 and diseases cross ETL as per result of field scouting.

1. **Roving Survey :**

Undertake roving survey at every 5 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 stage for applying Delay Dormant Spray observe 10 plants randomly in zig zag fashion in each orchard for identifying the proper growth stage initially i.e. green tip and pink bud stage and for recording the internal/population of sucking pests and defoliators at the later

growth stages i.e. from petal fall to harvesting. Record population of potential different biocontrol fauna also to arrive at the decision making stage. Record the major disease their intensity like scab and leaf spot along with deficiency related diseases exhibited and the plant during the course of fruit development.

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 San-jose-scale, scale count should be taken per unit area after flagging the particular limit of the plant while in case of mite, count should be taken per leaf after taping the leaves randomly from periphery of the selector 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 : Setup yellow fast coloured sticky traps for monitoring green aphid, one trap/ 5 trees. Locally available empty yellow palmolive-tin coated with grease / vasline / caster oil an outer surface may also be used.

3.2 Through pheromone traps : Certain pests of apple like gypsy moths and codling moths required 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 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 fruits pests adequate sampling techniques are not available. This is particularly true for pests with non-uniform distribution such as San-jose-scale, trunk borers, green fruit worms. Economic threshold for sp. 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 vigor. However, it seems certain that there is a considerable tolerance for loss of leaves of leaf function in tree fruits and some insight into tolerable levels (or ranges) can be of value.

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 unfavourable for biological control.

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

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

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

| S.No. | Name of Pest | Range | Intensity Size | Sample | Remarks |
|-------|-------------------|--|------------------------------------|--|--|
| 1. | San-Jose-scale | a) 1-5 scales/sample b) 6-12 scales/sample c) 13 l above/sample | Low Medium High (Serious) | 1.4cm ² 1.4cm ² 1.4cm 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 | 1 Leaf 1 Leaf 1 Leaf 1 Leaf | From petal fall stage to fruit dev. stage. Post harvest stage |
| 3. | Hairy Caterpillar | Appearance of caterpillar on foliage. | | | Depending on survey observation |
| 4. | Tortrix moth | Appearance of infestation on the apical shoots exhibiting scorching. | | | -do- |
| 5. | Woolly aphid | a) Presence of pest on truck in trace/small patches b) Presence of pest on trucks c) Presence of pest on limbs and terminal shoots | Low Medium High (Serious) | | -do- -do- -do- |
| 6. | Foliar diseases | Even less than 20.0% of the foliage is affected When > 20% of foliage affected | High High | | From petal fall onwards Last fruit Dev. stage |

III. INTEGRATED PEST MANAGEMENT STRATEGIES :

A. Cultural Practices :

1. Proper selection of cultivars, having commercial value and suitable for effective cross pollination be made.
2. Loamy soils slightly acidic to neutral (5.5 to 6.5 ph) are suitable for cultivation of Apple trees/plantation.
3. Plant material for laying quality fruit orchard should be obtained from registered nursery.
4. Avoid planting of saplings infested with San-Jose-scale, woolly aphid and borers.
5. For raising of nurseries, the soil selection be made which is free from pest infestation.
6. Make use of recommended quantum of FYM in the soil for raising of nursery and laying of orchard.
7. Make use of balanced dose of chemical fertilizers at the recommended crop stages.
8. Avoid excessive use of nitrogen and phosphorus fertilizers.
9. If the plants / trees exhibit the deficiency of micro nutrients go for the application of the same on the basis of soil and leaf analysis.

10. Application of nitrogen can be made in splits only as per the recommendations; 1st dose along with phosphorus and potassium be made about 15 days before expected bloom, 2nd dose may be applied about 3 weeks after fruit set and the last 3rd dose may be applied in the end of July.
11. Shallow cultivation be adopted in spring in order to conserve moisture.
12. Leguminous cover crops should be grown in orchards to improve soil fertility, for preventing soil erosion and controlling of weeds etc.
13. Growing of flower plants, especially marigold and maize on the peripheries will help in conserving of both predators and parasitoids.
14. In rich soils, the fertilizer doses may be halved or regulated on the basis of leaf analysis report.
15. Maintain 33.0% of plant population in Apple Orchards as pollenizers, every third row should be a pollenizer.
16. 3-4 bee hives should be provided/ha. for better population.
17. Need based irrigation must be provided to Apple trees during the cropping season.
18. Under rainfed/drought conditions tree canopy should be weeded and hoed in late spring and basins should be prepared and covered with 10-15 cms. of Mulch (Rotten Pine needles, Straw, Hay, Cut grasses, FYM etc.).
19. Trees should neither be forced to drought nor to water lodging conditions.
20. Proper pruning of Apple trees be done for obtaining quality fruit.
21. Light to moderate pruning should be done in bearing trees.
22. Remove over crowding branches and large limbs if growing parallel.
23. Pruning cuts should be made close to the branches leaving no stubs.
24. Large wounds should be covered with superior white lead paint / bordeaux paint.
25. Leave scattered fallen tree trunks and branches in orchards for trapping egg laying of scolytids during the month of June and burn them at the end of June or 1st week of July.
26. Collect and destroy grubs of root borers, while preparing basins.
27. Avoid injury to the roots or the collar.
28. Change the nursery site after every two to three years.
29. Rogue out infected plants.
30. Keep the orchard area clean from weeds and bushes to avoid excessive humid conditions.
31. Supporting stakes used in orchards should be free from any borer / scale infestation.
32. Soil solarization by using polyethylene mulch be adopted before raising plant nursery.

B. Mechanical Practices :

1. Remove of dead and dyeing fruit trees to ward off borer infestation.
2. Pruning and destruction of scale and borer infested branches.
3. Collection and destruction of egg masses of hairy caterpillars, especially from barks of shade trees (willow and populus) planted on the peripheries of the orchards.
4. Stapling burlap skirts around tree trunks infested with hairy caterpillar and collection of larvae and pupae from May to end of June and their subsequent destruction.
5. For defoliating and fruit eating beetles shake non bearing trees over a cloth sheet at dusk which is useful in collecting and destroying the beetles in kerosenized water.
6. Clear the stem borer hole with flexible wire and then insert 0.5 gms. para Dichlorobenzene (PDCB) and plug the hole with pudding material or insert cotton wick soaked with patrol or methyl parathion 1 ml/lit. H₂O or dichlorvos 0.15% ml/H₂O.
7. Clip off terminal shoots with unshed cluster of dry leaves in winter for the destruction of shoot borers.
8. All badly infested, trees or dead and dying wood should be cut and burnt before leaf drop.
9. Install a light trap near the orchard to collect and kill the beetles in kerosenized water.

Diseases:

1. Destroy the affected seedlings.
2. Complete collection and burning of the foliage and pruned wood in the orchards itself after leaf fall.
3. Clipping of mildew affected twigs.
4. Remove completely girdled limbs. Canker must be cleaned with sharp knife and should be covered with bordeaux paint.
5. Remove all the mummified fruits, dead twigs and prunings from the orchards.
6. Pruning of suckers and water sprouts.

3. Biocontrol 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.
- 1.3 Solarisation of nursery beds.

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 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 *Exorista* sp., *Drino* sp., *Apanteles* sp., *Sarcophaga* sp., *Pollenia* sp., *Helina* sp., *Anilastus* sp., *Anthomyia* sp., *Euplectrus* sp., 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 *Brachymeria* sp., *Monodontomerus* sp., *Hyposoter* sp., *Exorista* sp. and *Pimpla* sp. to protect the parasitoids from scheduled spray effects.
- 2.6 Clipping off twigs having mummies (woolly aphid) without exit holes before spraying and tying such twigs with unsprayed trees supporting woolly aphid population to enhance the parasitoid activity.

3. Augmentation :

3.1 Monitor the incidence of sucking pests like San-jose-scale, Mite, Woolly aphid, Green Aphid and release of :

A. Predators : Lady bird, beetles - *Chilocorus bijugus*, *Pharoscyrmus horni*, *Coccinella septempunctata*, *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* @ 10000-20000/infested tree at least 15 days of insecticidal sprays and 10 days after fungicidal sprays against San-jose-scale and *Aphilinus mali* @ 1000-1500/infested tree against Woolly aphid. 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 necessary to rely upon pesticides as per the list in Annexure-III.
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-III / A can be minimised 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 :
 - a) Tractor mounted sprayers/power sprayers for effective spray coverage.
 - b) Discourage using underscriptive in efficient sprayers.
 - 2.8 Use proper spray volume per unit area.
3. 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.

E. Integrated Control of Codling 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 species fruits also.

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 1st generation are seen from late May or early June depending on earliness or lateness of the season.

Varietal Incidence :

Apple is the preferred host and damage may range as high as 95%. All the varieties and cultivars of Apple grown in Ladakh are attacked by it.

Integrated Control Measures :

- a. 1. All loose bark of apple trees should be scraped off to remove overwintering sites for the caterpillars. Vicinity of trees should also 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 240 mm. wide, can be tied round the tree trunks by late July till end of October to provide alternative overwintering 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 either buried deep in the soil.
4. As far as possible the overwintering caterpillars should be collected from the loose bark, other debris, bands used for trapping and destroyed.

b. **Biological :**

1. Releases 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 feeding on overwintering caterpillars and also important for causing natural mortality.

c. **Sex Pheromone Traps :**

Use sticky traps (Delta traps) baited with the synthetic Codling moth pheromone/ 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.
- iii) **For mating disruption :** These traps for any of the above techniques should be installed at a height of 6-8 feet from ground on apple trees from late May to 3rd week of July and again from 2nd week of August to end of August.

d. **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 1st generation larvae i.e. after petal fall again depending on climatic conditions and another two to three weeks later where regular infestation by Codling moth occur depending on altitude and first emergence of codling moth. The best date for spraying varies considerably within a locality.

Where infestation by codling moth is barely detectable spray once during the first 15 days of July. There is wide choice of insecticides for use against Codling moth which include.

Chlorpyrifos and Fenitrothion,(0.02%), Ethion (0.05%), Diazinon (0.04%), Malathion (0.05%).

F. **Management of Fruit Drop:**

1. **Early Drop:** Resulting from unpollinated or unfertilized blossoms. Early drop can be corrected/minimised by maintaining 33% of plant population in apple orchards as pollenizers, every third row should be a pollenizer.
2. **June Drop:** Due to moisture stress and a fruit competition. June drop can also be minimised by adopting the cultural practices as under rainfed/drought conditions tree canopy should be weeded and hoed in late spring and basins should be prepared and covered with 10-15 cm of mulch.
3. **Preharvest Drop:** The problem of pre-harvest drop is most severe in early cultivars where 40-60% fruits drop. In mid season cultivars viz. Red Delicious, Royal Delicious and Golden Delicious it is about 15-20%. To control preharvest drop, spray N.A.A. (Naphthalene acetic acid) @ 10 ppm. with water and the spray should be done about a week before the expected drop.

IV. STAGewise IPM PRACTICES TO BE ADOPTED

| S.No. | Crop Stage | Pest | Stage-wise IPM Practices |
|-------|-----------------------|---|---|
| 1. | Green tip | San-Jose-scale | Mech. prac. Pruning and destruction of scale infested twigs. Chem. prac. Spraying of winter spray oils or diesel oil emulsion/oil soap (potash based) (1:10) (1/4 green tip to 1/2 green tip). |
| | | Mite | Chem. prac. The aforesaid delay dormant spray is to be impregnated with *Ethion 50 EC @ 1ml/lt. of emulsion. |
| | | Woolly Aphis | Chem. prac. Treat the Woolly aphid infested tree with *Thimet 10-G (25-30 gms./tree) or *Furadon 3G (70-80 gms./tree) by removing the 5 cm. soil around the tree trunk. |
| | | Hairy caterpillars | Mech. prac. Collect and destroy the egg masses of hairy caterpillars, from the barks of apple trees particularly from the shade trees (willow and poplar) planted on the peripheries of the orchards. |
| | | Borers | Mech. prac. Pruning and destruction of borer infested twigs, removal of dead drying fruit trees by destruction. |
| | | | Chem. prac. Clear the stem borer hole with flexible wire and then insert 0.5 gms. para dichloro benzene (PDCB) and plug hole with puddling material or insert cotton wick soaked with petrol or methyl parathion 1ml/lt. water or dichlorvos 0.15% 2ml/lt. water. |
| | Scab | Cul. prac. Provide proper drainage in orchards to drain off surface water. | |
| 2. | Pink Bud Stage | Scab | Chem. prac. Conduct 1st spray as per schedule. Ref. Annexure - III |
| | | Powdery mildew | Cul. prac. Clip off and destroy the mildewed twigs. |
| | | San-jose-scale, Mite & Hairy Caterpillars | Monitoring Biocontrol prac. Regular monitoring may be conducted. Conduct surveys and surveillance for conservation of natural enemies and observe pest and defenders (P:D) ratio for San-Jose scale and mite |
| | | Chem. prac. Conduct sprays (need based) as per recommendations only after determining the economic threshold levels (ETL). Ref. Annexure III. | |
| 3. | Petal fall | Scab & other foliar diseases | Monitoring Regular monitoring for the build up of disease. |

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| | Chem. prac. | Conduct 2nd spray as per schedule ref. Annexure III. |
| | Mech. prac. | Clip and destroy the mildewed tree parts. |
| | Monitoring | Conduct regular surveys and surveillance for determining the uprise of pests and crossing of ETL. |
| Hairy Caterpillars | Mech. prac. | Burlaping may be done for the management of the Pests. |
| Bark beetle | Mech. prac. | Plaster the infested trees (stems and trunks) with the mixture of 10.0% carbaryl dust/chlorpyrifos 5.0% and the clay in the ratio of 1:6. |
| Borers | Mech. prac. | Adopt the practice as mentioned under S.No. 1 (Borers) if not adopted at green tip stage. |
| | Chem. prac. | Adopt the practice as mentioned under S.No. 1 (Borers) if not adopted at green tip stage. |
| Woolly Aphid | Biocontrol prac. | Conserve the natural enemies. Make releases of <i>A. mali</i> @ 1000-15000/infested tree and of Lady Bird Beetles @ 15-30/infested tree. |
| Woolly Aphid | Chem. prac. | For controlling the infestation of pest, on non bearing trees, place 10-20 gms. of phorate or Aldicarb 10-g. at 5.0 cms. depth in root zone in presence of sufficient moisture or by providing light irrigation. |
| San-jose-scale Mite, Tortrix | Biological practice | Conserve the natural/enemies. Release <i>Encarsia</i> sp., <i>Aphytis</i> sp. @ 10000-20000/infested tree or LLB 30-50 adults/tree or Chrysopa 10-20 1st instar larvae/tree. |
| | Chem. prac. | After 80.0% of petal fall of red delicious cultivar spray the insecticides as recommended – ref. Annexure III. |
| Fruit set Scab | Monitoring | Conduct regular monitoring for the build up stage (Pea) of foliar diseases for determining the ETL/intensity. |
| | Ch. practice | Spray only after determining the intensity and other factors as recommended(ref. Annexure III) - |
| Powdery mildew | Mech. prac. | As recommended under S.No. 2 |
| | Ch. practice | Spray with dinocap (0.05%) as per need only. |
| Hairy caterpillars | Mech. prac. | Burlaping may be done for the management of the pest. |
| San-Jose-scale Aphids, Mite | Monitoring | Regular monitoring for the buildup of the pest. |

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|----|------------------------------------|-------------------------------------|---|
| | | Biocontrol practices | Make release of chryspa @ 10-20 1st instar larval/tree. Make releases of LBB @ 30-50/tree. Make releases of Encarsia sp. and Aphytis sp. @ 10000-20000 adults infested/tree. |
| | Woolly aphid | Biocontrol practices | Make releases of <i>Aphelinus mali</i> @ 1000-1500/tree. Clip off twigs having mummies without exit holes before spraying and tie such twigs with unsprayed trees supporting woolly aphid population to enhance the parasitoid activity. |
| | Mites | Monitoring | In case of mite infestation, observe P&D ratio. If pest and defender ratio exceeds 10:1 or mite population exceeds 8 mites / leaf go for sprays. |
| | | Chem. prac. | Spray the trees with the recommended insecticides only (ref. Annexure III). |
| | Bores | Mech. prac. | Repeat as mentioned under S.No. 1 |
| | | Chem. prac. | Repeat as mentioned under S.No. 1. If treatment not given. |
| 5. | Fruit Dev. Stage-I | Scab & other foliar fungal diseases | Monitoring Regular monitoring for the build up of diseases. |
| | | Chem. prac. | Conduct 4th spray with the recommended fungicides (ref. Annexure III), only after determining the disease intensity through AESA. |
| | Powdery mildew | Mech. prac. | Remove the mildew bearing shoots/leaves and destroy them. |
| | Hairy caterpillar | Mech. prac. | Burlap skirts around tree trunks infested with the pest for trapping the larvae and pupae, collect the same for destruction. |
| | Defoliating & fruit eating beetles | Mech. prac. | Shake the non bearing trees over a cloth sheet at dusk which is useful in collecting and destructing the beetles in kerosenized water. |
| | Bark beetles | Cultural prac. | Leave scattered fallen tree trunks and branches in the orchards for trapping egg laying of scolytids and destroy them at the end of June or 1st week of July. |
| | | Mech. prac. | Adopt the practice as mentioned under S.No. 3 if the same has not been adopted at stage 3. |
| | | Mech. prac. | Install a light trap near the orchard to collect and kill the beetles in kerosenized water. |
| | Borers | Mech. prac. | Removal of dead and drying fruit trees to ward off borer infestation. |

Chem. prac. Adopt the practice as mentioned under S.No. 1 if the same has not been adopted.

San-Jose-scale Mite, Tortricids, leaf miners & aphids. Monitoring Conduct regular monitoring for the buildup of pests and determining the population of bioagents.

Biocontrol practice Conserve the natural enemies. Make releases of bioagents as mentioned at S.No. 4. Release of *Trichogramma* sp. @ 50,000/ha. Adopt the practice against woolly aphid as mentioned at S.No. 4.

Chem. prac. Conduct the sprays as recommended(ref. Annexure III)only after determining P:D ratio and other factors.

6. Fruit Dev. Stage-II Scab & other foliar disease Monitoring Regular monitoring for the build up of disease.

Chem. prac. Conduct 5th spray as recommended (ref. Annexure III) only after determining the disease intensity through AESA/surveillance.

Powdery mildew Mech. prac. Adopt the practice as mentioned at S.No.5 if required.

Hairy caterpillars Mech. prac. Collect and destroy the egg masses.

Bores Mech. prac. Adopt the practice as mentioned at S.No.1. Chem. prac. Adopt the practice as mentioned At S.No. 1 if not adopted earlier to this stage.

San-Jose-scale Mite, Tortrix, leaf miners & aphids. Monitoring Regular monitoring for determining the population of pest and defender.

Bio. prac. Repeat the practices as mentioned under S.No. 5.

Chem. prac. Conduct the sprays if needed as recommended(ref. Annexure III) only after determining the P:D ratio and other factors.

7. Fruit Dev. Stage-III Scab & other foliar diseases Monitoring Conduct regular monitoring for observing the pest/disease situation.

Sooty Blotch & Fly speck Chem. prac. Conduct 6th spray, only after determining the disease intensity through AESA/surveillance, as recommended(ef. Annexure III) .

Hairy caterpillars Mech. prac. Repeat the practice as mentioned under S.No.6.

Borers Mech. prac. Repeat the practice as mentioned under S.No.1.

Chem. prac. Adopt the practice as mentioned at S.No.1 if not adopted earlier at this stage.

| | | | |
|---|---------------------------------|---------------------|---|
| | San-Jose-scale | Monitoring | Regular monitoring for the build up of pests. |
| | Woolly aphid, | Biocontrol | Repeat same as mentioned under fruit Dev. |
| | Aphis, Mites, | practice | stage - II. |
| | Tortricids | Chem. prac. | Conduct the sprays with recommended chemicals only after determining the pest defender ratio/population of bioagents through AESA. (Need based) |
| 8 | Fruit Dev. Stage-IV | Monitoring | Regular monitoring may be done for the build up of diseases & determining the ETL. |
| | Scab & other foliar diseases | Chem. prac. | Conduct 7th spray with recommended chemicals(ref. Annexure III/A) only when there is 20% of the foliage affected with leaf spots (ETL). |
| | Sooty blotch & Fly speck | | Preharvest spray with Ziran 80 WP (0.20%) or Ziram 27 W/L (0.6%) or Mancozeb 75 or P (0.3%) or captan 50 WP (0.3%) be done 25 days before harvest against post harvest diseases in long term storage in case of the cultivars reaching harvest. |
| | Hairy caterpillars | Mech. prac. | Collect and destroy the egg masses of the pest. |
| | San-Jose-scale, W.Aphis, Aphids | Monitoring | Strict regular monitoring may be done for the build up of the pests, especially Mites & San-Jose-scale. |
| | | Biocontrol practice | Repeat same as mentioned under S.No. 4. |
| | | Chem. prac. | Need based chemical sprays with recommended chemicals(ref. Annexure III) only after determining the pest population/ETL through AESA and surveillance. |
| | Borers | Mech. prac. | Repeat same as given under S.No. 1. |
| | | Chem. prac. | Repeat same as given in green lip stage if treatment not given earlier. |
| 9 | Pre-harvest Stage | Monitoring | Regular monitoring for the build up of disease. |
| | Scab & other foliar diseases | Chem. prac. | Conduct the pre harvest spray with recommended chemicals only (ref. Annexure III) 25 days before harvest. |
| | S. blotch & Fly speck | Chem. prac. | Dip the harvested fruits in 5.0% sodium bicarbonate solution for 10 minutes and wipe with clean coarse cloth. |
| | Hairy caterpillars | Mech. prac. | Collection and destruction of egg masses. |
| | Borers | Mech. prac. | Removal and destruction of dead drying fruit trees to check the infestation of the borers. |
| | | Chem. prac. | Repeat same as mentioned in green tip stage if required after observing the intensity of pest. |

San-jose-scale,
Woolly Aphis
& Mites

Biological

Repeat same as mentioned under fruit development stage - II.

Chem. prac.

In case there is serious infestation of any of these pests in individual plant with no bioagent present, apply spot treatment with the recommended chemicals. Otherwise no insecticide spray is required.

**9. Post Harvest Scab & other
Foliar diseases**

Mech. prac.

Complete collection and destruction of pruned wood and infested foliage from the orchards.

San-Jose-scale
& Mites.

Mech. prac.

Removal and destruction of culled fruits and scab infested twigs from the orchards.

Biological

Conduct AESA and observe P & D ratio if P & D ratio is 20:1 or more or there are 20 mites or more per leaf conduct sprays as recommended.

Woolly Aphis

Chem. prac.

In case there is severe infestation of the pest in pockets or individually, apply spot treatment with Malathion (0.1%) and Methyl demeton (0.25%) or Endosulfan (0.05%) after ensuring the absence of any bioagent in the pocket.

A. Diseases

- i) Blue mould
- ii) Bitter rot
- iii) Brown rot

Cult. prac

Carefully handle the fruits during harvesting, picking, grading, packing, transportation and storage to avoid injury.

Keep surrounding of package houses and store houses clean by destroying the culled fruits everyday.

Cool the fruits to storage temperature (32-38°F) as rapidly as possible.

Use protective packing to reduce number of cuts, and bruises, especially during transit.

Chem. prac.

Pre-harvest sprays 2-3 weeks before harvest with Mancozeb, Zineb, captan or any other organic fungicide (0.2-0.3%).

Dip the fruit in sodium ortho phenyl phenate (1000-2000 ppm solution) or dip the fruit in Diphenyl Amine (1000-2000 pm) solution to control storage scald.

B. Disorders

- i) Corky core of apple

Chem. prac.

Spray the trees with borax immediately after the fruit harvest, but before leaf fall, (10gm/20 lts. of water).

In case of severity apply 2nd spray at petal fall.

- ii) Water core of Apple

Chem. prac.

Spray the standard micronutrient mixture, essentially containing calcium during 1st week of July.

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| | | Infested soil of basins should either be replaced or treated separately with 3.0% formal-dehyde during dormancy. |
| | Cul. prac. | Structure of clayed soils should be amended by adding more organic matter. |
| | Cul. prac. | Central drainage systems should be followed. |
| | Mech. prac. | The affected tree should be approach grafted with seedlings. |
| | Biological prac. | Make use of <i>Trichoderma harzianum</i> , <i>T viride</i> with neem cake. |
| | Chem. prac. | Plant as a whole and the root system be sprayed with 20.0 ppm. Aureofungin or for curing the ailing tree at least 3 drenchings of carbendazim (100 gm/100 lts. of water) be made. |
| Stem brown | Cul. prac. | Disease can be effectively controlled by adoption of judicious pruning of all dead wood and proper orchard management. |
| | Chem. prac. | The spray schedule as recommended at Annexure III will also take care of the problem. |
| Hairy caterpillars | Mech. prac. | To check the infestation during ending season, collect and destroy the egg masses of the pest. |
| San-Jose-scale | Mech. prac. | Pruning and destruction of scale infested branches and twigs. Removal and destruction of the heavily infested (young trees) from the orchard. Removal and destruction of left over/culled, infested fruit from the orchards. Removal of mummified fruits from the orchards. |
| | Chem. prac. | In case of severe infestation go for the dormant oils (diesel) spray. |
| Woolly Aphid | Chem prac. | For efficient management of subterranean aphids, drench the base around apple trees by applying Dichlorvos (0.05%) or Chlorpyriphos (0.03%). |
| Borers, pin hole/shot hole & stem borers | Mech. prac. | Heavily infested trees/dead or drying trees/ dying wood should be pruned and destroyed to check the infestation for next season. |
| | Mech. prac. | Clip off terminal shoots with unshed cluster of dry leaves in winter for the destruction shoot borers. |
| Water lodging | Cul. prac. | Provide proper drainage in orchards. |

V. DO'S AND DON'TS IN APPLE PEST MANAGEMENT:

| DO'S | DON'TS |
|---|---|
| <p>A. Grow only recommended cultivars.</p> | <p>Do not grow under script material which vary greatly in fruiting pattern and pest susceptibility.</p> |
| <p>B. Agronomical Practices :</p> | |
| <p>1. Consider soil profile and texture before establishing an apple orchard.</p> | <p>Don't establish an orchard in the soils not suited for apple cultivation.</p> |
| <p>2. Loamy soils with slightly acidic to neutral (5.5 to 6.5 p/h) must be preferred for establishing an orchard.</p> | <p>Don't establish the orchard either in high acidic or high alkaline soil.</p> |
| <p>3. Cool climate with low winter temperature and little rainfall are most suitable for apple cultivation.</p> | <p>Avoid the localities with frequent hail and storms for apple cultivation.</p> |
| <p>4. Root stocks should generally be raised from the seeds of wild crab or white dotted Red Apple. Solarisation of nurseries be adopted before raising plant nurseries.</p> | <p>Seeds of fallen fruits which have been affected by fungus or any other organism should be avoided for raising root stock.</p> |
| <p>5. To check the infection of soil borne fungus in the nursery make use of antagonistic fungus i.e. <i>Trichoderma viride</i> and <i>T. harzianum</i>. Neem cakes can also be used to ward off any soil pest.</p> | <p>Don't raise the nurseries in low lying areas, especially where no drainage can be made. Surface water must be drained off wherever possible.</p> |
| <p>6. Both stock and scion must be healthy and preferably of known pedigree.</p> | <p>Do not use the material from unknown pedigree.</p> |
| <p>7. Nursery area for producing quality fruit should have proper irrigation, drainage and fencing besides having fertile soil.</p> | <p>Trees should neither be forced to drought nor to water lodged conditions.</p> |
| <p>8. Plant material for laying an orchard should be obtained from registered nurseries only.</p> | <p>Don't take the planting materials from unregistered / private nurseries.</p> |
| <p>9. For producing quality fruits, the trees should be pruned properly to have a well balanced tree.</p> | <p>Don't apply the fertilizers into wet or too dry soils.</p> |
| <p>10. Trees should be irrigated whenever needed and wherever irrigation facilities are available.</p> | <p>Don't over irrigate the orchards.</p> |
| <p>11. Under rainfed conditions tree canopy should be weeded and hoed in late spring and basins should be prepared which must</p> | <p>Under rainfed condition restrict the use of nitrogen into 2 split dose only.</p> |

be covered with 10-15 cms. of mulch (rotten Pine Needles, Straw, hay, cut-grasses and FYM etc).

12. Trees should be supplied with FYM and all the three major and micro nutrients on the basis of soil and leaf analysis.

Don't over dose the trees with any of the fertilizers.

13. Thinning should be done for obtaining optimum yield of high quality grade fruit and for breaking the rhythm of alternate bearing by conducting the sprays of the recommended chemicals.

Thinning should be avoided if drought like conditions prevail and there is no irrigation facilities.

14. Shallow cultivation of cover crops may be adopted in spring in order to conserve moisture.

Don't cultivate the fodder crops in the orchards as it not only adds to the infestation of defoliators (Army worm) but also enhances Rodent infestation.

15. Leguminous cover crops be grown in orchards to improve soil fertility, to prevent soil erosion and controlling of weeds.

16. Fertilizers should be applied 30.0 cms. away from the trunk in old trees.

Don't apply the fertilizers and FYM close to the trunks especially in old trees.

17. In rich soils, the fertilizer doses may be halved or regulated on the basis of leaf analysis report.

Don't make use of raw cow dug or raw FYM.

18. In orchards with well established cycles of one off year and one on year, the fertilizer doses should be reduced to 50.0% during off year.

19. Maintain 33.0% plant population in apple orchards of pollinizers, every 3rd row should be a pollinizer.

Don't cultivate the cultivars without the sufficient (33%) number of pollinizers.

20. 3-4 bee hives should be provided/ha. for better pollination.

Don't make pesticidal sprays during flowering period as it kills the pollinators.

21. Place flower bouquets of pollinizers on the delicious cultivar trees to facilitate better pollinization.

22. In biennial bearing cultivars, the thinning programme during one year should be done with the application of recommended chemicals only.

23. Orchards of hillocks must be ploughed thoroughly in autumn season for retention

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| <p>of moisture during winter and destruction of live rodent burrows.</p> | |
| <p>24. White wash the tree trunks (with hydrated lime 22.5 kg. + zinc sulphate 1.8 kg. + 100 gallons of water) against sun burn and pest attack.</p> | |
| <p>C. <u>Pest Management</u> :</p> | |
| <p>1. Water shoots, diseased, insect infested and intermingling branches should be removed as early as possible.</p> | <p>Don't allow the water shoots, diseased and insect infested pant material to remain in the orchards.</p> |
| <p>2. Light to moderate pruning should be done in bearing trees preferably in late season.</p> | |
| <p>3. Pruning should be done close to the branches leaving no stubs.</p> | <p>Don't leave pruned portions unpainted.</p> |
| <p>4. Ensure the destruction of heavily infested trees/ dead and drying fruit trees to ward off borer infestation.</p> | |
| <p>5. Collection and destruction of egg masses of hairy caterpillars, burlaping around tree trunks for collection of larvae and pupae and their subsequent destruction may be done.</p> | |
| <p>6. Destroy the affected seedlings.</p> | |
| <p>7. Complete collection and destruction of foliage during fall by decomposition.</p> | <p>Don't burn collected foliage to avoid air pollution.</p> |
| <p>8. Conduct sprays during monitoring and evening hours only.</p> | <p>Don't spray during hot period of the day.</p> |
| <p>9. Remove completely girdled limbs. Cankered portions must be cleared with sharp knife and should be covered with bordeaux paint.</p> | <p>Don't use stickers while using fungicide, Dodine.</p> |
| <p>10. Remove all the mummified/culled fruits, dead twigs and pruning from the orchards and their destruction.</p> | |
| <p>11. Make use of stickers (adjuvants) for better efficiency of fungicides.</p> | |
| <p>12. While preparing delay Dormant oil sprays solutions add water to stock solution as per the recommendations only.</p> | <p>Don't use thick dormant spray solution which will be harmful for plants.</p> |

13. Ensure regular scouting/monitoring for timely detection of ETL's required for need based application of chemical sprays.

Don't go for blanket spray without field roving.

14. Use only recommended pesticides at the recommended dosages for the control of various pests and diseases.

Don't use unrecommended mixtures of various insecticides in any case.

Don't use the insecticide at lesser/over dosages than the recommendations.

15. Clip off the mildewed affected twigs.

16. Use recommended pesticides and spray technology only as per need and especially atleast 3-4 weeks prior to harvest.

Don't use the substandard leaky/ defective equipment and expired pesticides.

17. Encourage the cultivation of flowering plants and maize on the peripheries for the conservation of both predators and parasitoids.

D. Harvesting Practices :

1. Make use of orchard ladder and trained persons for fruit picking.

Don't climb the fruit tree for picking.

2. Fruits should be harvested only after ensuring their proper maturity.

Don't harvest premature fruits.

3. Unhook the fruit with upward twisting movement.

Don't pull the fruit while harvesting.

Make sure that the fruits don't get any wound or bruises while harvesting/handling.

4. Containers should have soft lining.

Don't make use of containers without lining.

E. Post Harvesting :

1. Harvested fruits should be placed gently in cushioned containers to avoid any damage/injury.

2. Remove field heat before placing them in cold store by pre cooling (Air cooling).

3. Place the harvested fruits on soft bed of grass in a cool dry and shady place.

VI. SAFETY PARAMETERS IN PESTICIDES USAGE

| S. No | Name of pesticide | Classification as per Insecticides Rules, 1971 | Colour of Toxicity Triangle | WHO classification by hazard | First aid measures | Symptoms of poisoning | Treatment of poisoning | Waiting period (No. of days) |
|-----------------------------------|-------------------|--|-----------------------------|---------------------------------|--|--|---|------------------------------|
| INSECTICIDES | | | | | | | | |
| ORGANOCHLORINE PESTICIDES | | | | | | | | |
| 1. | Endosulfan | Highly toxic | Yellow | Class II - Moderately Hazardous | Remove the person from the contaminated environment. | Nausea, vomiting, restlessness, tremor, apprehension, convulsions, coma, respiratory failure and death | - Gastric lavage with 2-4 L. tap water - Catharsis with 30 gm. (10 oz) sodium sulphate in one cup of water - Barbiturates in appropriate dosages repeated as necessary for restlessness or convulsions - Watch breathing closely, aspirate, oxygen and/or artificial respiration, if needed. - Avoid oils, oil laxatives and epinephrine (Adrenalin) - do not give stimulants. - Give calcium gluconate (10% in 10 ml. Ampules) intravenously every four hours. | |
| 2. | Dicofol | Moderately toxic | Blue | Class III - Slightly hazardous | In case of (a) Skin contact - Remove all contaminated clothings and immediately wash with lot of water and soap; (b) Eye contamination - Wash the eyes with plenty of cool and clean water; (c) Inhalation - Carry the person to the open fresh air, loosen the clothings around neck and chest, and (d) Ingestion - If the victim is fully conscious, induce vomiting by tickling back of the throat. Do not administer milk, alcohol and fatty substances. In case the person is unconscious make sure the breathing passage is kept clear without any obstruction. Victim's head should be little lowered and face should be turned to one side in the lying down position. In case of breathing difficulty, give mouth to mouth or mouth to nose breathing. Medical aid: Take the patient to the docotr/Primary Health Centre immediately along with the original container, leaflet and label. | | | |
| ORGANOPHOSPHATE PESTICIDES | | | | | | | | |
| 3. | Ethion | Highly toxic | Yellow | Class II - Moderately Hazardous | | Mild - anorexia, headache, dizziness, weakness, anxiety, | For extreme symptoms of O.P poisoning, injection of atropine (2-4 mg., for | |

| | | | | | | | |
|-----|------------------|------------------|------------|------------------------------------|--|--|--|
| 4. | Methyl parathion | Extremely toxic | Bright red | Class I a - Extremely hazardous | | tremors of tongue and eyelids, miosis, impairment of visual acuity. | adults, 0.5-1.0 mg for children) is recommended, repeated at 5-10 minute intervals until signs of atropinization occur. |
| 5. | Dimethoate | Highly toxic | Yellow | Class II - Moderately hazardous | | Moderate- nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis. | Speed is imperative |
| 6. | Phorate | Extremely toxic | Red | Class I b - Highly Hazardous | | Severe - diarrhoea, pinpoint and non-reactive pupils, respiratory difficulty, pulmonary edema, cyanosis, loss of sphincter control, convulsions, coma and heart block. | - Atropine injection - 1 to 4 mg. Repeat 2 mg. when toxic symptoms begin to recur (15-16 minute intervals), Excessive salivation - good sign, more atropine needed; |
| 7. | Malathion | Moderately toxic | Blue | Class III - Slightly hazardous | | | - Keep airways open, Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed. |
| 8. | Diazinon | Highly toxic | Yellow | Class II - Moderately Hazardous | | | - For ingestion lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact, wash with soap and water (eyes- wash with isotonic saline). Wear rubber gloves while washing contact areas. |
| 8. | Dichlorvos | Highly toxic | Yellow | Class II - Moderately Hazardous | | | |
| 9. | Chlorpyrifos | -do- | -do- | -do- | | | |
| 10. | Quinalphos | Highly toxic | Yellow | Class II - Moderately Hazardous | | | |
| 11. | Fenitrothion | -do- | -do- | -do- | | | In addition to atropine give 2-PAM (2-pyridine aldoxime methiodide). 1 g and 0.25 g for infants intravenously at a slow rate over a period of 5 minutes and administer again periodically as indicated. More than one injection may be required. |
| | | | | | | | Avoid morphine, |

| | | | | | | | |
|--|--|--|--|--|--|--|---|
| | | | | | | | theophyllin, aminophyllin, barbiturates or phenothiazines. |
| | | | | | | | Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine. |

CARBAMATES

| | | | | | | | |
|-----|----------|-----------------|--------|------------------------------------|--|---|---|
| 12. | Aldicarb | Extremely toxic | Red | Class I a - Extremely hazardous | | Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhoea, epigastric pain, tightness in chest. | <ul style="list-style-type: none"> - Atropine injection 1 to 4 mg. Repeat 2 mg when toxic symptoms begin to recur (15-60 minute intervals). Excessive salivation - good sign, more atropine needed. - Keep airway open. Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed. - For ingestion, lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact was with soap and water (eyes - wash with isotonic saline). Wear rubber gloves while washing contact area. - Oxygen - Morphine, if needed. |
| 13. | Carbaryl | Highly toxic | Yellow | Class II - Moderately hazardous | | | <p>Avoid theophyllin and aminophyllin or barbiturates.</p> <p>2-PAM and other oximes are not harmful and in fact contra indicated for routine usatge.</p> |

Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.

FUNGICIDES

| | | | | | | | |
|-----|--------------------|------------------|-------|--|--|---|---|
| 14. | Dinocap | Moderately toxic | Blue | Class III - Slightly hazardous | | Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin etc., | No specific antidote. Treatment is essentially symptomatic. |
| 15. | Carbendazim | Slightly toxic | Green | Table 5 - Unlikely to present acute hazard in normal use | | | |
| 16. | Ziram | Moderately toxic | Blue | Class III - Slightly hazardous | | | |
| 17. | Mancozeb | Slightly toxic | Green | Table 5 - Unlikely to present acute hazard in normal use | | | |
| 18. | Captan | -do- | -do- | -do- | | | |
| 19. | Zineb | Slightly toxic | Green | Table 5 - Unlikely to present acute hazard in normal use | | | |
| 20. | Borax | -do- | -do- | -do- | | | |
| 21. | Copper oxychloride | Moderately toxic | Blue | Class III - Slightly hazardous | | | |
| 22. | Fenarimol | Moderately toxic | Blue | Table 5 - Unlikely to present acute hazard in | | | |

Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.

FUNGICIDES

| | | | | | | | |
|-----|--------------------|------------------|-------|--|--|---|---|
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| 18. | Captan | -do- | -do- | -do- | | | |
| 19. | Zineb | Slightly toxic | Green | Table 5 - Unlikely to present acute hazard in normal use | | | |
| 20. | Borax | -do- | -do- | -do- | | | |
| 21. | Copper oxychloride | Moderately toxic | Blue | Class III - Slightly hazardous | | | |
| 22. | Fenarimol | Moderately toxic | Blue | Table 5 - Unlikely to present acute hazard in | | | |

| | | | | | | | |
|-----|--------------|------|------|--|--|--|--|
| 23. | Dodine | -do- | -do- | normal use Class III - Slightly hazardous | | | |
| 24. | Hexaconazole | -do- | -do- | Table 5 - Unlikely to present acute hazard in normal use | | | |
| 25. | Penconazole | -do- | -do- | -do- | | | |

OTHERS

| | | | | | | | |
|-----|-------------------------|---------------------|------|-----------------------------------|--|---|---|
| 26. | Furadon | | | | | | |
| 27. | Paradichloro benzene | | | | | Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin etc., | No specific antidote. Treatment is essentially symptomatic. |
| 28. | Aureofungin | Moderately toxic | Blue | Class II - Moderately toxic | | | |
| 29. | Bitertanol | | | | | | |

RODENTICIDES

| | | | | | | | |
|-----|--------------|--------------------|---------------|---------------------------------------|--|--|--|
| 30. | Bromodiolone | Extremely toxic | Bright red | Class I a - Extremely hazardous | | <p>Bleeding from nose, gums and into conjunctiva, urine and stool & coma</p> <p>Possible polar and petechial rash, late- massive echymoses or hematoma of skin, joints, brain hemorrhage</p> | <ul style="list-style-type: none"> - Give Vitamin K1 15-25 mg for adults; 5-10 mg. for children orally; - Transfuse with fresh blood if bleeding is severe or until anemia is corrected. - Iron (Ferros sulfate) by mouth for correction of secondary anemia, 0.3 gm t.i.d. |
|-----|--------------|--------------------|---------------|---------------------------------------|--|--|--|

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. Plants 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 methodology of AESA is an under :

A. Field observations :

- a) Enter the orchard atleast 15 - 20 feet away from road/bund. Select an apple 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, San-jose-scale & Woolly, Aphis and defenders like LBB, Green Lace wings, Anthocorids and Bugs, Spiders and Predatory Ants and Phytoseiid Mites.
 - iv) Record various diseases and their intensities.
 - v) Record insect damage in percentage or otherwise in care of non uniform pests like San-jose-scale.
- c) Record parameters like number of mites/leaf randomly around the tree canopy on the periphery at chest and head height. This concept is needed to establish the initial life stages, distribution of Mite. Secondly regular counts of Motile mite a predator (LBB) population on a 7-10 day interval are needed. The Mite population is sampled by determining the no. of motile stages on at least 10 leaves collected around the tree and from five or more trees per monitored orchard. The no. of trees selected to sample would depend largely on the size of the orchard. The trees selected for samplings should be representative of the entire orchard in size and cultivar. Preferably cultivars which are sensitive to Mite population should be taken for sampling. The predator population is surveyed on the same tree as the mite and is accomplished by slowly walking around the periphery of the tree and recording the no. of adults and larvae visually. The predator survey should be done before leaves are collected for sampling the mite population or the no. of main limbs infested with San-jose-scale, no. of scales/unit area (say 1.6 sqm. at a marked position on a particular and linear portion say for 10 cms. length which should be painted (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 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 size, sunny partially sunny, cloudy, rainy etc. for the proceeding week.

B. Drawing :

First draw the plant with actual no. 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 care 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) When no. of mites is 5 to 8 or more the group may advocate for any recommended pesticide especially when the weather is hot and likely to prevail during petal fall stage and pest defender ratio is 10:1.
- ii) When no. of mites is more than 5 to 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.
- iii) When it is hot and dry without any rain, group may suggest for no spray otherwise recommended against scab. Similarly they can suggest monitoring and surveillance only for build up of leaf spot till ETL is crossed by the disease.
- iv) In case of woolly aphid if 2-3 larvae of *Chrysopa spp.* or of *Syrphid fly* are present on infested twig or 50% aphids are mummified then there is no need of chemical spray.
- v) In case of San-Jose-scale if 50% of scales are parasitised by its parasitoids or 2-3 Lady Bird Beetles are present per infested twig then there is need of chemical spray.

AESA BY EXTENSION FUNCTIONARIES :

The extension functionaries during the regular visit to the village mobile 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, with IPM components 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 farmers to adopt AESA in their fields.

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.

Seasonal Varieties/Cultivars and Resistant/Tolerant Cultivars of Apple Recommended for Cultivation.

| A. Early Season | | Local Name | App. Harvest Time |
|--|-------------------------|--------------------------|---|
| i) | Irish Peach | Janathan | 2nd 3rd week of July |
| ii) | Jonathan | Janathan | 4th week of August |
| iii) | Cox's Orange Pippin | Kesri Trel | 4th week of August |
| iv) | Benoni June Eating | Saharanpuri | 3rd 4th week of April |
| v) | Tydemans Early | Red June | 3rd - 4th week of June |
| vi) | Mollie's delicious | | 3rd week of July |
| B. <u>Mid Season :</u> | | | |
| i) | Red Gold | Red Gold | 2nd 3rd week of Sept. |
| ii) | Queen's Apple | Behi Chout | 3rd week of September |
| iii) | Rome Beauty | Behi Chout | 3rd week of September |
| iv) | Scurlet Sibirian | Kichham Trel | 4th week of September |
| v) | King of Pippins | Kichham Trel | 4th week of September |
| vi) | Royal Delicious | Royal Delicious | 2nd week of August |
| vii) | Red Delicious | Red Delicious | 3rd week of August |
| C. <u>Late Season :</u> | | | |
| i) | American Apirouge | American Trel | 1st week of October |
| ii) | Kerry Pippin | Phokla | 1st week of October |
| iii) | Lal Ambri | Lal Ambur | 1st week of October |
| iv) | Sunhari | Sona Ambur | 1st week of October |
| v) | Chamure | Chamur | 1st week of October |
| vi) | Goldren Delicious | Chamur | 3rd week of September to 2nd week of October |
| vii) | Royal Delicious | Starking Delicious | 1st week to 2nd week of October |
| viii) | Red Delicious | Delichian | 1st week to 2nd week of October |
| ix) | Ambur | Ambri | 1st week to 2nd week of October |
| x) | Baldwin | Lal Farashi | 1st week to 2nd week of October |
| xi) | White Dotted Red | Maharaji | 1st week of November |
| xii) | Granny smith | Winter variety | Mid October |
| D. <u>Resistant Varieties :</u> | | | |
| | Name of Cultivar | Resistant Against | Season |
| i) | Firdous | Scab | Mid season |
| ii) | Shireen | Scab | Mid season |
| iii) | Akbar Gubhan | Scab | Mid season |

PESTICIDES RECOMMENDED FOR APPLE PEST MANAGEMENT

| S.No. | Crop Stage | Name of the Pesticides | Dosage | Target Pest | Remarks |
|------------------------------|---------------------------|--|--|--|--|
| 1. | Greentip | A. <u>Insecticides</u> : | | | |
| | | a) Diesel oil + Fish Oil Spray (Delay Dormant) potash based Add ethion 50EC @ 1ml/lit. of emulsion | 1:10 (stock sol. water) 1:15 (stock sol. water) | San-jose-scale, mite, woolly aphid & over- wintering catterpillars | (1/4" to 1/2" tip stage) (1/4" to 1/2" tip stage) |
| | | b) Winter spray oils | 3-4 ltrs/200 litre of water | do | |
| 2. | Pink bud | A. <u>Insecticide</u> : | | | |
| | | a) Endosulfan 35 EC | 140 ml/100lts. of water | San-jose-scale, mite | Make the spray of S.No. 2 incase spray I is missed. But after 3-4 days of 2b. |
| | | b) Chloropyriphos 20 EC | 100 ml/100lts. of water | San-jose-scale, mite | |
| | | | | San-jose-scale, mite | |
| | | B. <u>Fungicides</u> : | | | |
| a) Fanarimol 12 EC | 40 ml/100lts. of water | Scab | (Conduct the spray after about 3 weeks of 1st spray) | | |
| b) Bitertanol 25 wp | 50 gms/100lts. of water | | | | |
| c) Dodine 56 wp | 60 gms/100lts. of water | | | | |
| 3. | Petalfall | A. <u>Insecticides</u> : | | | |
| | | a) Phosalone 35 EC | 140 ml/100lts. of water | San-jose-scale, mite | (Conduct the spray only after 3-4 days of fungici- dal spray at the stage 2 B). |
| | | b) Dimethoate 30 EC | 100 ml/100lts. of water | aphis, tortrixids | |
| | | c) Quinalphos 25 EC | 100 ml/100lts. of water | Thrips | |
| | | B. <u>Fungicides</u> : | | | |
| a) Hexaconazole 5 EC (0.04%) | 50 ml/100lts. of water | Scab, leaf, spot | (Conduct spray about 14-18 days after 2nd spray | | |
| 4. | Fruit Stage (Pea size) | A. <u>Insecticides</u> : | | | |
| | | a) *Dicofol 18.5 EC | 108ml/100lts. of water | Mite, aphis, woolly | Conduct the spray 3-4 |

b) Methydemeton 25 EC 80 ml/100lts. of water aphids, tortricids and days of 4 B.
san-jose-scale

c) *Abamectin 1.8 EC 555 ml/100lts. of water

B. Fungicides :

a) Mancozeb 75 wp 300 gms/100lts. of water Scab and other (Conduct the spray 14-
b) Ziram 80 wp 200 gms/100lts. of water foliar diseases 18 days after 3rd spray)

c) Ziram 27 EC 600 ml/100lts. of water

d) Captan 50 wp 300 gms/100lts. of water

5. Fruit Development stage-I

A. Insecticides :

a) Methyl demeton 25 EC 80 ml/100lts. of water San-jose-scale Conduct the spray after
b) Phosalone 35 EC 140 ml/100lts. of water woolly aphid, mite, 3-4 days of 5 B.
c) *Dicofol 18.5 EC 108 ml/100lts. of water tortricids, aphids,
leaf miner

B. Fungicides :

a) Panconazole 10 EC 50 ml/100lts. of water Scab and other Conduct the sprays 14-
b) Fenarimol 12 EC 40 ml/100lts. of water foliar diseases 18 days after 4th spray.
c) Bitertanol 25 EC 50 gms/100lts. of water

6. Fruit Dev. Stage-II

A. Insecticides :

a) Methyl demeton 25 EC 80 ml/100lts. of water San-jose-scale, Conduct the spray after
b) Dimethoate 30 EC 100 ml/100lts. of water mite, leaf miner, 3-4 days of 6 B.
c) Endosulfan 35 EC 140 ml/100lts. of water tortricids, aphids,
and woolly aphids

d) *Abamectin 1.8 EC 555 ml/100lts. of water

B. Fungicides :

a) Hexaconazole 5 Ec (0.030%) 30 ml/100lts. of water Scab and other Conduct the spray 14 -
foliar diseases 18 days after 5th spray

7. Fruit Dev. Stage-III

A. Insecticides :

a) Dimethoate (0.05%) 100 ml/100lts. of water San-jose-scale, Need based
b) Endosulfan (0.05%) 140 ml/100lts. of water aphids, mite & tortricids
c) Quinalphos (0.025%) 100 ml/100lts. of water
d) Phosalone (0.05%) 140 ml/100lts. of water

| | | | | | |
|-----|-----------------------|------------------------------|-------------------------|---------------------|-------------------------|
| | | e) Chloropyriphos (0.020%) | 100 ml/100lts. of water | | |
| | | B. Fungicides : | | | |
| | | a) Panconazole 10 EC | 50 ml/100lts. of water | Scab and other | Conduct the spray 14 - |
| | | b) Dodine 65 wp | 60 gms/100lts. of water | foliar diseases | 18 days after 6th spray |
| 8. | Fruit Dev. Stag-IV | A. Insecticides : | | | |
| | | a) Methyl demeton 25 EC | 80 ml/100lts. of water | San-jose-scale, | Need based |
| | | b) Phosalone 35 EC | 140 ml/100lts. of water | mite, woolly aphid, | |
| | | c) Endosulfan 35 EC | 140 ml/100lts. of water | aphis | |
| | | d) Chloropyrophos 20 EC | 100 ml/100lts. of water | | |
| | | e) Dimethoate 30 EC | 100 ml/100lts. of water | | |
| | | B. Fungicides : | | | |
| | | a) Hexaconazole 5 EC (0.03%) | 30 ml/100lts. of water | Scrab and other | Conduct the spray 14 - |
| | | b) Bitertatrol 25 EC | 50 gms/100lts. of water | foliar diseases | 18 days after 7th spray |
| | | c) Fanarimol 12 EC | 40 ml/100lts. of water | | |
| 9 | Pre-harvest | A. Insecticides : | | | |
| | | a) Endosulfan 35 EC | 140 ml/100lts. of water | Pests as under | Need based |
| | | b) Chloropyriphos 20 EC | 100 ml/100lts. of water | S.No.7 | |
| | | c) Phosalone 35 EC | 140 ml/100lts. of water | | |
| | | B. Fungicides : | | | |
| | | a) Ziram 80 wp | 200 ml/100lts. of water | Scab and other | Need based |
| | | b) Ziram 27 EC | 600 ml/100lts. of water | foliar diseases | |
| | | c) Mancozeb 75 wp | 300 ml/100lts. of water | | |
| | | d) Captan 50 wp | 300 ml/100lts. of water | | |
| 10. | Post harvest | A. Insecticides : | | | |
| | | a) *Ethion 50 EC | 100 ml/100lts. of water | San-jose-scale, | Need based |
| | | b) Chloropyriphos 20 EC | 100 ml/100lts. of water | mite, woolly aphis | |

*Not as per the approved usage under Insecticides Act, 1968.

BASIC PRECAUTIONS IN PESTICIDE USAGE**A. Purchase :**

1. Purchase only just required e.g. 100, 250, 500 or 1000 g/l 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 house premises.
2. Keep only in original container with intact seal.
3. Do not transfer pesticides to other containers.
4. Never keep them together with food or feed/fodder.
5. Keep away from 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 pesticides.
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. Equipments :

1. Select right kind of equipment.
2. Do not use leaky, defective equipment.
3. Select right kind of nozzle.
4. Do not 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.

3. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV sprayer.
3. Wash the sprayer and buckets etc. with soap water after spraying.
3. Containers, buckets etc. used for mixing pesticides should not be used for domestic purposes.
3. Avoid entry of animals and workers in the fields immediately after the spraying.

3. Disposal :

3. Left over spray solution should not be drained in ponds or water lines etc. Throw it in barren isolated area, if possible.
3. 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 pesticides container for any purpose.

3. Cautions during spraying :

3. If operator feels giddiness, uneasy, he must discontinue spraying /dusting at once.
3. Operator should not spray/dust more than 4 hours at a stretch in a day.
3. Operator should not take up spray/dusting work with empty stomach.