



IPM PACKAGE NO. 39



INTEGRATED PEST MANAGEMENT PACKAGE

FOR

LARGE CARDAMOM



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

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IPM PACKAGE FOR LARGE CARDAMOM

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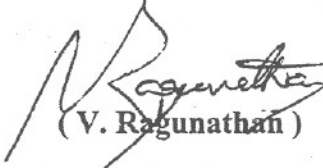
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FOR E W A R D

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.

April 1, 2002



(A.D. Pawar)
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IPM PACKAGE FOR LARGE CARDAMOM

The large Cardamom (*Amomum subulatum* Roxburg) (Scitaminae: Zingiberaceae), commonly known as "Bada Elaichi", is an important spice crop of India. It is mainly cultivated in moist deciduous and evergreen forests of sub-Himalayan tracts especially in Sikkim(70%), Darjeeling Distt. of West Bengal and to some extent in the North Eastern States and Uttaranchal. It is grown in about 25,700 ha with an annual production of 3500-4000 MT.

I. MAJOR PESTS:

1. PESTS OF MAJOR IMPORTANCE:

1.1 Insect pests

- (i) Leaf eating caterpillar, *Artona chorista* Jordon
- (ii) Banana aphid, *Pentalonia nigronervosa* f. *caladii* (Goot)
- (iii) Shoot fly, *Merochlorops dimorphus* Cherian

1.2 Nematode

- (i) Root knot nematode, *Meloidogyne incognita*

1.3 Diseases

- (i) Chirkey virus disease
- (ii) Foorkey virus disease
- (iii) Wilt (*Fusarium oxysporum*)
- (iv) Seedling rot & collar rot (*Fusarium oxysporum*)

1.4 Weeds

- i) *Cynodon dactylon*
- ii) *Cyperus* spp.
- iii) *Panicum* spp.
- iv) *Dactylactenium aegyptium*

2. PESTS OF MINOR IMPORTANCE

2.1 Insect Pests.

- (i) Hairy caterpillar, *Eupterote* spp.
- (ii) Aphid, *Micromyzus kalimpongensis*
- (iii) Maize aphid, *Rhopalosiphum maidis* Fitch, *R. padi*(Lin)
- (iv) Stem borer, *Glypheterix* spp.
- (v) Leaf thrips, *Heliothrips haemorrhoidalis* Bouche, *Rhipiphorothrips cruentatus* Hood

- (vi) Lace-wing bug, *Stephanitis typica* (Distant)
- (vii) Grass hopper, *Mazarredia* sp. Bolivar, *Chrotogonus* sp.
- (viii) White grub, *Holotrichia* sp.
- (ix) Green beetle, *Basilepta femorata* Jacoby
- (x) Rhizome weevil, *Prodiocetes haematicus* Cherrolat
- (xi) Bagworm, *Acanthopsyche* sp.
- (xii) Leaf folding caterpillar
- (xiii) Mealy bugs

2.2 Diseases

- (i) Spike rot (*Fusarium* & *Rhizoctonia* sp.)
- (ii) Leaf spot (*Pestalotiopsis versicolor* (Speg.)
- (iii) Leaf streak (*Pestalotiopsis roynae*(Speg)
- (iv) Leaf rust (*Phakospora elettaria* (Racib)
- (v) Leaf blight (*Colletotrichum* sp.)
- (vi) Capsule rot (*Pestalotiopsis* sp.)

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.

a. Rapid Roving Survey (RRS):-

In the beginning of the crop season, survey routes are required to be identified in the pest & 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 & disease situation. Record the incidence of pest, disease and defender population at each spot in 5 plants at random and 12 spots per ha.

b. 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.

c. **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. Climate factors.
6. Farmers past experience.

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

III. INTEGRATED PEST MANAGEMENT STRATEGIES

a. Insect Pests Management

1. Leaf eating caterpillar

- ♣ Collect and destroy infested leaves alongwith larvae in June-July and October-December months.
- ♣ Community approach of mechanical control by all the farmers of the locality when the outbreak is observed may totally suppress this pest in the course of 2-3 years.
- ♣ There are natural enemies occurring in the cardamom fields like predator (Pentatomid bugs), larval-pupal parasitoids (*Medina sp.*, *Bactromyza sp.*, *Venturia sp.*, *Mesochorus sp.*), larval parasite (*Apanteles*, *Dolichogenedeia*) which considerably reduce the pest population in the field so, conserve them.
- ♣ During severe infestation, when caterpillars are in early stage (skeletonization of the leaves) spray *quinalphos 25 EC at 0.05% (200 ml/100 lt of water) or *endosulfan 35 EC at 0.05% (143 ml/100 lt of water.)
- ♣ If caterpillars are in later stage (defoliation of the plant) spray *quinalphos 25 EC at 0.1% (400 ml/100 lt of water) or *endosulfan 35 EC at 0.1% (286 ml/100 lt of water)
- ♣ During rainy season, 100 ml wetting agent or 100 gm washing powder per 100 lt of water may be added with insecticide solution.

2. Aphids

- ♣ The removal and destruction of diseased plants are helpful in control of further spread of disease and in reduction of aphid population.
- ♣ Destroy all the wild *Ammomum*, *Alpinia*, *Colocasia*, *Curcuma*, collateral host plants of the aphid vector in and near the plantations.
- ♣ Spraying of 0.03% *dimethoate or *phosphomidon after removal of 'Foorkey' or 'Chirkey' affected clumps in March-April gives adequate control

3. Shootfly

- ♣ Its damage is more in first 2-3 years after planting. Therefore, regularly visit the new plantations to monitor shootfly incidence
- ♣ Remove infested young shoot at ground level and destroy.
- ♣ If infestation is high, spraying of *dimethoate or *quinalphos at 0.05% will be helpful.

4. Stem borer

- ♣ Remove and destroy the infested shoots based on 'dead heart' symptoms.
- ♣ If infestation is more, spraying with *phosphomidan or *quinalphos at 0.1% during first week of July may bring down the population.

5. White grub

- ♣ The mechanical collection of adult beetles at dusk during the emergence period is an effective method in managing the pest.
- ♣ Entomogenous fungus, *Metarhizium* is also effective.
- ♣ The infested plants can be treated with *chlorpyrifos 20 EC @ 0.04% or *quinalphos at 0.05%.

6. Leaf thrips

- ♣ Collect infested leaves and destroy
- ♣ Spray *monocrotophos or *quinalphos at 0.025%, if severe infestation is observed in the nursery.

7. Bagworm

- ♣ Remove mechanically the cases of bag worms in the nursery and main plantation and destroy.

b. Nematode Management

- ♣ Change the nursery site every year.
- ♣ Rake the soil of nursery sides and expose to sun light.
- ♣ Use only healthy nematode free seedlings
- ♣ Drench nursery beds with 2% Formaldehyde and cover them with polythene sheets for 72 hours.
- ♣ Treat the nursery beds with *carbofuran 3 g @ 0.3 to 0.6 g a.i./sq.m

c. Diseases Management

(i) Chirkey & Foorkey virus diseases.

- ♣ Regular survey of the plantation to trace out diseased plants.
- ♣ Remove completely diseased plants alongwith rhizome & roots and destroy as soon as they are traced.
- ♣ Use healthy disease free planting material preferably seedlings.
- ♣ Suckers planting may be avoided, particularly of those collected from diseased areas.
- ♣ Do not raise nurseries in the vicinity of infected plantations.
- ♣ Destroy all the collateral host plants of the aphids in and near the plantation.
- ♣ Spray 0.03% *dimethoate or *phosphomidon to control vector population of aphids.
- ♣ In the areas with continuous small holdings rouging has to be adopted on community basis to keep the disease under check.

(ii) Wilt disease

- ♣ Planting in swampy or dry areas may be avoided.
- ♣ Collect and bury the affected plants in deep pits at an isolated place.
- ♣ Drench 0.5% *mancozeb or 0.2% thiram to check the further spread of the disease in nurseries as well as in main plantations.

(iii) Leaf spot and Leaf streak

- ♣ Spray 0.2% copper oxychloride or Fosteyl AL 80%WP @1400-2000 g/ha in February-March and September-October.

(iii) Spike rot

- ♣ Avoid the accumulation of leaf mass or waste plant parts over the inflorescence/spike during rainy season.
- ♣ Spills of soil over the spike may be avoided at the time of base making by pouring soil to the plant base.
- ♣ Collect and bury affected flowers/spikes.

d. Weed Management

- ♣ Depending on the intensity of weed growth, 2-3 rounds of weeding either hand or sickle weeding are required in a year.
- ♣ First weeding may be done in Feb-April, before application of 1st split of fertilizer and just before starting of flowering in plantation at low altitude areas in particular.

- ♣ Second round of weeding may be attended in May-June before starting of flowering in middle and high altitude areas.
- ♣ The IIIrd round of weeding, removal of dried leaves, unproductive tillers etc may be done before harvest in September-October depending the altitude of the area.

*Not as per approved usage under Insecticide Act, 1968

IV. CROP STAGE-WISE IPM PRACTICES

5.1 Nursery stage

(i) Nematode management

- ♣ Change the nursery site every year to avoid nematode infestation.
- ♣ Drench nursery beds with 2% Formaldehyde and cover them with polythene sheets for 72 hrs.
- ♣ Apply well rotten farm yard manure.
- ♣ Treat the nursery beds with *carbofuran 3 g @ 0.3 to 0.6 gm a.i. per sq. m.

(ii) Seed selection

- ♣ Use only seeds from certified nurseries.
- ♣ Select the seeds or clumps for planting from the diseased free healthy plants.
- ♣ Select the variety which suits to particular altitude area and locality.

(iii) Chirky/Foorkey disease

- ♣ Monitor the nursery for Chirky/Foorkey viral diseases and destroy diseased seedlings to avoid further spread.
- ♣ Spray 0.03% dimethaote or phosphomidon to control vector population of aphids.

(iv) Leaf thrips

- ♣ Its incidence is more in cardamom seedling at lower altitude during April to November.
- ♣ Collect and destroy the infested leaves.
- ♣ If infestation is severe, spray monocrotophos or quinalphos at 0.025%

(v) Weeding

- ♣ Attend weeding time to time.

(vi) Watering

- ♣ Over watering may be avoided.

5.2 Plantation stage.

(i) Shade Management

- ◆ Large cardamom is a shade loving crop, maintain optimum shade.

(ii) Fertilizer application

- ◆ Apply well decomposed farm yard manure.
- ◆ Apply chemical fertilizers based on soil test application @ 40:60 :40 kg N,P2O5 and K2O per kg in two splits - once in April-May on receipt of 1st summer shower and 2nd split in September-October before monsoon is over.

(iii) Weeding

- ◆ Maintain weed free plantation but avoid manual weeding by scraping the soil surface because it adversely affects the soil physical conditions and exposes bare soil to destructive forces of the climate same as under 4.5.

(iv) Mulching and Earthing up

- ◆ Thick mulching with dry leaves/grass may be applied on the base of the rhizome to keep the soil moist.
- ◆ In old plantations, earthing up is necessary to cover exposed roots and rhizomes of the plants.

(v) Pests and diseases Management

- ◆ As mentioned earlier under 4.1 and 4.2.

5.3 Flowering Stage

- ◆ Encourage the population of honey bee which are the main pollinators and also help to increase the yield.
- ◆ Remove mulch from inflorescence/spikes during rainy season.
- ◆ Spraying should be taken during afternoon when the pollinators activities are minimum.
- ◆ Spike rot management as in 4.3 (iii).

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5.4 Harvesting Stage

- Harvest at the right maturity of the capsules at different altitudes to avoid the damage by rats, monkeys and wild cats etc.

V. DO'S AND DON'TS IN LARGE CARDAMOM IPM

	Do's	Don'ts
1.	Grow only recommended varieties for the particular altitude and area	Don't grow varieties which are not suitable for the particular altitude and region.
2.	Use only certified seeds	Don't collect seeds from unknown sources and diseased prone areas.
3.	Use acid treated seeds for early and high germination	Without seed treatment germination will be delayed.
4.	Treat the seeds with approved chemical/bioproducts for the control of seed borne diseases/pests	Don't use seeds without seed treatment with biocides /chemicals
5.	Use NPK fertilizers as per the soil test recommendations	Avoid imbalance use of fertilizers.
6.	Use only recommended pesticides at the recommended dosages for control of various pests.	Do not use unrecommended pesticides or mixture of various pesticides.
7.	Apply pesticides as a last resort when pest incidence is above economic threshold level (ETL)	Do not apply pesticide on calendar basis.

CROP: LARGE 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)
INSECTICIDES								
ORGANOCHLORINE PESTICIDES								
1.	Endosulfan	Highly toxic	Yellow	Class II - Moderately Hazardous	<p>Remove the person from the contaminated environment.</p> <p>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.</p> <p>Medical aid: Take the patient to the doctor/Primary Health Centre immediately along with the original container, leaflet and label.</p>	Nausea, vomiting, restlessness, tremor, apprehension, convulsions, coma, respiratory failure and death	<ul style="list-style-type: none"> - 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. 	
ORGANOPHOSPHATE PESTICIDES								
2.	Quinalphos	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	

3.	Phosphamidon	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.
4.	Chlorpyrifos	Highly toxic	Yellow	Class II - Moderately hazardous		Moderate - nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis.	Speed is imperative
5.	Dimethoate	Highly toxic	-do-	-do-		Severe - diarrhoea, pinpoint and non-reactive pupils, respiratory difficulty, pulmonary edema, cyanosis, loss of sphincter control, convulsions, coma and heart block.	<ul style="list-style-type: none"> - 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; - Keep airways 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, 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,</p>

							<p>theophyllin, aminophyllin, barbiturates or phenothiazines.</p> <p>Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.</p>
CARBAMATES							
6.	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"> - 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. <p>Avoid theophyllin and aminophyllin or barbiturates. 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							
7.	Mancozeb	Slightly toxic	Green	Table 5 - Unlikely to present acute hazard in normal use.		Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin etc.,	No specific antidote. Treatment is essentially symptomatic.
8.	Thiram	Slightly toxic	Blue	Class III - Slightly hazardous			
9.	Copper oxychloride	Slightly toxic	Blue	-do-			

ANNEXURE-I

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. mt. 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/carwigs 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 ration 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.

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.
