



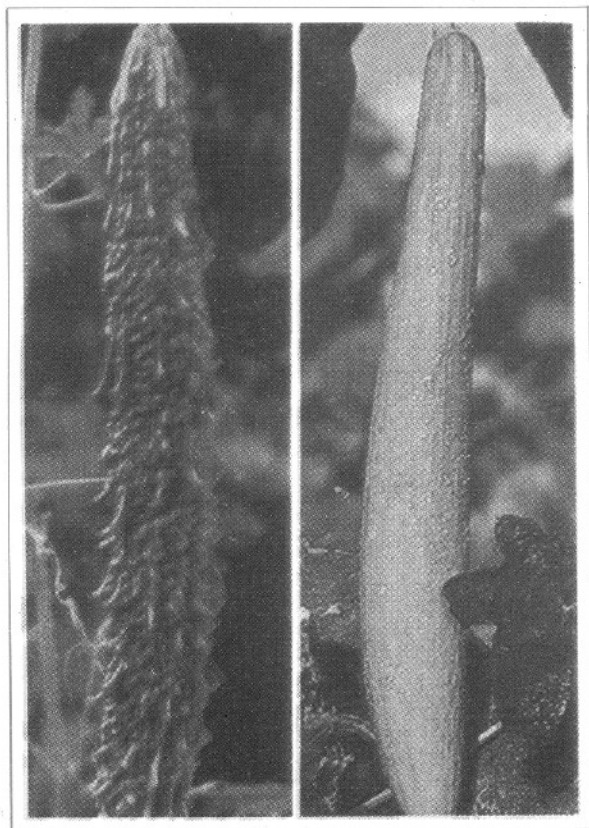
IPM PACKAGE NO. 21



# INTEGRATED PEST MANAGEMENT PACKAGE

## FOR CUCURBI TACEOUS VEGETABLES

(CUCUMBER, BOTTLE-GOURD, BITTER-GOURD, SPONGE-GOURD,  
SNAKE-GOURD, ASH-GOURD, PUMPKIN, SQUASH)



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 CUCURBITACEOUS VEGETABLES

## Contents

<b>SUBJECT</b>	<b>Page No.</b>
Foreward	i
Preface	ii
Acknowledgements	iii
<b>I. MAJOR PESTS</b>	
A. Pests of National Significance	1
B. Pests of Regional Significance	1
<b>II. PEST MONITORING</b>	
A. Agro-eco-system Analysis (AESA)	2
B. Field scouting	2
C. Yellow water pan/sticky traps	2
D. Nematodes	3
E. Economic threshold levels (ETL)	3
<b>III. IPM Strategies for Cucurbitaceous vegetables</b>	
A. Cultural Practices	3
B. Mechanical control	4
C. Biological control	4
D. Chemical control	5
<b>IV. CUCURBIT CROP VIS-À-VIS IPM PRACTICES</b>	6
<b>V. DO'S AND DON'TS IN VEGETABLE IPM</b>	7
<b>VI. SAFETY PARAMETERS</b>	8-10
<b>ANNEXURES - I &amp; II</b>	11-16



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

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

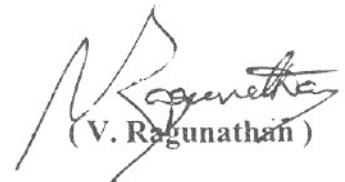
**DR.V. RAGUNATHAN**  
**Plant Protection Adviser**  
**To the Government of India**

**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. Ragnathan)

## 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.

## ACKNOWLEDGEMENTS

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- II. Coordinator, Technical Session : Dr. M.P. Misra, Dy. Director (Ent.), Dte. of PPQS, Faridabad
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- IV. Expert input : 1. Dr. H.R. Sardhana, Sr. Scientist (Ent.), NCIPM, ICAR, New Delhi  
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3. Dr. N.S. Rao, Sr. Scientist (Ent), PDBC, ICAR, Bangalore  
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6. Dr. A.M.A. Rodent Specialist, NPPTI, Hyderabad  
7. Sh. S.M. Singh, AD(E), Central IPM Centre, Ganganagar  
8. Sh. S.K. Verma, PPO (PP), Cnetral IPM Centre, Sriganganagar.  
9. Dr. D. Kanungo, Jt. Director, CIL, Dte of PPQS, Faridabad  
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12. Dr. B.S. Phogat, Agronomist (H), Dte of PPQS, Faridabad  
13. Dr. Jasvir Singh, AD(E), Dte of PPQS, Faridabad  
14. Sh. V.K. Sharma, PPO (E), Dte of PPQS, Faridabad
- V. Technical input:
1. Sh. S.P. Singh, APPO, IPM Div., Dte of PPQS, Faridabad.
  2. Sh. K.S. Sharma, SSA, IPM Div., Dte of PPQS, Faridabad.
  3. Sh. Yogesh Kumar, SSA, IPM Div., Dte of PPQS, Faridabad.
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# IPM PACKAGE FOR CUCURBITACEOUS VEGETABLES

(Cucumber, Bottle-gourd, Bitter-gourd, Sponge-gourd, Snake-gourd,  
Ash-gourd, Pumpkin, Squash)

## **I. MAJOR PESTS**

### **A. Pests of National Significance**

#### **1. Insects**

- 1.1 Spotted leaf beetle
- 1.2 Green leaf hopper
- 1.3 Fruit fly
- 1.4 Red pumpkin beetle

#### **2. Diseases**

- 2.1 Anthracnose
- 2.2 Wilt
- 2.3 Downy mildew
- 2.4 Powdery mildew

#### **3. Nematodes**

- 3.1 Root-knot nematode
- 3.2 Reniform nematode

#### **4. Rodent**

- 4.1 Small bandicoot

#### **5. Mite**

- 5.1 Red Spider mite

### **B. Pests of Regional Significance**

#### **1. Insect Pests**

- 1.1 Cotton aphids
- 1.2 Potato aphids
- 1.3 Pumpkin caterpillar
- 1.4 *Mylocerus pretiosus*
- 1.5 Serpentine leaf miner
- 1.6 Hairy caterpillar

## **2. Disease**

2.1 Bud necrosis virus transmitted by thrips

## **3. Rodent**

3.1 House rat

## **II. PEST MONITORING**

### **A. Agro Eco System Analysis (AESA):-**

AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyse field situations with regard to pests, defenders, soil conditions, plant health, the influence of climatic factors and their interrelationship for growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices. The basic components of AESA are:-

1. Plant health at different stages.
2. Built-in compensation abilities of the plants.
3. Pest and defender population dynamics.
4. Soil conditions.
5. Climatic factors.
6. Farmers past experience.

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

### **B. Field Scouting**

AESA requires skill and so only the trained farmers can undertake their exercise. However, other farmers also can do field scouting in their own fields at regular intervals to monitor the major pest situation. Simple field scouting on pest situation by the farmers helps to minimize pesticide usage to a large extent.

### **C. Yellow pan/sticky traps**

Set up yellow pan/sticky traps for monitoring thrips @ 10 traps per ha. Locally available empty yellow palmolive tins coated with grease/Vaseline/castor oil on outer surface may also be used as yellow pan trap.

## D. Nematodes

Root knot nematode cause galls and reniform nematode cause 'dirty roots'. Their presence can be detected by "trypan blue" stain solutions in water which turns nematode egg sac dark blue whereas the roots stay uncoloured.

## E. Economic Threshold Levels (ETL)

The Economic Threshold Level (ETL) is an attempt to improve decision-making practices by using partial economic analysis on the impact of the control practice such as spraying a pesticide. At the ETL the benefit of spraying is equal to the losses caused by the insects in the field. The farmers are advised to take appropriate control measures when the incidence crosses ETL. Economic threshold levels for some of the major pests are listed below:

Pests	ETL
Leaf hopper	2.5 nymphs/leaf
Spotted leaf beetle	1 insect/m <sup>2</sup>
Nematodes	1-2 juveniles/g of soil

## III. IPM STRATEGIES FOR CUCURBIT VEGETABLES

### 1. Cultural Practices:

- 1.1 Deep ploughing during summer to expose the nematodes to solar radiation and also the resting stages of the pests.
- 1.2 Crop rotation with paddy in low-lying areas is very effective, against downy and powdery mildew.
- 1.3 Preventing the crops from overlapping, and adequate spacing to minimise the length of leaf wetness periods, for downy mildew disease management.
- 1.4 Late planting helps in delayed development of powdery mildew.
- 1.5 Deep ploughing and trimming of the field bunds to destroy the existing rodent burrows.
- 1.6 Use balanced dose of fertilizers for obtaining plant population and healthy crop stand, which would be capable of competing with weeds in initial stages of crop growth.



## 2. Mechanical Control

- 2.1 Growing a few scattered cucurbit plants in January and destroying the attracted beetles by hand collection is useful.
- 2.2 Eradication of disease infected plants.
- 2.3 Removal of alternate hosts from the field particularly for virus disease management.
- 2.4 Destruction of wild cucurbit plant and crop residues reduces the incidence of root knot and reniform nematodes and anthracnose and powdery mildew respectively.
- 2.5 Avoiding wounds at harvesting helps in reducing infection particularly to gummy stem blight disease.
- 2.6 Hand collection of adult beetle from plants.
- 2.7 Vinegar + sugar syrup in a pot or in a pumpkin as a baiting technique helps in controlling fruitfly.
- 2.8 Use male annihilation techniques using Methyl Eugenol (0.1%) along with Vinegar + Sugar syrup for monitoring the pest incidence.

## 3. Biological Control

### 3.1 Conservation

- 3.1.1 Conserve natural enemies such as *Opius compensatus*, *O. incisus*, *Spalangia philippinensis*, *O. fletcheri*, *O. composans* which are very active parasites against fruitfly in the field by regular monitoring.
- 3.1.2 In addition to these parasites, general predators like Coccinelids, Syrphids, Spiders, Carabids, Staphylinids, Dragonfly, Damselfly, predatory miridbugs, predatory Pentatomids, Nabid bugs, Reduviid bugs, Anthocorid bugs, Geocorid bugs, predatory mites, predatory thrips also actively suppress the pest population.
- 3.1.3 Erect bird perchers @ 50/ha to attract birds, which in turn feeds on pests.

### 3.2 Augmentation

- 3.2.1 Seed treatment with *T. viride* 2 g per 100 g of seed.
- 3.2.2 Release *Chrysoperla carnea* @ 2 grubs/plant against soft-bodied insects.
- 3.2.3 Application of *T. viride* @ 50 gm in 10 kg. FYM during early stages of the crops along the rows, which helps in inhibiting soil borne fungus infection.
- 3.2.4 Spray *Baevaria bassiana* ( $2 \times 10^6$  cfu/g) against red pumpkin beetles.

### 4. Chemical Control

- 4.1 Spray 5% NSKE during early stage of the crop once and later at 15 days interval will effectively control sucking pests.
- 4.2 Spraying of \*chlorpyrifos 100 g a.i/ha to kill adult pumpkin beetle when they are found on foliage.
- 4.3 Foliar spray with thiophanate methyl 70% WP @1430gm a.i/ha or mancozeb or zineb 1.500 to 2.0 kg a.i/750 ltr. of water/ha. helps in controlling the anthracnose disease.
- 4.4 Spraying with dinocap 48% EC @300 ml/ha, diluted in 750 liter of water gives good control over powdery mildew.

Note- Since cucurbits are monoecious (Highly cross pollinated crops), spraying of chemicals should be minimised particularly during flowering stage in order to ensure conservation of honeybees as they are good pollinators.

- 4.6 In direct seeded crops, treatment of seeds with \*carbosulfuron (25 ST) @ 3% (w/w) reduces the root knot nematode problem.
- 4.5 Bromodiolone 0.005% bait (15 gm/burrow) to be placed inside the live burrows for rodent management.

#### IV. CUCURBIT CROP VIS-À-VIS IPM PRACTICES

Stage	Pest	Practices
1. Pre-sowing	Resting stages of pests Nematodes Rodents	Deep summer ploughing Application of 200 kg. neem cake. Crop rotation with non cruciferous crops once in a year. Application of *carbofuran 1 kg/ha of a.i. at the time of sowing in heavily infested areas. Deep ploughing and trimming of the bunds to destroy the existing rodent burrows.
2. Seed-seedling	Collar rot  Virus Beetles	Seed treatment with <i>T. viride</i> @ 2 gm per 100 g seeds. Apply 50 gm <i>T. viride</i> in 10 kg. FYM, all along the rows. Removal of alternate hosts from field. Hand collection of grubs and adults from the foliage. Spray <i>B. bassiana</i> ( $2 \times 10^6$ cfu/g). Spray Carbaryl 50WP 1 kg/ha in 500 litres.
3. Vegetative	Beetle Downy & Powdery mildew, leaf spot. Downy mildew  Virus Nematodes  Pumpkin Caterpillar Sucking pest	As in seedling stage. Optimum irrigation. Spray Dinocap 48% EC 300 ml in 750 ltr. water per ha. Spray Zineb 1.5 to 2.0 kg a.i./750 to 1000 lt. of water/ha. Removal of alternate hosts and infected plants from field.  Release of <i>C. carnea</i> @ 2 grubs/plant.  Spray 5% NSKE.
4. Reproductive	Downy & Powdery mildew Virus Beetles Fruitfly   Rodents	As per vegetative stage.  Optimum irrigation. Same as in vegetative stage. Hand collection of grubs and adults from the foliage. Careful harvest to avoid mechanical damage to the fruits. Use of bait vinegar + sugar syrup solution in a pot . Methyl eugenol or citronella oil 1% in water in small pots for monitoring. Bromodiolone 0.005% bait (15 gm/burrow) to be placed inside live burrows.

## V. DOs AND DON'Ts IN VEGETABLE IPM

DO's	DON'Ts
1. Deep ploughing is to be done on bright days during the months of May and June. The field should be kept exposed to sunlight atleast for 2-3 weeks.	Do not plant or irrigate the field after ploughing, atleast for 2-3 weeks, to allow desiccation of weed's bulbs and/or rhizomes of perennial weeds.
2. Grow only recommended varieties.	Do not grow varieties not suitable for the season or the region.
3. Sow early in the season.	Avoid late sowing as this may lead to reduced yields and incidence of white grubs and diseases.
4. Always treat the seeds with approved chemicals/bio-products for the control of seed borne diseases/pests.	Do not use seeds without seed treatment with biocides/chemicals.
5. Sow in rows at optimum depths under proper moisture conditions for better establishment.	Do not sow seeds beyond 5-7 cm depth.
6. Maintain optimum and healthy crop stand, which would be capable of competing with weeds at a critical stage of crop weed competition.	Crops should not be exposed to moisture deficit stress at their critical growth stages.
7. Use NPK fertilizers as per the soil test recommendations.	Avoid imbalance use of fertilizers.
8. Use micronutrient mixture after sowing as top dressing separately.	Do not mix micronutrients with fertilisers and incorporate into the soil.
9. Conduct AESA weekly in the morning preferably before 9 am. Take decision on management practices based on AESA, ETL P:D ratio only.	Do not apply chemical pesticides on calendar basis.
10. Spray pesticides thoroughly to treat the undersurface of the leaves particularly for mites, <i>Spodoptera</i> , <i>Epilachna</i> grubs, etc.	Do not spray pesticides at midday since, most of the insects are not active during this period.
11. Apply short persistent pesticides to avoid pesticide residue in the soil and produce.	Do not apply pesticides during proceeding seven days before harvest.

## CROP: CUCURBITACEOUS VEGETABLES

## 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.	Chlorpyrifos	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 docotr/Primary Health Centre immediately along with the original container, leaflet and label</p>	<p>Mild – anorexia, headache, dizziness, weakness, anxiety, tremors of tongue and eyelids, miosis, impairment of visual acuity.</p> <p>Moderate- nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis.</p> <p>Severe – diarrhoea, pinpoint and non-reactive pupils, respiratory difficulty, pulmonary edema, cyanosis, loss of sphincter control, convulsions, coma and heart block.</p>	<p>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.</p> <p>Speed is imperative</p> <ul style="list-style-type: none"> <li>- 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;</li> <li>- Keep airways 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, wash with soap and water (eyes- wash with isotonic saline). Wear rubber gloves while washing contact areas.</li> </ul> <p>In addition to atropine give 2-PAM (2-pyridine</p>	

							<p>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

2.	Carbofuran	Extremely toxic	Red	Class I b – Highly hazardous		Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhoea, epigastric pain, tightness in chest.	<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 area.</li> <li>- Oxygen</li> <li>- Morphine, if needed.</li> </ul>
3.	Carbaryl	Highly toxic	Yellow	Class II – Moderately hazardous			
4.	Carbosulfan	-do-	-do-	-do-			

								<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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#### FUNGICIDES

5.	Thiophanate methyl								
6.	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.
7.	Zineb	Slightly toxic	Green	-do-					
8.	Dinocap	Moderately toxic	Blue	Class III – Slightly hazardous					

#### RODENTICIDES

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

AESA is an approach , which can be gainfully employed by extension functionaries and farmers to analyse field situations with regard to pests, defenders, soil conditions, plant health, the influence of climatic factors and their interrelationship for growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices. The basic components of AESA are:-

1. Plants health at different stages.
2. Built in-compensation abilities of the plants.
3. Pest and defender population dynamics.
4. Soil conditions.
5. Climatic factors.
6. Farmers past experience.

The methodology of AESA is as under:-

**A. Field Observations:-**

- a) Enter the field at least 5 ft. away from the bund. Select a site with a dimension of 1 sq. mt. randomly.
- b) Record visual observations in following sequence:-
  - i) Flying insects (both pests & defenders)
  - ii) Close observation on pests and defenders which remain on the plants.
  - iii) Observe pests like pod borer 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 parameters like number of leaves, branches, plant height and reproductive parts of the selected plants which 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) Record soil conditions viz. flooded, wet or dry.
- f) Observe rodent live burrows.



- g) Repeat the step (a) to (f) in four sites randomly selected.
- h) Record the climatic factors viz. sunny, partially sunny, cloudy, rainy etc. for the preceding week.

**B. Drawing:**

First draw the plant with actual number of branches/ leaves etc. at the centre on a chart. Then draw pests on left side and defender on the right side. Indicate the soil condition, weed population, rodent damage etc. Give natural colours to all the drawing, for instance, draw healthy plant with green colour diseased plant/ leaves with yellow colour. While drawing the pests and the defenders on the chart care should be taken to draw them at appropriate part of the plant, where they are seen at the time of observation. The common name of pest and defenders and their population count should also be given alongwith diagram. The weather factor should be reflected in the chart by drawing the diagram of sun just above the plant if the attribute is sunny. If cloudy, the clouds may be drawn in place of sun. In the 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 by raising questions relating to change in pest and defender population in relation to crop stages, soil condition 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: (Examples)**

- i) During bud/flowering initiation stage, 2 to 3 eggs/plant or one larva/10 plants are observed. Apply 250 L.E. NPV/ha or NSKE 5%.
- iii) Some of the defenders like lady bird beetles, spiders, lacewing bug, reduviid bug, *Campoletis* sp., wasps play useful role in arriving at P:D ratio i.e. 1:1.

- g) Repeat the step (a) to (f) in four sites randomly selected.
- h) Record the climatic factors viz. sunny, partially sunny, cloudy, rainy etc. for the preceding week.

**B. Drawing:**

First draw the plant with actual number of branches/ leaves etc. at the centre on a chart. Then draw pests on left side and defender on the right side. Indicate the soil condition, weed population, rodent damage etc. Give natural colours to all the drawing, for instance, draw healthy plant with green colour diseased plant/ leaves with yellow colour. While drawing the pests and the defenders on the chart care should be taken to draw them at appropriate part of the plant, where they are seen at the time of observation. The common name of pest and defenders and their population count should also be given alongwith diagram. The weather factor should be reflected in the chart by drawing the diagram of sun just above the plant if the attribute is sunny. If cloudy, the clouds may be drawn in place of sun. In the 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 by raising questions relating to change in pest and defender population in relation to crop stages, soil condition 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: (Examples)**

- i) During bud/flowering initiation stage, 2 to 3 eggs/plant or one larva/10 plants are observed. Apply 250 L.E. NPV/ha or NSKE 5%.
- iii) Some of the defenders like lady bird beetles, spiders, lacewing bug, reduviid bug, *Campoletis* sp., wasps play useful role in arriving at P:D ratio i.e. 1:1.

## **AESA BY EXTENSION FUNCTIONARIES:-**

The extension functionaries during their regular visit to the village 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 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 neem formulations/safe pesticides are to be used for specific pest situation. Such an exercise may be repeated by the extension functionaries during every visit to the village and motivate the farmers to adopt AESA in their fields.

## **AESA BY FARMERS:-**

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

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

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