



IPM PACKAGE NO. 22



**INTEGRATED
PEST MANAGEMENT
PACKAGE
FOR
BRINJAL**



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 BRINJAL

Contents

SUBJECT	Page No.
Foreward	i
Preface	ii
Acknowledgements	iii
I. MAJOR PESTS	
A. Pests of National Significance	1
B. Pest of Regional Significance	1
II. PEST MONITORING	
A. Agro-eco-system Analysis (AESA)	2
B. Field scouting	2
C. Yellow water pan/sticky traps	3
D. Nematodes	3
E. Economic threshold levels (ETL)	3
III. IPM STRATEGIES FOR BRINJAL	
A. Cultural Practices	3
B. Mechanical control	4
C. Biological control	5
D. Biopesticides	6
E. Botanical pesticides	6
F. Chemical control	6
IV. BRINJAL CROP STAGE-WISE IPM PRACTICES	7-8
V. DO'S AND DON'TS IN BRINJAL IPM	9-10
VI. SAFETY PARAMETERS IN PESTICIDES USAGE	11-15
ANNEXURES - I & II	16-23



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

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

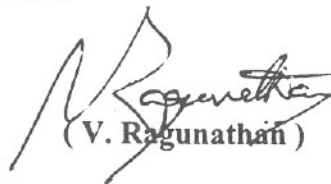
DR.V. RAGUNATHAN
Plant Protection Adviser
To the Government of India

FORWARD

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)
Director (IPM)

ACKNOWLEDGEMENTS

The IPM Package of Practices for **Brinjal** crop was discussed and finalised in the National Workshop on IPM held at National Plant Protection Training Institute (NPPTI), Hyderabad during May 14-17, 2001. The technical input received from the following experts is thankfully acknowledged.

- I. Chairman, Technical Session : Dr. A.D. Pawar, Director (IPM),
Dte of PPQS, Faridabad
- II. Coordinator, Technical Session : Dr. M.P. Misra, Dy. Director (Ent.),
Dte. of PPQS, Faridabad
- III. Co-chairman, Technical Session : Dr. R.B.L. Bhaskar, Jt. Director (Bio.)
Dte of PPQS, Faridabad
- IV. Expert input : 1. Dr. B.J. Divakar, Sr. Entomologist, NPPTI, Hyderabad
2. Dr. N.S. Rao, Sr. Scientist (Ent), PDDBC, ICAR, Bangalore
3. Dr. U. Sreedhar, Sr. Scientist CTRI (ICAR), Rajahmundry
4. Dr. C.M. Srivastava, PPO(PP), Central IPM Centre, Gorakhpur
5. Dr. K.S. Kapoor, PPO (E), Cnetral IPM Centre, Jalandhar
6. Sh. M.V. Srinivasa, PPO(E), Central IPM Centre, Bangalore
7. Dr. D. Kanungo, Jt. Director, CIL, Dte of PPQS, Faridabad
8. Dr. Brajendra Singh, Entomologist, Dte of PPQS, Faridabad
9. Dr. B.S. Phogat, Agronomist (H), Dte of PPQS, Faridabad
10. Dr. Jasvir Singh, AD(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.
 4. Sh. R.S. Tomer, SSA, IPM Div., Dte of PPQS, Faridabad.
 5. Sh. Laxmi Chand, SSA, IPM Div., Dte of PPQS, Faridabad.
 6. Mohd. Abrar Alam, Stenographer, IPM Div., Dte of PPQS, Faridabad.
 7. Sh. N.K. Mishra, LDC, IPM Div., Dte of PPQS, Faridabad.

IPM PACKAGE FOR BRINJAL

I. MAJOR PESTS

A. Pests of National Significance

1. Insect Pests

- 1.1 Jassids
- 1.2 Shoot and fruit borer
- 1.3 Aphid
- 1.4 White fly

2. Diseases

- 2.1 Damping off
- 2.2 Phomopsis blight
- 2.3 Little leaf of brinjal
- 2.4 Bacterial Wilt

3. Nematode

- 3.1 Root-Knot nematode

4. Weeds

- 4.1 Lamb square (*Chenopodium album*)
- 4.2 Pimpernel (*Anagallis arvensis*)
- 4.3 Sweet clover (*Melilotus* spp.)
- 4.4 Fumitory (*Fumaria indica*)
- 4.5 Cornspurry (*Spergula arvensis*)
- 4.6 Blue grass (*Poa annua*)
- 4.7 Canary grass (*Phalaris minor*)
- 4.8 Rabbit foot grass (*Dactyloctenium aegyptium*)

B. Pests of Regional Significance

1. Insect Pests

- 1.1 Plume moth
- 1.2 Bud worm
- 1.3 Gall midge
- 1.4 Mealy bug
- 1.5 Leaf roller
- 1.6 Leaf webbing caterpillar
- 1.7 Termites
- 1.8 Grey weevil
- 1.9 Spider mites

- 1.10 Tobacco cut worm
- 1.11 Stem borer
- 1.12 Hadda beetle
- 1.13 Thrips

2. Diseases

- 2.1 Blight
- 2.2 Cercospora leaf spot
- 2.3 Root and Collar rots
- 2.4 Damping off
- 2.5 Spotted wilt virus

II. PEST MONITORING

1. 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 plant.
- 3. Pest and defender population dynamics.
- 4. Soil conditions.
- 5. Climatic factors.
- 6. Farmer's past experience.

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

2. 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 field at

regular intervals to monitor the major pest situation. Simple field scouting on pest situation helps to minimize pesticide usage to a large extent.

3. Yellow Water Pan/Sticky Traps

Set up yellow water pan/sticky traps for monitoring whitefly, thrips etc. @ 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.

4. Nematodes

Root knot nematode causes gall formation and reniform nematode causes dirty root symptoms. Their presence can be detected by using "Trypan Blue" stain, which turns nematode egg sacs dark blue in colour, whereas the roots remain uncoloured.

5. 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 up the appropriate measures, whenever the incidence crosses ETL.

III IPM STRATEGIES

1. Cultural Practices

- 1.1 Phytosanitation to reduce sources of inoculum such as removal of plants after final harvest, volunteer plants. Clean planting material, preferably certified seeds should be used.
- 1.2 Crop rotation with french beans reduces the bacterial wilt disease incidence. Crop rotation with non host crop for root knot and reniform nematode eg. sorghum and wheat. Also intercropping with marigold, onion and garlic is recommended for nematode management.

- 1.3 Adopt raised nursery beds (10 cms) for good drainage thereby avoid damping off in solanaceous nurseries by preventing soil borne fungi viz., *Pythium*, *Phytophthora*, *Rhizoctonia* etc.
- 1.4 Soil solarization using black HDPE transparent polythene sheets (60 to 100 guage) on nursery beds for about 15 to 21 days which helps in killing weed seeds, nematodes and resting stages of insects and diseases.
- 1.5 Deep summer ploughing also helps in exposing resting stages of pests to sunlight.
- 1.6 Avoiding overdose of Nitrogen and Phosphorous fertilizers on brinjal reduce the incidence of fruit and shoot borer.
 - Avoid excess use of water for disease management.
 - Use of ash dust reduces the incidence of shoot & fruit borers.
- 1.7 Destruction of crop residues/debris and alternate host material reduces the inoculum load of many foliar diseases.
- 1.8 Crop seedlings should be planted timely in well prepared fields at recommended spacing. Use balanced doses of fertilizers to obtain optimum plant population and healthy crop stand, which would be capable of competing with weeds at initial stages of crop growth.
- 1.9 Selection of less susceptible varieties like SB 17-4, PBR-129-5, Punjab Barsati, Arka Kasumkar, Pusa Purple Round, Punjab Meetam for shoot & fruit borer.

2. Mechanical Control

- 2.1 Collection and destruction of egg masses, larvae and adults of Hadda beetle, tobacco cutworm, etc.
- 2.2 Removal of damaged shoots, fruits and fruit borer and destruction.
- 2.3 Use of yellow pan/sticky traps for sucking pests @ 10 per ha.
- 2.4 Regular destruction of damaged fruits at each harvest in brinjal to reduce the population.

- 2.5 Crop should be maintained weed free for 4 to 6 weeks after planting by resorting to timely hand hoeings and hand weeding.

3. Biological Control

3.1 Conservation

- (a) *Pristomerus testaceus*, *Cremastus flavoorbitalis*, *Bracon greeni*, *Phanerotoma* sp., *Campyloneura* sp. on *Lorbanalis*; *Pristomerus euzopherae* against *E. perticella*; *Microbracon psarae* against *Psra bipunctalis*; *Chrysonotomyia appannai*, *Chrysocharis johnsoni*, *Elasmus* sp., *Pediobius feveolatus*, *Tetrastichus ovulorum* against *Epilachna* sp.; *Aphidius* sp. on aphids; *Eurytoma* sp. on *Asphondylia* sp.
- (b) In addition to these parasites, general predators like Coccinellids, Syrphids, Spiders, Carabids, Staphylinids, Dragonfly, Damselfly, Predatory miridbugs, Predatory pentatomids, Nabid bugs, Reduviid bugs, Anthocoridbugs, Geocorid bugs; Predatory mite, Predatory thrips also actively suppress the pest population. *Stethorus panperculus* is active predator on red spider mite.
- (c) Since these natural enemies are highly prone for pesticides, avoiding unnecessary sprays are the best way to conserve them.
- (d) Grow cowpea or pulses on the bunds to buildup natural enemy fauna.
- (e) Instal bird perchers @ 50/ha.

3.2 Augmentation

- (a) Release *Chrysoperla carnea* @ 2 grubs per plant to control aphids and other soft bodied insects during early in the season.

- (b) Inundative release of *T. chilonis* @ 50,000 per ha, in brinjal 5 times starting from flower initiation stage at weekly interval against fruit and shoot borer.

4. BIOPESTICIDES

- (a) Spray *Bacillus thuringiensis* var *kurstaki*, the commercial preparation @ 500 g/ha against lepidopteran pests.
- (b) Seed treatment with *Trichoderma viride*/*T.harzianum* @ 2 gm per 100 gm of seeds to prevent seed and soil borne infection of fungal diseases.

5. Botanical Pesticides

- 5.1 Five per cent NSKE spray for sucking pests in early stages of the crop; it also takes care of serpentine leaf miner, etc.
- 5.2 Application of Neem Cake @ 200 kg per ha., a basal dose at the time of land preparation for controlling root-knot nematode infection.

6. Chemical Control

- 6.1 Chemical pesticide should be used on need basis as a last resort. Only when pest population intensity crossed economic threshold level, the safer pesticides should be applied judiciously.
- 6.2 Foliar spray of Carbendazim 50% @ 300gm/ha to control early leaf spots (*Alternaria solani*) whenever the disease is noticed.
- 6.3 Application of bleaching powder @ 15 kg/ha before planting against Bacterial wilt infection in endemic areas.
- 6.4 Application of Carbofuran 1 kg a.i./ha during early stages of crop to avoid sucking pests and also nematodes.
- 6.5 Spray Endosulfan 525 g a.i./ha to control insect pests. Alternate spray of Endosulfan @ 525 g a.i./ha and Cypermethrin 50 g a.i./ha at 15 days interval.

- 6.6 Root dipping in dimethoate 0.02%, 6 hours before transplanting for the control of little leaf disease of Brinjal by avoiding jassids infestation in early stages of the crop.
- 6.8 For weed management apply Fluchloralin @ 0.9 to 1.35 kg a.i./ha as preplanting soil incorporation.
- 6.9 Treat nursery bed with Carbofuran 3 G @ 0.3 to 0.6 a.i/ha Sq.m.

IV. BRINJAL CROP STAGE-WISE IPM PRACTICES

Stage	Pest	Practices
1. Pre-sowing	Resting stages of pests	Deep summer ploughing Application of Neem Cake @ 200kgs. per ha. Treat nursery beds with Carbofuran 3 G @ 0.3 to 0.6 gm. a.i/sq.m.
	Termite	Soil treatment with Chlorpyrifos @ 500 gm a.i/ha. in endemic areas.
	Soil borne diseases	Raised nursery beds. Avoid over dose of Nitrogenous and Phosphorous fertilizers to reduce the shoot and fruit borer incidence. Use <i>Trichoderma</i> sp & <i>Pseudomonas</i> biopesticides @ 4 gm per kg seed.
2. Seed & Seedling	Hadda Beetle	Hand collection of eggs, grubs and adults particularly hand picking of 3rd instar grubs. Eradication of <i>Solanum nigrum</i> . Spray Endosulfan 525 g a .i/ha. or Carbaryl 1000 g a.i/ha. Spraying must be thorough to deal larvae which are present at under surface of leaves.

	Weeds	Timely planting optimum spacing. Apply balance dose of fertilizers. Maintain weed free field for 4-6 weeks after planting by resorting to hand hoeing /hand weedings.
	Aphids, Jassids Mites	Release <i>Chrysoperlla</i> @ 2 grubs/plant Spray NSKE 5%
3. Vegetative	Fruit and Shoot borer	Remove damaged shoots. Release <i>Trichogramma chilonis</i> @ 50,000/ha for five times at weekly interval
	Weeds	Maintain weed free field for 4-6 weeks after planting by adopting timely hand hoeing weedings.
	Hadda Beetle Aphids, Leaf hopper Mites	As shown in seedling stage. As shown in seedling stage. As shown in seedling stage.
	Bacterial wilt	Roguing of affected plants. Application of 15 kg bleaching powder per ha through irrigation.
4.Reproductive	Fruit and shoot borer	Remove damaged shoots. Continue to release <i>Trichogramma chilonis</i> . Spray Endosulfan @ 525 g a.i/ha.
	Hadda Beetle Aphids, Leaf hopper Mites	As shown in seedling stage. As shown in seedling stage. As shown in seedling stage.
	Bacterial wilt	Roguing of affected plant.

V. DO'S AND DON'TS IN BRINJAL CULTURE

S.No.	DO'S	DON'TS
1.	Deep ploughing is to be done on bright sunny days during the months of May and June. The field should be kept exposed to <i>sun light</i> atleast for 2-3 weeks	Do not plank 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.	Pre-emergence herbicides should be applied immediately after sowing before the emergence of weeds and crop.	Pre-emergence herbicides should not be applied after emergence of crop or weeds as they cannot control the germinated weeds as well as they may cause phytotoxicity to the crop.
7.	Herbicides like Fluchloralin should be incorporated into the soil immediately after spraying, to avoid its photodegradation.	Soil incorporation of Fluchloralin should not be delayed or avoided for achieving effective weed control.
8.	Apply only recommended herbicides at recommended dose, proper time, as appropriate spray solution with flat fan or flat jet nozzles.	Pre-emergence as well as soil incorporated herbicides should not be applied in dry soils. Do not apply herbicides alongwith irrigation water or by mixing with soil, sand or urea.
9.	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.

10.	Use NPK fertilizers as per the soil test recommendations.	Avoid imbalance use of fertilizers.
11.	Use micronutrient mixture after sowing as top dressing separately.	Do not mix micronutrients with fertilizers and incorporate into the soil.
12.	Conduct AESA weekly in the morning preferably before 9 a.m. Take decision on management practice based on AESA, ETL and P:D ratio only.	Do not apply chemical pesticides on calendar basis.
13.	Install pheromone traps at appropriate period.	Do not store the pheromone lures at normal room temperature (keep them in refrigerator).
14.	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.
15.	Apply Ha NPV, SLNPV 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.
16.	In case of pests which are active during night like <i>Spodoptera</i> spray recommended biocides/chemicals at the time of their appearance in the night.	Do not apply pesticides/biocides when it is not absolutely required.
17.	Spray pesticides thoroughly to treat the under surface of the leaves particularly for mites, <i>Spodoptera</i> , <i>Epilachna</i> grubs etc.	Do not spray pesticides at mid day since, most of the insects are not active during this period.
18.	Apply short persistent pesticides to avoid pesticide residue in the soil and produce.	Do not apply pesticides during preceding 7 days before harvest.
19.	Follow the recommended procedure of trap technology in tomato and Cole crops.	Do not apply long persistent pesticide on trap crop, otherwise it may not attract the pests and natural enemies.

VI. 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.	Dimethoate	Highly toxic	Yellow	Class II – Moderately Hazardous		Mild – anorexia, headache, dizziness, weakness, anxiety, tremors of tongue and eyelids, miosis, impairment of visual acuity.	For extreme symptoms of O.P poisoning, injection of atropine (2-4 mg., for adults, 0.5-1.0 mg for children) is recommended, repeated at 5-10 minute intervals until signs of atropinization occur.
3.	Chlorpyrifos	Highly toxic	Yellow	Class II – Moderately hazardous		Moderate- nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis. Severe – diarrhoea, pinpoint and non- reactive pupils, respiratory difficulty, pulmonary edema, cyanosis, loss of sphincter control, convulsions, coma and heart block.	Speed is imperative - 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. 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 off phenothiazines.	
							Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.	

CARBAMATES

4.	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"> - 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 	
5.	Carbaryl	Highly toxic	Yellow	Class II – Moderately hazardous				

							<p>area.</p> <ul style="list-style-type: none"> - Oxygen - Morphine, if needed. <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>
--	--	--	--	--	--	--	--

FUNGICIDES

6.	Carbendazim	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.	Wettable sulphur	Slightly toxic	Green	-do-			
8.	Dinocap		Blue				
9.	Tridemorph		Blue	Class III – Slightly hazardous			

HERBICIDES

10.	Fluchloralin	Moderately toxic	Blue	Class III – Slightly hazardous		Headache, palpitation, nausea, vomiting; flushed face, irritation of nose, throat eyes and skin etc.,	No specific antidote. Treatment is essentially symptomatic.
-----	--------------	------------------	------	--------------------------------	--	---	---

SYNTHETIC PYRETHROIDS

11.	Cypermethrin	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.	
12.	Dicofol		Blue	Class III – Slightly toxic				

AGROECOSYSTEM ANALYSIS

IPM is based on ecological interactions between the environment, plants, herbivores and their natural enemies. The maximum yield of the crop is determined by plants and their health. The health of the plant is determined by the environment and the herbivores. The herbivores are balanced by their natural enemies.

Agro-eco-system analysis is an approach, which can be gainfully employed by group of farmers for decision making in IPM. The basic components of AESA are:-

- (a) Plant health at different stages.
- (b) Compensation abilities of the plant.
- (c) Pest and defender population.
- (d) Soil condition, irrigation status etc.
- (e) Weather conditions.
- (f) Past experience of the farmer in the situation.
- (g) Other investment opportunities.

The goal of the AESA activity is to analyse the field situation by observation, drawing and discussion. At the end of the activity the group should have made a decision about any action required for the field. The eco-system analysis is done weekly.

Time required - 120 minutes

Materials required: one note book, one large size paper, pencils and drawing crayons, polythene bags, plastic vials, rubber band and chloroform.

Procedure

Go to the field, leave the border side, select fifth plant in a row for observation. Move 1 to 2 rows and select the fifth plant from that position for second observation. Likewise select a total of ten plants. Observe each plant on the following parameters and record.

Insect-pest, disease and defenders count: Count the larger pests and beneficials found on different branches and leaves of the plant. Start from the top of the plant and work downwards. Count the egg masses, larvae and adults of defoliators and workout defoliation per cent. Count the flower and fruit feeding insects and assess the percentage of fruits affected by them. Count the branches that are affected by die-back or other shoot diseases.

Select three leaves from the sample plant, one take from the top, one from the middle and one from the bottom of the plant. Pick or turn the leaf and count the number of sucking pests and predatory mites. Also record different leaf-spot disease symptoms and count the number of spots. Estimate the percentage of leaf area affected.

Out of ten sample plants, assess the number of plants with virus symptoms. Like wise, for wilting symptoms. Pull wilting plants and observe symptoms on the roots (cut the roots to observe the colour of the vascular tissue).

Out of ten sample plants, note the number of plants with flowers/fruits to assess the percentage of plants flowering/fruited.

Plant parameters - Measure the height of the plant, number of leaves, width of foliage, etc.

Walk through the whole plot to assess any other beneficial, pests or diseases, not observed on the ten sample plants, is occurring; note the uniformity in growth of the plants. Make records of the soil condition, water situation and presence of weeds (observe the different kinds of weeds and severity).

Rats: Count number of plants affected by rats, also record number of live burrows in the plot.

Weather: Record last week's weather parameter.

Find a shady place to sit as a group. Each group should sit together in a circle with pencils, crayons and data from each of the field activities and the drawing of the AESA of the previous week.

Make a drawing on the large piece of paper for each plot observed. The rules for drawing are as follows:

Draw the plant with the correct number of branches, leaves, flowers, fruits write the plant height and number of green and yellow leaves some where. If the plant is healthy, colour the plant green. If disease occurs, draw the disease. If the plant is yellow, colour it yellow. Draw dead or drying leaves in yellow. For weeds, draw the approximate density and size of weeds in relation to the size of the vegetable plant. Draw the kinds of weed in the field.

For pest population draw the different insects found in the field on the right side of the plant, write the average number next to the insect. Also write the local name next to the insect. The data can also be summarized in a table on the right side.

For natural enemy populations, draw the insects and spiders as found in the field on the left side of the plant. Write the average number of natural enemies and their local names next to the drawing.

For rats write the average number of fruits/heads attacked.

If the week was mostly sunny draw a sun. If the week was mostly sunny and cloudy together draw a sun but half covered with dark clouds. If the week was cloudy all the day for most of the week put just dark clouds.

If the fertilizer was applied, then draw a picture of a hand throwing N,P or K depending on the type of fertilizer used.

If pesticides were used in the field, show sprays with a nozzle and write the type of chemical coming out of the nozzle. If granules were broadcast, show a hand with the name of pesticide being broadcast.

Now discuss the field situation among the group and arrive at a conclusion for the management practices required for the field. The discussion may be centered around as detailed below:

Steps	What to observe	What to ask	Actions
1.	Weather	Rain/dry? trends in Weather dry/wet Season, effects on crop	Do we need to water? Preparation of beds? Disease management.
2.	Crop condition	Age of crop, seedling/ Vegetable growth/ flowering/fruiling/ colour of leaves, leaf spots? Die back? Discuss?	Need fertilizer? Need watering? Fungicides? Special topic?.
3.	Field condition	Soil structure hard/wet? Weeds present?	Hand weeding? soil aeration?
4.	Herbivores	What herbivores? Population? Damaging?	Insect zoo Special topic
5.	Natural enemies (and neutrals)	What natural enemies? Population? Damaging?	Insect zoo Special topic
6.	Activities in neighbour's fields Decisions made	Do neighbours spray? What was sprayed?	Compare with FP Plot
7.	Decisions made last week	Was the decision made effective? Do we need to do similar action?	Insect zoo Special topic

4.2 PIT FALL TRAP

Due to nocturnal behaviour and hiding during day time insect pests like greasy cutworm, *Agrotis ypsilon* cannot be observed on plant in the vegetable fields during day time. Like wise many ground dwelling predators like ground beetles which play major role in regulating the population of lepidopterous pest like *Helicoverpa armigera*, *Spodoptera litura* cannot be assessed properly by visual observations.

The pit fall trap method is effective in these situations. Pit fall trap is a simple plastic container (1 liter capacity) without lid. Container with half filled water with a few drops of teepol on water surface. Observation should be made 48 to 72 hours after fixing the trap. Ten traps may be required per hectare of vegetable crop.

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 house premises.
2. Keep only in original container with intact seal.
3. Do not transfer pesticides to other containers.
4. Never keep them together with food or feed/fodder.
5. Keep away from 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 polythene bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover the head (Do not use polythene bag contaminated with pesticides).
5. Read the label on the container before preparing spray solution.
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 pesticides.
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 polythene 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 same 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 windy direction.
5. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV spraying.
6. Wash the sprayer and buckets 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 field immediately after the spraying.

G. Disposal

1. Left over spray solution should 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 other purpose.

WARNINGS

1. Consult expert of the field of Plant Protection before use of any pesticide, regarding doses and time of application.
2. Don't use pesticides in wrong way.
3. Select pesticides wise fully.
4. Use pesticides judiciously on need based manner.
5. Don't use green leaves as food after spray of pesticides.