



IPM PACKAGE NO. 65



INTEGRATED PEST MANAGEMENT PACKAGE

FOR
OLIVE



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 OLIVE

CONTENTS

| SUBJECT | PAGE No. |
|--|----------|
| Foreward | i |
| Preface | ii |
| Acknowledgements | iii |
| I. Major Pests : | 1-2 |
| A. Pests of National Significance | |
| 1. Insect pests | |
| 2. Diseases | |
| 3. Weeds | |
| B. Pests of Regional Significance | |
| 1. Insect pests | |
| 2. Diseases | |
| 3. Weeds | |
| 4. Termites | |
| 5. Rodents | |
| II. Varieties/Cultivars recommended for cultivation | 3 |
| III Pest Monitoring : | 4-7 |
| A. Agro Eco System Analysis | |
| B. Survey/Field scouting | |
| C. Economic Threshold Levels | |
| IV. Integrated Pest Management Strategies: | 8-12 |
| A. Cultural Practices | |
| B. Mechanical Practices | |
| C. Biological Practices | |
| D. Chemical control measures | |
| V. Stagewise IPM Practices to be adopted | 13-17 |
| VI. Do's & Don'ts in Olive Pest Management | 18-21 |
| VII. Management of Fruit Drop | 22 |
| VIII. Annexures (I, II & III) | 23-29 |



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DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE

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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.


(P. S. CHANDURKAR)^{14/8/03}

August, 2003

P R E F A C E

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

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

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

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

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

7th October, 2003



(A. D. Pawar)
Addl. PPA-cum-Director(IPM)

IPM PACKAGE FOR OLIVE

I. MAJOR PESTS:-

A. PESTS OF NATIONAL SIGNIFICANCE

1. Insect pests:

- | | | |
|-----|-------------------|-----------------------------------|
| 1.1 | Olive Black Scale | (<i>Saissetia oleae</i>) |
| 1.2 | Olive White Scale | (<i>Matacaronema japonica</i>) |
| 1.3 | Olive Psylla | (<i>Euphyllura pakistanica</i>) |
| 1.4 | Olive Lace Bug | (<i>Eteoneus sp.</i>) |

2. Diseases:

- | | | |
|-----|--------------|--|
| 2.1 | Anthrachnose | (<i>Gloeosporium olivarum</i>) |
| 2.2 | Wilt | (<i>Colletotrichum gloco sporoides</i>) (<i>Verticillum spp.</i>) |

3. Weeds:

a) Monocot

- | | | |
|-----|---------------|--------------------------------|
| 3.1 | Congo Grass | (<i>Imperata cylindria</i>) |
| 3.2 | Burmuda Grass | (<i>Cynodon doctylon</i>) |
| 3.3 | Knot Grass | (<i>Paspalum conjugatum</i>) |
| 3.4 | Nut Grass | (<i>Cyperus rotundus</i>) |

b) Dicot

- | | | |
|-----|---------------------|------------------------------|
| 3.5 | Sorrel | (<i>Oxalis latifolia</i>) |
| 3.6 | Swine Cress | (<i>Coronopus didymus</i>) |
| 3.7 | Creeping spiderling | (<i>Borreria hispida</i>) |

- 1.5 Pentotomid Bug (*Holotrichia sp.*)
(*Erthesina fullo*)

2. Diseases:

- 2.1 Olive Canker (Olive knot) (*Pseudomonas sayastanoi*)
2.2 Peacock Eye (Peacock spot) (*Cycloconium oleaginum*)
2.3 Olive Shield (*Macrophoma/Sphaeropsis dalmatica*)
2.4 Sooty Mould (*Capnodium Elaeophihum*)

3. Weeds:

- 3.1 Bathua (*Chenopodium spp.*)
3.2 Neelafulnu (*Agerateum spp.*)
3.3 Dubgrass (*Cynodon dactylon*)
3.4 Motha (*Cyperus spp.*)

4. Termites

5. Rodents

- 5.1 Soft Furred Field Rat (*Melardia meltada*)
5.2 Indian Mole Rat (*Bandicota bengalensis*)
5.3 Vole (*Alticola sp.*)

II. VARIETIES/CULTIVARS RECOMMENDED FOR CULTIVATION

Oil Type

Frontoio (L)

Corotina

Lecenio

Ascoiterana

Aglandeau

E. Early, L. Late

Pandolina

Pickle Type

Ascolano (E)

Corotina

Tonda Iblea

Picholina

Messinese

Cerignola

Itrana

III. PEST MONITORING:

A. Agro Eco System Analysis (AESA)

AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyse field situations for 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/bud swell. Based upon the results of the roving surveys, the state extension functionaries have to concentrate for greater efforts at block and village levels as well as through farmers to initiate field scouting especially to know the proper bud stage for applying the delayed dormant oil spray. 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 after every 5 orchards depending upon 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 10 plants randomly in zig zag fashion in the orchard for identifying and for recording the intensity/population of sucking pests and defoliators at the later growth stages i.e. from bud burst/petal fall to harvesting. Record population of potential different biocontrol fauna to arrive at the decision making stage. Record the major diseases and their intensity along with deficiency related diseases exhibited during the course of fruit development.

2. Field Scouting :

Field scouting for pests / diseases and biocontrol fauna/ flora by extension agencies and farmers should be undertaken once in a week work out ETL or pest defender ration. In case of Olive scale, scale count should be taken per unit area after flagging the particular limb of the plant. The State Department of Horticulture should make all possible efforts by using different media, mode and publicity to inform the farmers for field scouting in the specific crop area having indication of pest and disease build up.

3. Pest Monitoring through Traps:

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

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

3.3 Through light traps: Most of the moths of leaf roller caterpillars and a few beetles of root/stem borers get attracted towards light during night. Therefore, installation of light traps in the orchards help in monitoring of initial build-up of pest population.

C. Economic Threshold 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, green fruit worms. Economic threshold for 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 vigor. However, it seems certain that there is a considerable tolerance for loss of leaves or leaf function in fruits trees 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.

ETL: Economic threshold is the density 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 justifying the cost of artificial control measures. These costs should be measured in the broadest sense possible.

| S.No. | Name of Pest | Range | Incidence /Extent | Remarks |
|-------|-----------------|---|----------------------------------|---|
| 1. | Olive Scale | a) 1-5 scales/sample b) 6-12 scale/sample c) 13 & above/sample | Low Medium High | |
| 2. | Defoliators | Appearance of caterpillars in foliage. | - | Depending on survey observations. |
| 3. | Olive Psylla | a) Presence of pest on trunk in traces/small patches. b) Presence of pest on trunk and limbs. c) Presence of pest on limbs and terminal shoots. | Low Medium High | -do- -do- -do- |
| 4. | Foliar diseases | a) Just appearance of diseases or upto 5% area infested. b) 6-15% foliage/twigs/limbs affected. c) >15% of foliage/twigs/limbs affected | Traces/ low Medium High | The level may be influenced by prevailing weather conditions and also vary from disease to disease. |

Note: There may be variation in the worked out ETL for different pests so other factors of the place may also be taken into consideration for fixing the ETLs.

IV. INTEGRATED PEST MANAGEMENT STRATEGIES

A. Cultural practices:

- Proper selection of cultivars, having commercial value and suitable for effective cross pollination be made.
- Loamy/clay underlain with a hard pan well drained, slightly acid to alkaline (6.5-8.0 pH) soils should be selected for cultivation.
- Avoid the sites having high velocity winds and prone to hail storm, for planting.
- The places for laying the successful orchards should have temperatures not below 12.6⁰C with annual rainfall of 100-120 mm during winter. The localities should be free from early fall and late spring frost.
- Its cultivation can be undertaken in areas ranging from 650 m to 2300 m above sea level and annual mean temperature should be between 15-30⁰C, in 30-45⁰ latitude north and south of the equator.
- For laying an orchard grafted trees should be preferred as they are more resistant to climatic factors.
- Plant material for laying quality fruit orchards should be obtained from a registered nursery.
- Avoid planting of infested saplings.
- For raising of nurseries, the soil dis-infection of rooting media (sand) should be undertaken before plantation of cuttings.
- Make use of recommended quantum of FYM in the soil for laying of nursery and orchard.
- Avoid use of excessive nitrogenous and phosphorus fertilizers.
- If the plants exhibit the deficiency of micro nutrients go for the application of the same.
- Application of nitrogen should be made in split doses, half in the month of march and ½ in July after onset of rains.
- Inter-cropping of leguminous crops, like mash/moong etc. should be encouraged.
- Growing of flowering plants especially marigold and maize on the peripheries will helping conservation of both predators and parasites.
- In rich soils, the fertilizer doses may be halved or regulated on the basis of leaf analysis report.

- Maintain 11.0% of pollinising varieties while laying on olive orchard viz. Frontoio, Corotina, Ascolano and Ascoiterana.
- Irrigate the plantation/orchards timely during fruit development and during high temperatures, flood irrigation is desired.
- Plants should be trained on modified leader system giving semi spherical shape to tree after considering growth pattern of cultivar, and mode of cultivation.
- Bearing trees should be given light pruning and the crown be thinned occasionally to allow the sunlight to enter.
- Remove weak and old shoots and in old trees rejuvenating pruning is advised for improvement in field.
- Pruned cuts should be made close to the branches leaving no stubs and wounds should be covered with superior white lead paint/Bordeaux paste.
- Light hoeing should be adopted during summer and after monsoon months.

B. Mechanical Practices:

- Remove of dead and drying fruit trees to ward off borer infestation.
- Pruning and destruction of scale and psylla infested branches.
- Collection and destruction of infested leaves.
- Removal and destruction of infested/culled fruits.
- Pruning of water sprouts, dead and interfering branches during dormant period should be undertaken.
- Weak and old shoots should be tinned out to keep the trees in vigorous growing stage.
- White washing impregnated with CuSO_4 of the tree trunks may be adopted before onset of summer.

C. Biological Practices:

- Before laying or raising of plant nursery make use of *Trichoderma viride* and *T. harzianum* to control soil borne disease.
- Make use of neem cakes while raising plant nurseries to ward off any soil pests.

- Conservation of predators like Green Lace Wings, Lady bird beetles, Hover Flies, Anthocorids, Spiders and Carabids.
- Growing of flowering plants, especially Marigold and Maize on the peripheries and legumes as inter cropping help in conservation of natural enemies.
- Clip off twigs having mummies (psylla) without exit holes before spraying and tie such twigs with unsprayed trees supporting the psylla population to enhance the parasitoid activity.

Augmentation:

Monitor the incidence of sucking pests like psylla, scale insects and aphids and make release of:

A. Predators: Lady bird beetles, like different spp. of *Chilocorus bijugus*, *Pharoscymnus horni*, *Coccinella septempunctata*, *Chilocorus tristis*, *Adalia bipunctata*, *Synharmonia sp.* *Exochomus quadripustulatus*, *Hippodamia-convergens*, *Stethorus sp.* @ 30-50 adults/infested tree.

B. Parasitoids: *Metaphycus sp.* @ 1000-2000 per infested tree at least 15 days after insecticidal sprays or 10 days after fungicidal sprays may be released.

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-II.
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-II 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 biopesticides and neem based formulations as per the recommendations of SAU.
- 2.7 Proper spray equipments should be used:
Tractor mounted sprayers/power sprayers for effective spray coverage.
- 2.8 Use proper spray volume per unit area.

3. Cautions during spraying:

- 3.1 If operator feels giddiness, uneasy, he must discontinue spraying/dusting at once.
- 3.2 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.

4. Weed Management

a) Preventive Measures

- 4.1 Before establishing orchard follow the summer deep ploughing to expose and destroy the underground vegetative parts of the deep rooted perennial weeds.
- 4.2 Follow the recommended agronomic management practices of land preparation, planting distance, fertilizer and irrigation etc. to have healthy plants stand.

b) Control Measures

- 4.3 Smothering of weeds by using mulching with straw/hay/plastic sheets.
- 4.4 Use bullock drawn or power operated or hand operated implements for controlling weeds as and when needed.

5. Rodent Management:

- 5.1 Adopt orchard sanitation.
- 5.2 Do not cultivate fodder crops especially oats in orchards.
- 5.3 Make use of Bromodiolon concentrate bait @ 0.005% a.i. in two applications at an interval of one week.
- 5.4 Adoption of community approach may be taken.

V. STAGewise IPM PRACTICES TO BE ADOPTED

| S.No. | Crop stage | Pest | IPM Practices | |
|-------|------------|----------------------|---------------|---|
| 1. | Bud Swell | Olive Scale | Monitoring | Conduct regular monitoring and surveillance |
| | | | Chemical | Conduct sprays (need based) as per the recommendations only after determining ETL. |
| | | Canker | Cultural | Avoid wounds to the trees and use of infested plants, grafts and cuttings. |
| | | | Mechanical | Cut out the galls and disinfect all wounds and pruning tools. |
| | | | Chemical | Go for the application of Bordeaux mixture or copper oxychloride during winter. |
| | | Wilt | Cultural | Avoid planting olives where infection has been noticed. |
| | | | Mechanical | During dormancy cut out the dried branches and destroy them. |
| 2. | Bud Burst | Olive Scale | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Chemical | Conduct sprays (need based) as per the recommendations only after determining ETL. |
| | | Bark beetle | Cultural | Avoid stocking of wood heaps around olive plantation. |
| | | | Mechanical | Plaster the infested trees (stems & trunks) with the mixture of 10.0% carbryl dust or chloropyriphos 5.0% & the clay in the ratio of 1:6. |
| | | | Chemical | Conduct the sprays of carbryl or melathion or methyl parathion on wood heaps. |
| | | Canker | Cultural | Avoid wounds to the trees and use of infested plants, grafts and cuttings. |
| | | | Mechanical | Disinfect all wounds and pruning tools. |
| | | Wilt | Cultural | Avoid planting olives where infection has been noticed. |
| 3. | Flowering | Olive Scale & Psylla | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Biological | Conserve natural enemies. Make release of <i>Metaphycus zebralus</i> |

| | | | | |
|----|------------|--------------------------------|------------|---|
| | | | | against scale and releases of LBB & Lace Wings for both. |
| | | Bark Beetles | Cultural | Avoid stocking of wood heaps around olive plantation. |
| | | | Mechanical | Plaster the infested trees (stems & trunks) with the mixture of 10.0% carbryl dust or chloropyriphos 5.0% & the clay in the ratio of 1:6. |
| | | Canker | Cultural | Avoid wounds to the trees and use of infested plants, grafts and cuttings. |
| | | | Mechanical | Disinfect all wounds & pruning tools. |
| | | Wilt | Cultural | Avoid planting olives where infection has been noticed. |
| | | Anthracnose & Peacock Eye spot | Monitoring | Conduct regular monitor and surveillance. |
| 4. | Petal Fall | Olive Scale & Psylla | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Biological | Conserve natural enemies. Make release of <i>Metaphycus zebralus</i> against scale and releases of LBB & Lace Wings |
| | | | Chemical | Conduct sprays (need based) as per the recommendations only after determining ETL. |
| | | Bark Beetle | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Biological | Conserve natural enemies. Make release of <i>Metaphycus zebralus</i> against scale and releases of LBB & Lace Wings |
| | | | Chemical | Conduct sprays (need based) as per the recommendations only after determining ETL. |
| | | Bark beetles | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Cultural | Avoid stocking of wood heaps around olive plantation. |
| | | | Mechanical | Plaster the infested trees (stems & trunks) with the mixture of 10.0% carbryl dust or chloropyriphos 5.0% & the clay in the ratio of 1:6. |
| | | | Chemical | Conduct the sprays of carbaryl or |

| | | | | |
|----|-----------|--|----------------------------------|---|
| | | | | melathion or methyl parathion on wood heaps. If not done earlier. |
| | | Termites | Mechanical | i) Destroy termitaria in the vicinity of orchards. ii) Remove dead bark & fross. |
| | | | Chemical | Drench the soil with chloropyriphos (0.1%) or treat the trunk and main roots of the affected plants. |
| | | Defoliators | Mechanical | Installation of pheromone/light traps be done for monitoring of the pest. |
| | | | Biological | i) Conservation of natural enemies be done. ii) Release of <i>Trichogramma spp.</i> Be made @ 50000/ha. |
| | | | Chemical | Conduct the sprays of recommended pesticides only (need based) (ref. Annexure II) |
| | | Canker | Cultural | Avoid wounds to the trees and use of infested plants, grafts and cuttings. |
| | | | Mechanical | Disinfect all wounds & pruning tools. |
| | | Wilt | Cultural | Avoid planting olives where infection has been noticed. |
| | | Anthracnose and Peacock Eye Spot | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Chemical | Go for the sprays of recommended fungicides (ref. Annexure II) if needed. |
| 5. | Fruit Set | Olive Scale & Psylla | Monitoring | Regular monitoring be conducted. |
| | | | Biological | Conserve natural enemies. Make release of <i>Metaphycus zebralus</i> against scale and releases of LBB & Lace Wings for both. |
| | | | Chemical | Conduct sprays (need based) as per the recommendations only after determining ETL. |
| | | Bark Beetles, Defolators, Aphis & Termites | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Cultural, Biological Chemical | Same as mentioned under S.No. 4 above as per need. |
| | | Canker, Wilt, | Monitoring | Conduct regular monitoring and |

| | | | | |
|----|---------------------------|--|-------------------------------|--|
| | | Anthracnose & Peacock Eye Spot | | surveillance. |
| 6. | Fruit developmer | Olives scale, Psylla, Bark Beetles, Aphis, Defoliators & Termites. | Monitoring | Regular monitoring be conducted for determining ETL. |
| | | | Cultural, Biological Chemical | Same as mentioned under S.No. 4 above as per need. |
| | | Olive fly | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Mechanical | i) Hoeing of tree basins before spring season be done to expose pupal stage of fly. ii) Collection and destruction of fallen infested fruits be undertaken. |
| | | | Chemical | Apply 4 appliciations of a bait spray containing lebacid @ 0.3% against adults |
| | | Canker, Wilt, Anthracnose & Peacock Eye Spot | Monitoring | Conduct regular monitoring and surveillance. |
| | | | Mechanical Chemical | Same as mentioned under S.No. 4 above if needed. |
| | | Olive shield & Sooty Mould | Monitoring | Conduct regular monitoring and surveillance. |
| 7. | Less Active/Dormant stage | Olive Scale | Mechanical | Pruning and destruction of psylla infested shoots or its winter sites. |
| | | Bark Beetles | Cultural | Avoid stocking of wood heaps around olive plantation. |
| | | | Mechanical | Plaster infested trees (stems & trunks) with the mixture of 10.0% carbryl dust or chloropyriphos 5.0% & the clay in the ratio of 1:6. |
| | | | Chemical | Conduct the sprays of carbaryl or melathion or methyl parathion on wood heaps. |
| | | Termites | Mechanical | i) Destroy termitaria in the vicinity of orchards. ii) Remove dead bark and fross. |
| | | | Chemical | Drench the soild with chlorophyrichos (0.1%) or treat the trunk and main roots of the |

| | | | | |
|--|--|--|------------|--|
| | | | | affected plant. |
| | | Aphis & Defoliators | Mechanical | Overwintering population on trees/in the vicinity of trees should be destroyed. |
| | | Olivefly | Mechanical | Collect & destroy the refuse/culled fruits from the orchards. |
| | | Anthracnose, Olive shield, Sooty Mould, Peacock Eye spot | Mechanical | Collect and destroy the fallen foliage/culled fruits from the orchards. |
| | | Canker | Cultural | Avoid wounds to the trees and avoid use of infested plants, grafts and cuttings. |
| | | | Mechanical | Cut out the galls & disinfect all wounds & pruning tools. |
| | | | Chemical | Go for the application of Bordeaux mixture or copper oxychloride. |
| | | Wilt | Cultural | Avoid planting olives where infection has been noticed. |
| | | | Mechanical | Cut out the dried branches and destroy them. |

VI. DO'S & DON'TS IN OLIVE PEST MANAGEMENT

| DO'S | DON'T'S |
|--|--|
| 1. Grow only recommended cultivars. | Don't grow under script material which vary greatly in fruiting pattern and pest susceptibility. |
| 2. Clay underlain with hard pan/loamy soils slightly acidic to alkaline (6.5 to 8.0 P/H) must be preferred for establishing an orchard. | Don't establish an orchard either in high acidic or high acidic or high alkaline soil. |
| 3. For laying a quality orchard soils having adequate drainage facility be preferred. | Don't lay an orchard in soils having poor drainage facility. |
| 4. For laying a quality orchard and for obtaining maximum production, soil with calcareous silt be preferred. | Avoid locality having not calcareous silt soils for laying an orchard. |
| 5. Avoid the sites prone to hail storm and high velocity winds for laying an orchard. | Don't lay an orchard at sites having high velocity winds and prone to hail storm. |
| 6. At steep slopes site, make contour terraces to facilitate various practices and to prevent soil erosion. | Don't let the steep slops without contour terraces. |
| 7. Grafted trees be preferred as they are more resistant to climatic factors. | |
| 8. Minimum temperature of the place should not be below 12.0°C with annual rainfall 100-120 cm. | Avoid localities having early fall and late spring frost for olive cultivation. |
| 9. Pits for planting should be dug 2 months prior with 1 cubic metre size. | Don't dug the undersize pits for planting. |
| 10. For laying an orchard land should be made free from perennial bushes and other weeds. | Don't lay an orchard in the land having perennial bushes and other weeds. |
| 11. On sloppy and arid soils no tillage system is to be practiced for removal of weeds rather go for manual removal of weeds and perennial bushes. | |
| 12. Plant material for laying a quality orchard should be obtained from a registered | Don't take planting material from a unregistered nursery. |

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| nursery. | |
| 13. Solarization of nursery beds and disinfection of rooting media should be adopted before raising nurseries. | Don't use the infested seeds for raising the rootstock. |
| 14. Make use of antagonistic fungus and neem cake before raising a nursery or planting of cuttings. | Don't raise the nurseries in low lying areas. |
| 15. In localities with irrigation facilities, plant the trees with 10x10m or 5x5 m and in rainfed conditions and poor soils, the spacing should be 6x4m. | Don't plant the trees in over crowded pattern. |
| 16. Seed beds should be frequently watered to keep them moist. | Don't force the seed beds to dry or in water lodged conditions. |
| 17. Apply root hormone to cuttings before planting. | Don't plant the cuttings without the application of root harmones. |
| 18. Training should be done after considering growth pattern of the cultivar and mode of cultivation | Don't undertake training without considering growth factors. |
| 19. For obtaining quality fruits, the tree should be pruned properly. | Don't undertake random pruning. |
| 20. Bearing trees should be lightly pruned and crowns thinned occasionally to allow entry of sunlight | Don't under random pruning. |
| 21. In old trees rejuvenating pruning is advised to improve yield and do this proactice during least active period i.e. November to February. | Don't under pruning during active period. |
| 22. Regular shallow hoeing should be adopted during summer and after monsoon months. | Don't allow the weeds to grow. |
| 23. Tree basin flooding and drip irrigation can be adopted depending upon the availability of water. | |
| 24. Apply recommended dose of FYM during December, January/lease active peiod along with balanced dose of P&K. Apply | Don't make excessive use of FYM and fertilizers |

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| ½ of nitrogen in March and 2 nd ½ after onset of rains. | |
| 25. Grow green manuring and cover crops as inter crops to ensure uniform conditions for the growth of plant. | Don't cultivate the fodder crops as inter crops. |
| 26. During rainy season, growing of pulses, cash crops like potatoes, cereals or green manuring crops are useful. | |
| 27. Grow figs, pomegranates or almonds as fillers if the spacing is wide in olive orchards. | |
| 28. Maintain 11.0% of plant population as pollinizers. | Don't cultivate the cultivars without sufficient number of pollinizers. |
| B. Pest Management | |
| 1. Diseased, insect infested and intermingling branches should be roved and destroyed. | |
| 2. Ensure the destruction of heavily infested/dead trees from the orchards. | |
| 3. Collection and destruction of the infested fallen foliage and culled fruits from the orchards be ensured. | |
| 4. Have surveillance for pest/disease infestation during excessive rainfall and prolonged wet periods in rainy season. | |
| 5. Destroy termitaria in the vicinity of the orchards. | |
| 6. Use only recommended pesticides at the recommended dosages for the control of various pests/diseases. | Don't use the insecticide at sub/over dosages. |
| 7. Conduct sprays either in the mornings or in the late evening hours only. | Don't conduct the sprays during the hot/noon hours of the day. |
| 8. Encourage cultivation of flowering and maize crop on the peripheries of the orchards. | Don't allow the weeds to grow. |

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| C. Harvesting and Post Harvesting | |
| 1) Make use of orchard ladder and trained persons for picking of fruit. | |
| 2) Fruits should be harvested only after ensuring their proper maturity (deep purple colour) in both skin and pulp. | |
| 3) For table varieties green colour fruits (matured green stage) should be harvested. | |
| 4) Fruit should be preferably crushed for oil extraction within 24 hours of harvesting or before they begin to soft. | |
| 5) Harvesting can be done by the following methods: i) Natural dropping. ii) Picking by hand. iii) Beating with wooden pols. iv) Milking especially in dwarf sized cultivars. v) By using shakers. | |

VII. MANAGEMENT OF FRUIT DROP

A. Fruit Drop:

1. Premature fruit drop can be reduced by the application of potassium salt of NAA at 30 ppm.
2. Pre-harvest fruit drop can be reduced by application of sodium salt of NAA and 2,4-D.

B. Fruit set:

1. Spraying of aqueous solutions of putrescine dichloride at full bloom increases fruit set in self incompatible cultivars.
2. Spraying with L-arsinine also increases fruit set.
3. Spraying of aqueous sols. Of BA (150 & 300 ppm), TIBA (20 & 100 ppm), GA-3 (50 & 10 ppm) and CEPA (150 & 300 ppm) when applied to flowers reduced fruit drop.
4. Make use of NAA for thinning at 150 ppm approximately 2 weeks after full bloom during heavy cropping years.

AGRO ECO SYSTEM ANALYSIS (AESAs)

A. FIELD OBSERVATIONS :

- a) Enter the orchard at least 15-20 feet away from road/ bund. Select a plant of medium size randomly.
- b) Record the visual observations on the following parameters :
 - i) Flying insects (both pests and defenders).
 - ii) Close observation on pest and defenders which remain on the plant.
 - iii) Observe pests like scale, thrips, caterpillars and defenders like lady bird beetles, green lace wings, anthocorids, bugs, spiders, predatory ants and mites.
 - iv) Record various diseases and their intensities.
 - v) Record insect damage in percentage or otherwise in case of non uniform pests like scale.
- c) Record parameters like number of pest per leaf randomly around the plant canopy on the periphery at chest and head height. This concept is needed to establish the initial life stages and distribution of pest. Regular counts of pest and its enemy population on a 7-10 day interval are needed. The pest population is sampled by determining the number of pests on at least 10 leaves collected around the plant and from five or more plants per monitored orchard. The number of plants selected to sample would depend largely on the size of the orchard. The plants selected for samplings should be representatives of the entire orchard in size and cultivar. Preferably cultivars which are sensitive to pest attack should be taken for sampling. The bioagent population is surveyed on the same plant as the pest and is accomplished by slowly walking around the periphery of the plant recording the number of adults and larvae visually. The bioagent survey should be done before leaves are collected for sampling the pest population or the number of main limbs infested with scale.
- d) Record soil conditions viz. dry, wet or water lodged.
- e) Observe rodent live burrows.

f) Repeat the steps from (b) to (e) on at least 5 plants in a diagonal row or criss-cross fashion across the orchard to have overall average assessment of the orchard.

g) Record the climatic factors like sunny, partially sunny, cloudy, rainy etc. for the preceding week.

B. DRAWING :

First draw the plant with actual number of main limbs in the centre of a chart. Then draw pest 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 names of the pests 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 it is sunny. If cloudy, the clouds may be drawn in place of sun. In the case of partially sunny, the diagram of sun may be half masked with clouds.

C. GROUP DISCUSSION AND DECISION MAKING :

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

D. STRATEGY FOR DECISION MAKING :

- i) When weather is hot and dry without any rain, group may suggest for no spray otherwise recommended against fungal diseases. Similarly they can suggest monitoring and surveillance only for build up of disease till ETL is crossed.
- ii) In case of aphid or thrips 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.
- iii) In case of scale if 50% of scales are parasitised by its parasitoids or 2-3 lady bird beetles are present per infested twig then there is no need of chemical spray.

- iv) When more than 20% foliage of plants are affected by any disease and weather is humid, group may advocate for fungicide spray.

AESA BY EXTENSION FUNCTIONARIES :

The extension functionaries during their regular visit to the village should mobilise 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 and soil conditions on the likely build up of pest & defender population. They may also take the decision based on the AESA, with IPM components like release of defenders, application of neem formulations / safe pesticides 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 practise 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.

PESTICIDES RECOMMENDED FOR OLIVE PEST MANAGEMENT

| S.No. | Crop Stage | Name of the Pesticides | Dosage | Target | Remarks |
|-------|------------|--|-------------------------------------|---|---|
| 1. | Bud Swell | a) Methyl parathion or Fenvalerate or Refined mineral oil emulsion | 0.05% 0.01% 1.5% | Olive scale Bark beetle | Need based |
| 2. | Bud burst | a) Methyl parathion or Fenvalerate or Refined mineral oil emulsion b) Bordeaux mixture or copper oxychloride or Benzimidazole | 0.05% 0.01% 1.5% 0.02% | Olive scale Bark beetle Canker Wilt | In case the sprays are not done under S.No. 1 go for need based sprays Repeat the sprays after every three weeks. |
| 3. | Petalfall | a) Methyl parathion or Fenvalerate or Chloropyriphos b) Bordeaux mixture or copper oxychloride or Benzimidazole | 0.05% 0.01% 1.5% 0.02% | Olive scale Psylla Bark beetle Defoliator Aphis Termite Wilt Anthraconse Peacock eye spot | Need based after assessing ETL & P&D ration. Drench the soil with chloropyriphos or treat the truck & main roots of the affected plant. For termite. Repeat the treatment if needed. |
| 4. | Fruit set | a) Methyl parathion or Fenvalerate or Chloropyriphos b) Bordeaux mixture or copper oxychloride or Benzimidazole | 0.05% 0.01% 1.5% 0.02% | Olive scale Psylla Bark beetle Defoliator Aphis Termite Wilt Anthraconse Peacock eye spot | Need based after assessing ETL & P&D ration. Drench the soil with chloropyriphos or treat the truck & main roots of the affected plant. For termite. Repeat the |

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| | | | | | treatment if needed. |
| 5. | Fruit Development | a) Methyl parathion or Fenvalerate or Chloropyrifos b) Copper oxychloride or Bordeaux mixture or Benzimidazole c) Starch | 0.05% 0.01% 0.1% 1% | Olive scale Psylla Bark beetle Defoliator Aphis Olivefly Canker Wilt Anthracnose Peacock eye spot Olive shield Sooty mould | Need based treatment be undertaken after assessing ETL & P&D ration. Need based application be undertaken. Need based. |
| 6. | Less Active/Dormant | a) Methyl parathion or Fenvalerate or Chloropyrifos b) Bordeaux mixture or copper oxychloride or Benzimidazole | 0.05% 0.01% 1.5% 0.02% | Olive scale Psylla Bark beetle Defoliator Aphis Termite Wilt Anthraconse Peacock eye spot | Need based Need based. |

NB: However azardirectin formulations as per the recommendations of concerned SAUs maybe preferred over synthetic insecticides being safer in use.

BASIC PRECAUTIONS IN PESTICIDE USAGES

A. Purchase

1. Purchase only JUST required quantity e.g. 100, 250, 500 or 1000 gm/ 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 head with cap.
4. Use polythene bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover the head (Do not use polythene 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.

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 toothbrushes 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 doses and dilution.
2. Do not apply on hot sunny day or strong windy condition.
3. Do not apply just before the rains and also after the rains.
4. Do not apply against the wind direction.
5. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV sprayer.
6. Wash the sprayer and bucket etc. with soap water after spraying.
7. Containers, buckets etc., used for mixing pesticides should not be used for domestic purposes.
8. Avoid entry of animals and workers in the fields immediately after the spraying.

G. Disposal

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