



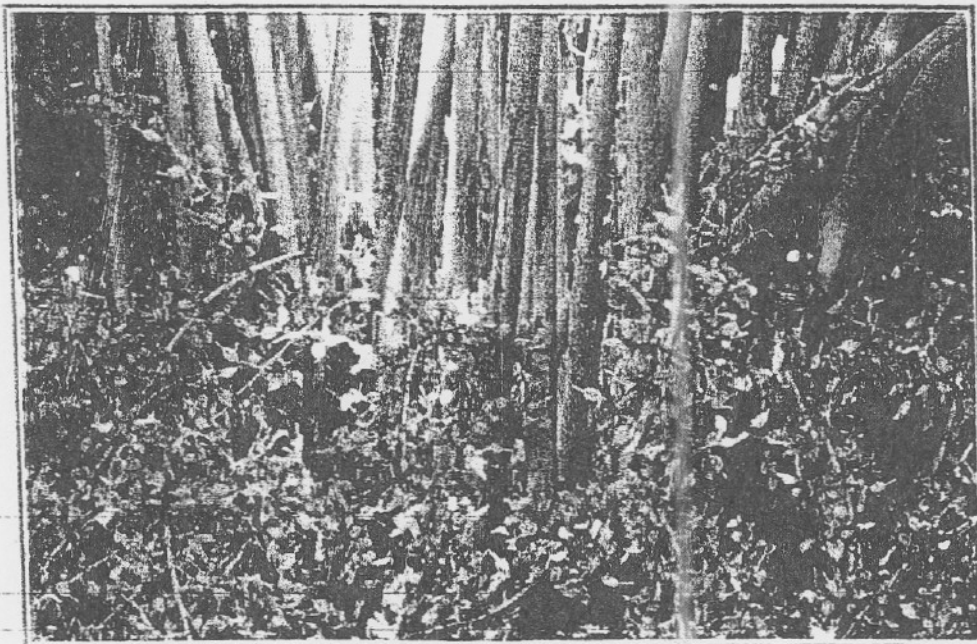
IPM PACKAGE NO. 38



# INTEGRATED PEST MANAGEMENT PACKAGE

FOR

## SMALL CARDAMOM



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

May, 2001

# IPM PACKAGE FOR SMALL CARDAMOM

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Government of India  
Ministry of Agriculture  
(Department of Agriculture & Cooperation)

**DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE**  
NH IV, FARIDABAD - 121 001 (Haryana)

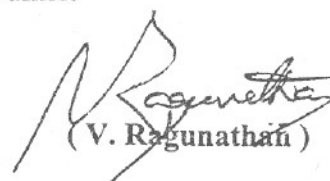
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To the Government of India

**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 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)

## PREFACE

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.

April 1, 2002



(A.D. Pawar)  
Director (IPM)

## ACKNOWLEDGEMENTS

The IPM Package of Practices for **Small Cardamom** crop was discussed and finalised in the National Workshop on IPM held at National Plant Protection Training Institute (NPPTI), Hyderabad during May 14-17, 2001. The technical input received from the following experts is thankfully acknowledged. The input received from Dr. S.N. Potty, Director (Research), Spices Board, Cochin is also gratefully acknowledged.

- I. Chairman, Technical Session : Dr. AD Pawar, Director (IPM), Dte of PPQS, Faridabad
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- III. Co-chairman, Technical Session : Dr. Bijender Singh, Entomologist Dte. of PPQ&S, Faridabad.
- IV. Expert input : 1. Dr. M.V.B. Rao, Dy. Director (PP), NPPTI, Hyderabad.  
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5. Sh. Gyaneshwer Banchor, SSA, Central IPM Centre, Ernakulam  
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## IPM PACKAGE FOR SMALL CARDAMOM

Small cardamom (*Elettaria cardamomum*), "the Queen of spices" is the native of the evergreen forests of Western Ghats in Southern India. Its cultivation is confined to the Southern states viz. Kerala, Karnataka, and Tamil Nadu accounting for 60, 30 and 10 per cent of the production respectively. The total area is estimated 81,113 ha in India.

### I. MAJOR PESTS:

#### A. PEST OF NATIONAL SIGNIFICANCE

##### 1. INSECT PESTS

- 1.1 Thrips (*Sciothrips cardamomi*)
- 1.2 Shoot borer (*Conogethes punctiferalis*)
- 1.3 Hairy caterpillar (*Eupterote sp.*)
- 1.4 Root grub (*Basilepta fulvicorne*)
- 1.5 Aphid (*Pentalonia nigronervosa*)

##### 2. DISEASES

- 2.1 Katte (Mosaic) Disease (viral)
- 2.2 Nursery Leaf spot (*Phyllosticta elettariae*)
- 2.3 Nursery leaf spot (*Fusarium sp.*, *Alternaria sp.*)
- 2.4 Damping off, Clump rot (*Pythium vexans*, *Rhizoctonia solani*, *Fusarium oxysporium*)
- 2.5 Azhukal or capsule rot (*Phytophthora meadii*)
- 2.6 Kokke kandu or cardamom vein clearing disease (viral)

##### 3. NEMATODE

- 3.1 Root knot nematode (*Meloidogyne incognita*)

##### 4. WEEDS

- 4.1 *Ageratum conyzoides*
- 4.2 *Cynodon dactylon*
- 4.3 *Panicum spp.*
- 4.4 *Cyperus spp.*

## B. PEST OF MINER/REGIONAL SIGNIFICANCE

### 1. INSECT PESTS

- 1.1 Shoot fly (*Formosina flavipes*)
- 1.2 Cutworm (*Acrilasisa plagiata*)
- 1.3 Lace wing bug (*Stephantis typicas*)
- 1.4 Early capsule borer (*Jamides alecto*) - Karnataka Region
- 1.5 White fly (*Kanagarajiella cardamomi*)

### 2. DISEASES

- 2.1 Chenthal (*Colletotrichum gloeosporioides*)
- 2.2 Leaf blotch (*Phaeodactylum alpiniae*)
- 2.3 Leaf spot (*Cercospora zingiberi*, *Sphaceloma cardamomi*)
- 2.4 Leaf rust (*Phakospora elettariae*)
- 2.5 Nilgiri necrosis (Viral)

## II. PEST MONITORING

The objective of pest monitoring is to detect the initial development of pest and diseases and also the biocontrol potentials in the field situations.

### 1. Rapid Roving Survey (RRS):-

In the beginning of the crop season, survey routes are required to be identified in the pest and disease endemic areas to undertake Rapid Roving Survey (RRS). During survey the observations are to be made at every 5-10 Kms. distance in the pre-selected route at 7-10 days intervals depending upon pest and disease situation. Record the incidence of pest, disease and defender population at each spot in 5 plants at random and 12 spots per ha.

### 2. Field scouting:-

Based on the observations of RRS the farmers at village level are to be mobilized to undertake field scouting. During field scouting farmers may record pest, disease, and defenders populations once in 7-10 days in their own fields as per Agro Eco System Analysis (AESA) approach. The State Departments of Agriculture should make all possible efforts by using different media, mode and publicity to inform the farmers the need for field scouting in the specific crop areas having indication of pest or disease built up.

### 3. Agro Eco System Analysis (AESA):-

AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyse field situations with regards to pest, defenders, soil conditions, plant health, the influence of climatic factors and their inter relationship 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 plant.
3. Pest and defenders population dynamics.
4. Soil conditions.
5. Climatic factors.
6. Farmers past experience.

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

## III. INTEGRATED PEST MANAGEMENT STRATEGIES

### 1. CULTURAL PRACTICES

- 1.1 Select pest/disease resistant/tolerant varieties etc.  
ICRI-2 (Mysore) – Tolerant to Azhukal disease  
ICRI-3 ( Malabar ) – Tolerant to Rhizome rot  
Mudigere-1 (Malabar) – Tolerant to thrips and shoot borer
- 1.2 Destruction of plant debris.
- 1.3 Prune the dry leaves before first spray in summer.
- 1.4 Treat the seed with acid to break the seed coat.
- 1.5 Frequent change of nursery beds for nematode management.
- 1.6 Keep proper spacing i.e.  
Primary nursery – 10 x 10 cm  
Secondary nursery - 20 x 20 cm  
Planting – 1.8 to 3 x 1.8 to 3 meter according to varieties and area
- 1.7 Vegetative propagation should be avoided in *KATTE* disease affected area.
- 1.8 Sow the seed in Sept. and transplant to main field during the last week of May after receipt of pre-monsoon showers or the 1<sup>st</sup> week of June soon after commencement of plant debris.
- 1.9 Provide proper mulching.
- 1.10 Remove the weed manually during May, Sept., and December/January and the same can be used for mulching.
- 1.11 Do timely earthing up.
- 1.12 Apply recommended manure and fertilizer as per soil testing.
- 1.13 Do shade regulation to provide 50-60 per cent filtered sunlight.



## 2. MECHANICAL PRACTICES

- 2.1 Remove disease affected seedlings and maintain proper phytosanitary measures in the nursery.
- 2.2 Practice regular rouging to check *Katte*, Nilgiri necrosis and vein clearing disease.
- 2.3 Destroy wild hosts like *Amomum*, *Alpinia*, *Curcuma*, *Colocasia*, *Caladium*, etc. if they show symptoms of *Katte*.
- 2.4 Destroy the *Azhukal* affected portions and plant debris.
- 2.5 Collect and destroy the beetles of *Basilepta fulvicorne* and larvae of *Eupterote sp.*
- 2.6 Use yellow sticky trap to control white fly @ 15-20 traps/ha.

## 3. BIOLOGICAL CONTROL

- 3.1 ~~Conserve~~ Use the natural enemies such as anthocoridae, lady bird beetles, chrysopids, praying mantis, braconids, ichneumonids, etc.
- 3.2 Apply *Trichoderma viride* or *Trichoderma harzianum* in plant basins to control *Azhukal* and rhizome rot diseases.

## 4. CHEMICAL CONTROL

- 4.1 Spray neem oil @ 3-5 ml/Litre against white fly. Add sufficient surfactants for emulsification.
- 4.2 Spray of \*fenthion or monocrotophos @ 0.075% against shoot and capsule borer within 15-20 days after the appearance of the pest.
- 4.3 Drench the soil with \*chlorpyrifos @ 0.04 % @ 3-4 litre/ clump or apply \*phorate @ 30-40 gm/ clump during April end-May and September to control root grub.
- 4.4 Spray \*dimethoate or quinalphos @ 0.05% to control shoot fly.
- 4.5 Apply quinalphos 0.025%, phosalone 0.07%, \* dimethoate 0.05% or \*acephate 0.075% against thrips.
- 4.6 Use Bordeaux mixture 1% or Fosetyl AL80% WP @1400-2000g/ha against *Azhukal* disease.
- 4.7 For nematode management apply \*carbofuran @ 80 gm/ 6 sq. m bed in primary nurseries and 200 gm/ 6 sq. m bed in secondary nurseries. In plantation \*carbofuran @ 60-80 gm/ plant or 20-40 gm of \*phorate with 300-500 gm of neem cake may be applied.

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\*Not as per approved usage under Insecticide Act, 1968

#### IV. CROP STAGE WISE IPM PRACTICES

Pre-sowing stage	Cultural Practices	<ul style="list-style-type: none"> <li>-Select Pests/diseases resistant/tolerant varieties.</li> <li>ICRI-2 (Mysore) – Tolerant to <i>Azhukal</i> disease</li> <li>ICRI-3 (Malabar) – Tolerant to Rhizome rot</li> <li>Mudigere-1(Malabar) – Tolerant to thrips and shoot borer.</li> <li>-Treat the seed with acid.</li> </ul>
Nursery stage	Mechanical practices	-Destroy plant debris.
	Cultural practices	<ul style="list-style-type: none"> <li>-Frequent change of nursery beds for nematode management.</li> <li>-Timely sowing and planting.</li> <li>-Keep proper spacing(Primary nursery 10 x 10 cm ; secondary nursery 20 x 20 cm)</li> <li>-Keep bed weed free.</li> <li>-Provide proper mulching and irrigation.</li> </ul>
Vegetative and Reproductive stage	Mechanical practices	-Rouge out diseased seedling.
	Chemical practices	-For nematode as suggested under chemical control.
	Cultural practices	-Provide proper irrigation, manure and fertilizers.
	Mechanical practices	<ul style="list-style-type: none"> <li>-Do trashing in time.</li> <li>-Use yellow sticky trap to catch white fly @ 15-20/ha.</li> </ul>
	Bio-logical methods	-Use <i>Trichoderma viride</i> or <i>T. harzianum</i> in the plant basin against <i>Azhukal</i> and Rhizome rot diseases.
	Chemical method	<ul style="list-style-type: none"> <li>-Spray neem oil @ 3-5 ml/litre against white fly.</li> <li>- Spray *fenthion or monocrotophos 0.075% against shoot and capsule borer within 15-20 days after the appearance of the pest.</li> <li>-Drench the soil with *chlorpyrifos 0.04 % @ 3-4 litre/ clump or apply *phorate @ 15-20 gm/ clump during April end - May and September to control root grub.</li> <li>-Spray *dimethoate or quinalphos 0.05% to control shoot fly.</li> <li>- Apply quinolphos 0.025%, phosalone 0.07%, *chlorpyrifos 0.05%, *dimethoate 0.05% or *acephate 0.075% against thrips and aphids.</li> <li>-Use Bordeaux mixture 1% against <i>Azhukal</i> disease.</li> <li>-For nematode management as suggested under chemical control.</li> </ul>

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

### V. DO'S AND DON'T'S IN CARDAMOM IPM

DO'S	DONT'S
1. Clean the area from all existing vegetation, stumps, roots and stones.	Don't select plain area for nursery bed.
2. Prepare bed with 1 meter width, 20 cm height and of required length.	Don't make too wide nursery bed.
2. Fumigate the beds with 2% Formalin (2 lit/100 lit of water) under polythene cover for 48 hrs (10 lit/bed) or do solarization.	Don't sow seed within week of fumigation.
3. Select recommended varieties.	Avoid pest susceptible varieties.
4. Collect ripened bold capsules from disease free mother clumps from 2 <sup>nd</sup> and 3 <sup>rd</sup> harvests for seed extraction.	Don't collect unripened capsules for seed.
5. Sow the seed in September preferably.	Avoid sowing before September.
6. Treat the seed with concentrated Sulphuric acid or nitric acid for two minute to break the seed coat.	Don't sow seed without acid treatment, as it will delay germination.
7. Sow seed in rows of 10 cm using seed rate 5 to 9 gm / m <sup>2</sup> seedbed.	Avoid thick sowing in seedbed.
8. Cover the bed with mulch material either with pottgrass or paddy straw.	Don't throw away the topsoil
9. Once sprouting is observed, remove the mulch and cover the bed with thinly sliced mulch materials.	Avoid the contact of mulch materials with the soil by supporting twigs laid across the bed.
10. Protect the seedlings from direct sunlight by coir mat pandal.	
11. When the seedling is of 3-4 leaf stage, transfer in secondary nursery/poly bag giving proper care.	
12. Remove diseased seedlings whenever noticed.	
13. Transplant the seedling in the main field during the last week of May after receipt of pre-monsoon showers or the 1 <sup>st</sup> week of June after commencement of South-West monsoon.	
14. Vegetative propagation can be done in <i>Katte</i> disease free area.	
15. Regulate shade properly, Southwestern slopes should be provided with more shade than North-Eastern slopes.	Don't plant rhizome in <i>Katte</i> disease affected area.

<p>16. Do hand weeding during May, Sept. and Dec./Jan.</p> <p>17. Apply proper manure, fertilizer and irrigation.</p> <p>18. Keep plant base mulched (5-10 meter thick ) except during June-Sept.</p> <p>19. Remove old tillers, dry leaves and leaf sheath once in year , one month after final harvest.</p> <p>20. Make regular survey for insect pests/diseases.</p> <p>21. Apply pesticide need based.</p> <p>22. Use pesticide in afternoon only.</p>	<p>Avoid too much shade and too much openness.</p> <p>Don't use spade for weeding, as it will cause soil erosion.</p> <p>Avoid imbalance fertilizer.</p> <p>Avoid calendar based application of pesticides and avoid dust formulation.</p> <p>Spray should not be done in morning hours especially between 7 to 11 am to protect bees.</p>
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CROP: SMALL CARDAMOM

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)
<b>INSECTICIDES</b>								
<b>ORGANOPHOSPHATE PESTICIDES</b>								
1.	Fenthion	Highly toxic	Yellow	Class Ib - Highly Hazardous	Remove the person from the contaminated environment.	Mild - anorexia, headache, dizziness, weakness, anxiety, tremors of tongue and eyelids, miosis, impairment of visual acuity.	For extreme symptoms of O.P poisoning, injection of atropine (2-4 mg., for adults, 0.5-1.0 mg for children) is recommended, repeated at 5-10 minute intervals until signs of atropinization occur.	
2.	Chlorpyrifos	Highly toxic	Yellow	Class II - Moderately 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.	Moderate- nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis.	Speed is imperative	
3.	Dimethoate	Highly toxic	Yellow	Class II - Moderately hazardous				
4.	Quinalphos	Highly toxic	Yellow	Class II - Moderately Hazardous				
5.	Phosalone	Highly toxic	Yellow	Class II - Moderately 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;	
6.	Acephate	Moderately toxic	Blue	Class III - Slightly Hazardous	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.		- Keep airways open, Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed.	
7.	Phorate	Extremely toxic	Red	Class Ia - Extremely Hazardous	Medical aid: Take the patient to the docotr/Primary Health Centre immediately along with the original container, leaflet and label.		- 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.	

							<p>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.</p> <p>Avoid morphine, theophyllin, aminophyllin, barbiturates or phenothiazines.</p> <p>Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.</p>
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**CARBAMATES**

8.	Carbofuran	Extremely toxic	Red	Class I b - Highly hazardous		<p>Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhoea, epigastric pain, tightness in chest.</p>	<ul style="list-style-type: none"> <li>- 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.</li> <li>- Keep airway open. Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed.</li> <li>- 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</li> </ul>
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							<p>area.</p> <ul style="list-style-type: none"> <li>- Oxygen</li> <li>- Morphine, if needed.</li> </ul> <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> <p>Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.</p>	
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AGRO-ECO-SYSTEM ANALYSIS (AESAs)

Agro-eco-system analysis (AESAs) is a process which involves periodical (weekly) observations of plant health, plant compensation abilities, ETL, climate factors, change of pest and defenders population and their inter-relationship. AESAs can be practiced by more than one group of trained farmers in a village. AESAs helps in decision making on management practice required to be adopted at each crop growth stage. AESAs technique may be useful in farmer to farmer IPM training programme also.

**Method:**

**A. Field Observations**

- a) Enter the field at least 5 ft. away from the bund. Select a site with a dimension of one sq. m. randomly.
- b) Record the observations in following sequence :
  - i) Flying insects (both pests and defenders)
  - ii) Close observation on pests and defenders which remain on the plants.
  - iii) Observe pests and defenders like ground beetle/rove beetle/earwigs by scrapping the soil surface around the plants.
  - iv) Record disease and its intensity.
  - v) Record insect damage in percentage.
- c) Record in one of the selected plants, parameters like number of leaves, branches, plant height and reproductive parts (plant should be flagged for making observation in the following weeks).
- d) Record the types of weeds, their size and population density in relation to crop plant.
- e) Observe the live burrows of rodents.
- f) Repeat the step (a) to (e) for other randomly selected four sites.
- g) Repeat the climate factors viz. sunny, cloudy, partly cloudy, rainy etc. for the preceding week.

**B. Drawing:**

Draw the entire observations in a chart paper with the plant at the centre ; pests on the left side and defenders on the right side. Use natural colours for the drawing. Indicate common names and population of pest and defenders per plant.



**C. Group Discussion and Decision Making:**

The observation using the previous and current charts should be discussed among the group members by raising relating to change in pest and defenders population, crop stage, etc. The group may evolve a strategy based up on 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)**

Some of the defenders like lady beetles, *Chrysoperla*, *Syrphids*, etc. play useful role in arriving at P:D ratio.

**1. By Farmers:**

After a brief exposure during IPM demonstrations/field training, farmers can practice AESA in their own fields. Wherever trained farmers are available their experiences could be utilized in training their fellow farmers in their own villages. Thus a large group of farmers could be made proficiently 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.

**2. By Extension Workers:**

The extension functionaries during their regular visit to the village mobilise the farmer, conduct AESA and critically analyse the various factors such as the pest population vis-à-vis 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, which IPM components like release of defenders, application of 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.

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BASIC PRECAUTIONS IN PESTICIDE USAGE

A. Purchase:

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

B. Storage:

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

C. Handling:

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

D. Precautions for Preparing Spray Solution :

1. Use clean water.
2. Always protect your NOSE, EYES, MOUTH, EARS and HANDS.
3. Use hand gloves, face mask and cover your head with cap.
4. Use polyethylene bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover the head (Do not use polyethylene bag contaminated with pesticides).
5. Read the label on the container before preparing spray solution.
6. Prepare spray solution as per requirement.
7. Do not mix granules with water.

8. Concentrated pesticides must not fall on hands etc. while opening sealed containers. Do not smell the sprayer tank.
9. Avoid spilling of pesticide solution while filling the sprayer tank.
10. Do not eat, drink, smoke or chew while preparing solution.
11. The operator should protect his bare feet and hands with polyethylene bags.

**E. Equipment:**

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

**F. Precautions for applying pesticides:**

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

**G. Disposal:**

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