



सत्यमेव जयते

IPM PACKAGE NO. 8



INTEGRATED PEST MANAGEMENT PACKAGE

FOR
GRAM



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 GRAM

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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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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. Rangunathan)

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.



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April 1, 2002

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IPM PACKAGE FOR GRAM

I. MAJOR PESTS

A. Pests of National significance

1. Insect pests

a. Gram pod borer

2. Diseases

a. Ascochyta blight

b. Fusarium wilt

c. Botrytis Grey mould

d. Dry root rot

3. Weeds

a. *Chenopodium album*

b. *Chenopodium murale*

c. *Lathyrus aphaea*

d. *Vicia sativa*

e. *Asphodelus spp*

4. Nematode

Root knot

Reniform

Lesion

5. Rodents

Smaller Bandi coot

B. Pests of Regional Significance

1. Insect Pests

a. Black beanaphid, Vector

Haryana

b. Whitegrub

Gujarat, Rajasthan

c. Termite

Rajasthan, Haryana

d. Semilooper

Eastern U.P.

e. Cutworm

Bihar, Haryana, West Bengal, Assam

f. Tobacco caterpillar

Andhra Pradesh

2. **Diseases**
 - a. Rust, *Uromyces* sp (Bihar, U.P.)

3. **Nematodes**
 - a. Pegionpea cyst nematode

II. **PEST MONITORING:**

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

1. **Rapid Roving Survey (RRS):**

- a. 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 Surveys (RRS). During survey the observations are to be made at every 5-10 km 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 on 5 plants at random and 12 spots per ha.
- b. Root-knot nematode produces diagnostic symptoms of "gall" formation on roots, reniform produces "dirty roots systems" and cyst nematode produces "pearly root disease". This can be seen with a hand lens. Stain roots with Trypan blue stain, egg sacs of nematodes turn deep blue, root remains unstained.
- c. The working index for rodent pests is 25 live burrows/ha.

2. **Field Scouting:**

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

3. **Agro-eco-system Analysis:**

ESA 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, 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 AESAs 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.

4. Pheromone trap monitoring:

Use pheromone traps for monitoring gram podborer. Install pheromone traps at a distance of 50 m @ 5 traps/ha for each insect pest. Use specific lure for each pest species and change the lure after every 15-20 days. Trapped moths should be removed daily. Presence of 4-5 moths for 2-3 days will be an indication for appearance of pest in the next 7-10 days.

5. Nematodes:

Field survey should be conducted to identify the major soil root nematodes infesting chickpea as they aggravate problem of some disease like *Fusarium* wilt, black root rot, collar rot and dry root rot.

6. Economic threshold levels (ETLs) :

S.No.	Pest insects	Stage of the crops	Economic threshold levels
Insects			
1.	Gram pod borer	Reproductive	2 to 3 eggs per plant or 2 to early instar/10 plants or one matured larva/10 plants
2.	Cut worm (<i>Agrotis</i>)	Seedling stage	One larva/meter square length under the soil near cut plant
3.	Semilooper	Vegetative phase	2 larvae/10 plants
4.	Termite (<i>Odontotermes</i>)	Seedling stage	5 damaged plants/sq. meter
5.	White grub	Seedling stage	5 grubs/sq. meter
Diseases			
6.	Wilt & root rot	Seedling/vegetative	5-10% plants infested
Rodents			
7.	Working index	Before padding	25 live burrows/ha.
Nematodes			
1.	Nematodes		1-2 larvae/gm of soil

III. INTEGRATED PEST MANAGMEENT STRATEGIES

A. Cultural

1. Deep ploughing in summer.
2. Destruction of stubbles

3. Apply well decomposed FYM or Neemcake/Mahua cake @ 500 kg/ha in nematode prone areas
4. Use tolerant/resistant varieties as given in Annexure - II
5. Crop rotation with non-leguminous crop to reduce soil-borne diseases such as wilt and root rot.
6. Early and timely sowing and select early maturing varieties.
7. Synchronous sowing in a village or area.
8. Inter crops with inseed/mustard/wheat/coriander/rabi sorghum.
9. Sow African Giant marigold as trap crop on border or in between the crop rows.
10. In case of endemic area of Fusarium wilt/dry root rot (*Rhizoctonia*) chickpea should not be grown in infested fields for at least three years.
11. Wider spacing (60 cm instead of 30 cm) for Botrytis grey mould or thinning out of infested crop to allow more light.
12. Detopping at 30 days after sowing.
13. Removal of weeds (*Chenopodium album*, *Vicia sativa*) at the flowering stage of the crop.
14. Avoid growing solanaceous crops during Kharif in the prone areas of root knot nematode.
15. Destroy rodent burrows and trim the bunds to avoid harbourage of Rodent Pest.

B. Mechanical

1. Putting of heaps of grasses so that congregated larvae can be killed in the morning.
2. Erection of 50-70 bird perchers/ha. Bird perchers should be removed just after maturity/harvesting of the crop.

C. Biological

1. Seed treatment with *Trichoderma viride* *T. harzianum* @ 4 gm/kg of seed.
2. Conserve campoplex, lady bird beetles, *Chrysopa*, Stinkbugs, Reduviid, Predatory wasps and spiders.
3. Spray NPV @ 250 L.E. + 0.5% Jaggery + 0.1% tinopal on noticing 1st instar larvae or eggs of pod borer (3 sprays at weekly intervals in evening hours)
4. Spray NSKE 5% at preflowering stage at 15 days interval.
5. Spray *Bacillus thuringiensis* var. kurstaki against Pod borer @ 0.75-1 kg/ha.

D. Chemicals

a. Insects

Insecticides	Insect	Dose (g a.i./ha)
Chlorpyrifos 20EC	Pod borer, cut worm	500
Thiodicarb* 75 WP	Pod borer	468
Chlorpyrifos 1.5 DP	Pod borer	375
Phenthoate 50 EC	Pod borer	1000
Quinalphos 1.5 DP	Pod borer	350
Fenvalerate 0.4 DP	Pod borer	80-100
Deltamethrin 2.8 EC	Pod borer	10-12.5

Carbaryl 5 DP	Pod borer	1250
Carbaryl 10 DP	Pod borer	2500
Carbaryl 50 WP	Pod borer	750
Endosulphan 35 EC	Pod borer, Aphid	350
Chlorpyrifos 20 EC	Termite (seed treatment)	15-20 ml/kg of seed formulation

b. Diseases:

Fungicides	Diseases	Dose kg seed
Carbendazim 25% DS	Ascochyta, Grey mould	0.75g/kg

c. Nematodes

Seed treatment with Carbendazim @ 3 percent reduces root knot and lesion nematode and combination of Carbendazim of Thiram with Carbosulfan @ 0.2 per cent reduces wilt problems also.

d. Rodent

Rodenticide	a.i. dose
Bromadiolone 0.005%	10-15 g per burrow to be placed inside the live burrows.

E. Weed Management Practices

- Follow recommended agronomic practices for land preparation, seed rate, proper fertilizer and irrigation management so as to achieve optimum plant population and healthy crop to reduce weed competition at early crop stage.
- The crop should be maintained weed free initially for 6-8 weekd by following timely inter culture and hand weeding.

IV CROP STAGE-WISE IPM PRACTICES:

S.No.	Crop Stage	Pest	IPM component	IPM practices
1.	Pre-sowing	<ul style="list-style-type: none"> - Pod borer - Cut worm - Termite - Wilt - Pod borer - Nematodes 	Cultural practices	<ol style="list-style-type: none"> 1. Deep ploughing in summer. 2. Apply well decomposed FYM or neem cake. 3. Synchronised sowing single recommended variety in village/area 4. Solar treatment to the soil using transparent polythene mulching for at least for 15 dys. 5. Inter cropping with linseed/coriander/mustard/wheat/sorghum (Rabi) 6. Early planting mid October to escape the peak activity of H. armigera 7. Marigold plantation should be adopted as trap crop/antagonistic crop for nematode. 8. Use tolerant/resistant varieties as indicated in Annexure-II Removal of crop stubbles
2.	Seed & Seedling	<ul style="list-style-type: none"> - Cut worm - Termite - Grey mould - Ascochyta - Nematode - Weeds 	Mechanical Cultural Practices Biological Chemical Cultural Practices	<ol style="list-style-type: none"> 1. Use Rhizobium culture @ 1 pkt+(200g), 190 kg seed for effective modulation 2. Thinning should be done in case of dense plant population 1. Seed treatment with Trichoderma @ 4 gm/kg of seed 1. Seed treatment with Carbendazim 25% DS @ 0.75 gm./kg. of seed 2. Seed treatment with Carbosulfan 25 EC @ 3% 1. Follow recommended agronomic practices for land preparation seed ratio proper and balanced fertilizer crop stand.
3.	Vegetative stage	Weeds Insect	Cultural Practices Mechanical Biological	<ol style="list-style-type: none"> 1. Inter culture and hand weeding for keeping the crop weed free for 6 to 8 weeks 2. Detopping to reduce pest occurrence 1. Regular monitoring of gram pod borer in south zone during entire crop season 2. Conservation of predatory wasp, spiders, insect parasitoids etc.
4.	Flowering and podding stage	Gram Pod borer Semilooper Rodents	Biological Botanical Biological Chemical control	<ol style="list-style-type: none"> 1. NPV 250 LE or B.t. var Kurstaki 1 kg/ha NSKE 5% or neem pesticides 1. Conservation of predators like spiders, chrysopa and other natural enemies by avoiding indiscriminate use of pesticides 2. Installing of bird perchers for predatory birds. 1. Spray of Endosulfan 35 EC @ 0.07% (2ml per litre of water) or Monocrotophos 36 SL @ 0.04% (1 ml per litre of water or Chloropyriphos 20 EC @ 0.05% (3.5 ml per litre of water) or * Profenofos @ 4 ml/litre of water or * Deltas @ 2.5 ml per

				<p>litre of water 500 to 600 litre of spray material per hectare of quinalphos @ 1.5 ml dust or Chlorpyrifos 1.5 ml, dust fenvalerate @ 0.4% dust 20 kg per hectare or *Thiodicarb @ 460 g a.i. per hectare.</p> <p>2. Apply Bromadiolone (0.005%) baits inside rodent's burrows</p>
5.	After harvest		Mechanical	<p>1. Destroy crop residue infested with disease and nematodes;</p> <p>2. Removal or burning to destroy the Nematode infested crop and immediately to check further multiplication of nematodes</p>

Note : - First spray of above mentioned insecticides should be started from 50% flowering/pod initiation stage of the crop preferably by the Biopesticides and 2nd spray if required by conventional insecticides.

 * Note as approved usage under Insecticides Act, 1968.

V. DO'S AND DON'TS IN GRAM IPM

Do's

1. Deep ploughing is to be done on bright sunny days during the month of May and June. The field should be kept exposed to sun light at least for 2-3 weeks. Remove crop debris from the field.

2. Grow only recommended varieties

3. Always treat the seeds with approved chemicals/bio products for the control of seed borne diseases/pests

4. Sow in rows at optimum depths under proper moisture conditions for better establishment.

5. Practice clean cultivation and remove weeds regularly.

6. Maintain optimum and healthy crop stand which would be capable of competing with weeds at a critical stage of crop weed competition.

7. Use appropriate strains of Rhizobium for better and effective nodulation. Use NPK fertilizers as per the soil test recommendations.

8. Conduct AESA weekly in the morning preferably before 9 am . Take decision on mangement practice based on AESA, ETL, P:D ratio only.

9. Install pheromone traps on 40-60 DAS for pod borer. Replace lures in 15-20 days.

Dont's

Do not plank or irrigate the field after ploughing, at least for 2-3 weeks, to allow desication of weed's bulbs and / or rhizomes of perennial weeds.

Do not grow varieties not suitable for the season or the region.

Do not use seeds without seed treatment with biocides/chemicals.

Do not sow seeds beyond 5-7 cm depth.

Do not allow to grown vetches (*V. stiva*) in pod borer prone areas.

Crops should not be exposed to moisture deficit stress at their critical growth stages.

Avoid imbalanced use of fertilizers.

Do not apply chemical pesticides on calendar basis.

Do not store the pheromone lures at normal room temperature (keep them in refrigerator).

10. Release parasites only after noticing adult moth catches in the pheromone trap or as per field observation. Do not apply chemical pesticides within 7 days of release of parasites.
11. Apply, HaNPV at recommended dose when a large number of egg masses and early instar larvae are noticed. Apply NPV only in the evening hours after 5 pm. Do not use the same sprayer for application of chemical pesticides and biocides.
12. In case of pests which are active during night like *Spodoptera* spray recommended biocides chemicals at the time of their appearance in the night. Do not apply pesticides/biocides when it is not absolutely required.
13. Cleaned implements can be used. Do not use soiled farms implements from nematode infested areas.

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 docotr/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, tremors of tongue and eyelids, miosis,	For extreme symptoms of O.P poisoning, injection of atropine (2-4 mg., for adults, 0.5-1.0 mg for children) is recommended,	
3.	Monocroto	Extremely	Bright	Class I b –				

	phos	toxic	red	Highly hazardous		impairment of visual acuity.	repeated at 5-10 minute intervals until signs of atropinization occur.
4.	Phenthoate	Highly toxic	Yellow	Class II – Moderately hazardous		Moderate- nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis.	Speed is imperative
5.	Profenophos	Highly toxic	Yellow	Class II – Moderately Hazardous			- 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.	Chlorpyriphos	-do-	-do-	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.	- 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. In addition to atropine give 2-PAM (2-pyridine aldoxime methiodide). 1 g and 0.25 g for infants intravenously at a slow rate over a period of 5 minutes and administer again periodically as indicated. More than one injection may be required. Avoid morphine, theophyllin, aminophyllin, barbiturates or phenothiazines.

							Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.
CARBAMATES							
7.	Thiodicarb	Extremely toxic	Red	Class II – Moderately hazardous		Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhoea, epigastric pain, tightness in chest.	<ul style="list-style-type: none"> - Atropine injection 1 to 4 mg. Repeat 2 mg when toxic symptoms begin to recur (15-60 minute intervals). Excessive salivation – good sign, more atropine needed. - Keep airway open. Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed. - For ingestion, lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact was with soap and water (eyes – wash with isotonic saline). Wear rubber gloves while washing contact area. - Oxygen - Morphine, if needed. <p>Avoid theophyllin and aminophyllin or barbiturates. 2-PAM and other oximes are not harmful and in fact contra indicated for routine usage.</p> <p>Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.</p>
8.	Carbaryl	Highly toxic	Yellow	Class II – Moderately hazardous			
FUNGICIDES							
9.	Mancozeb	Slightly toxic	Green	Table 5 –		Headache, palpitation,	No specific antidote.

10.	Captafol	Moderately toxic	Blue	Unlikely to present acute hazard in normal use. Class I a – Extremely hazardous	nausea, vomiting, flushed face, irritation of nose, throat eyes and skin etc.,	Treatment is essentially symptomatic.	
11.	Carbendazim	Slightly toxic	Green	Table 5 – Unlikely to present acute hazard in normal use.			
12.	Captan	-do-	-do-	-do-			
13.	Thiram	Moderately toxic	Blue	Class III – Slightly hazardous			
RODENTICIDES							
14.	Bromodiolone	Extremely toxic	Bright red	Class I a – Extremely hazardous	Bleeding from nose, gums and into conjunctiva, urine and stool & coma Possible polar and petechial rash, late-massive echymoses or hematoma of skin, joints, brain hemorrhage	- Give Vitamin K1 15-25 mg for adults; 5-10 mg. for children orally; - Transfuse with fresh blood if bleeding is severe or until anemia is corrected. - Iron (Ferros sulfate) by mouth for correction of secondary anemia, 0.3 gm t.i.d.	
SYNTHETIC PYRETHROIDS							
15.	Fenvalerate	Highly Toxic	Yellow	Class II – Moderately Hazardous	Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin, allergic manifestations etc.,	No specific antidote. Treatment is essentially symptomatic.	
16.	Deltamethrin	-do-	-do-	-do-			

Agro Eco System Analysis (AESAs)

AESA is an approach, which can be gainfully employed by extension functionaries & farmers to analysis field situations with regard to pests, defenders, soil condition, plant health, the influence of climatic factors and their inter-relationship 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 the 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 *S litura* 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 center on a chart. Then draw pest 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 along with 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 stage, 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 ration 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 50 L.E. NPV/ha or NSKE 5%.
- ii) Some of the defenders like lady bird beetles, spiders, lacewing bug, reduviid bug, *Campoletis* sp., wasps play useful role in arriving at P:D ration 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 analyze 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 trainings, farmers can practice AESA in their own fields. Wherever trained farmers are available their experience could be utilised in training their fellow farmers in their own villages. There is 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.

LIST OF TOLERANT/RESISTANT GENOTYPE (GRAM) AGAINST INSECT PESTS AND DISEASES

Pest/disease	Tolerant/resistance genotypes
Fusarium wilt	Tolerant genotypes – Avrodhi, JG 315, PUSA 209, GNG 16, JG 74, KPG 59, PUSA 212-240-244-256-413, ICC 32, Phule G5, Phule G12, BG 256, BG 372.
Ascochyta blight	Gaurav (H 75-35), PBGI GNG 146, BG 261, GNG 469
Multiple resistance	Bharti, PUSA 372-362, BG 391, KWR 108, H 355, ICCV 10 against wilt and root rot, Ascochyta and root rot GNG 469
Botrytis grey mould	BG 276, Dhanush, 235-38, ICC-38, ICC 202, ICC 1069
Ascochyta blight and wilt	GL 83119, GL 84038, GI-84-96, Flip 83-7, ILC 171, PUSA 224, H 91-35, H 91-37
Pod borer	JG 315, JG 74 (Central Zone), PDG 84-10 (Raj), CCV 7 (South Zone), H 208, 35 Avorodhi (NWPZ)

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.