



IPM PACKAGE NO. 19



**INTEGRATED
PEST MANAGEMENT
PACKAGE**

FOR

CRUCIFEROUS VEGETABLES

(CABBAGE, CAULIFLOWER, KNOL-KNOL, RADISH, BRACOLLI)



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 CRUCIFEROUS VEGETABLES

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

DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE
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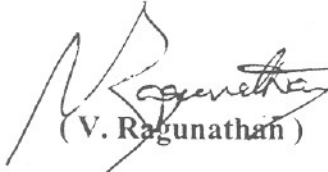
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FOR E W A R D

Integrated Pest management (IPM) approach has been globally accepted for achieving sustainability in agriculture. It has become more relevant due to a number of advantages like safety to environment, pesticide-free food commodities, low input based Crop Production Programme etc. Though IPM approach has been taken up since 1981, its impact has not been felt until 1994. Human Resource Development has helped to sensitise extension functionaries and farmers about the usefulness of IPM.

For successful implementation of IPM, the scattered information on various components of this eco-friendly approach forms basic necessity. In this direction, initial attempts were made in 1992 to harmonise the IPM Package of Practices of various crops. Subsequently concerted efforts were made in 1998, 2001 and 2002 to update and develop IPM package of practices for agricultural and horticultural crops. Presently, IPM package of practices for 51 crops have been finalised to help the extension workers and farmers to manage the pests/ diseases and to minimise the over use/ misuse of chemical pesticides. Efforts have been made to incorporate the relevant available technical input provided by the scientists of ICAR Institutes/ SAUs and State Departments of Agriculture. However, suggestions for further improvement in future publication/ revision will be of immense help. Hopefully, these IPM Package of Practices will be useful for the Researchers, Plant Protection Workers and Farmers alike.

April 1, 2002


(V. Raguathan)

P R E F A C E

In order to minimise the indiscriminate and injudicious use of chemical pesticides, INTEGRATED PEST MANAGEMENT (IPM) has been enshrined as cardinal principle of Plant Protection in the overall Crop Protection Programme under the National Agricultural Policy of the Govt. of India. IPM is an eco-friendly approach for managing pest and disease problems encompassing available methods and techniques of pest control such as cultural, mechanical, biological and chemical in a compatible and scientific manner. The greater emphasis has been given on biological control including use of biopesticides.


With a view to provide technical knowledge to the extension functionaries and farmers in the States, first National Workshop on IPM for harmonisation of Package of Practices was organized at National Plant Protection Training Institute (NPPTI), Hyderabad during June 29-30, 1992. Subsequently workshops were organized from April 15-17, 1998 and Nov. 5-6, 1998 at Directorate of Plant Protection, Quarantine & Storage, Faridabad and IPM package of practices for 20 crops were evolved on rice, cotton, vegetables, pulses, and oilseeds. In this series, two National Workshops on IPM have been conducted at NPPTI, Hyderabad and Dte. of PPQ&S, Faridabad during May 14-17, 2001 and Feb. 20-22, 2002 respectively to update 20 available IPM Packages and develop 31 new IPM Packages specially for Horticultural crops. In these workshops, 51 IPM Package of Practices for cereal crops (Rice, Wheat, Maize, Sorghum, Millets), commercial crops (Cotton, Sugarcane, Tobacco, Tea), pulse crops (Pigeonpea, Gram, Black gram/Green gram, Pea, Rajma), oilseeds (Groundnut, Soybean, Rapeseed/Mustard, Sesame, Safflower, Castor, Sunflower, Oilpalm), vegetables (Potato, Onion, Tomato, Brinjal, Okra, Chillies, Cruciferous vegetables, Leguminous vegetables, Cucurbitaceous vegetables), fruit crops (Citrus, Banana, Apple, Mango, Guava, Grapes, Pineapple, Sapota, Pomegranate, Litchi), spice and plantation crops (Small Cardamom, Large Cardamom, Black Pepper, Ginger, Coriander, Cumin, Fennel, Coconut, Cashew and Arecanut) have been finalised.

IPM technology manages the pest population in such a manner that economic loss is avoided and adverse side effects of chemical pesticides are minimized. The IPM packages encompasses various management strategies for containing the pest and disease problems. Pest monitoring is also one of the important component of IPM to take proper decision to manage any pest problem. It can be done through Agro-Ecosystem Analysis (AESA), field scouting, light, pheromone, sticky/yellow pan traps. The economic threshold levels (ETL) of important pests and diseases are also given in the packages to take appropriate control measures when pest population crosses ETL.

These IPM packages developed with the technical inputs from experts from Indian Council of Agriculture Research, State Agricultural Universities, Central Directorate of Plant Protection, Pesticide Industries and State Departments of Agriculture/Horticulture will provide technical backup in the management of pests, diseases, weeds, nematodes and rodents in the Indian Agriculture and Horticulture. These will also be useful in reducing the pesticide residues in exportable agricultural commodities and would also help in the management of pests/diseases/weeds/nematodes which may get inadvertently introduced in the country.

IPM Package of Practices for Agricultural and Horticultural crops will be helpful to minimize the ill effects of chemical pesticides to promote the IPM for sustainable production. These packages will be useful for the researchers, extension workers and farmers alike who are engaged in the agricultural practices.

April 1, 2002


(A.D. Pawar)
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IPM PACKAGE FOR CRUCIFEROUS VEGETABLES

(Cabbage, Cauliflower, Knol-khol, Braccolli and Radish)

1. MAJOR PESTS

A. Pests of National Significance

1. Insect Pests

- 1.1 Diamond backmoth
- 1.2 Leaf webber
- 1.3 Head borer
- 1.4 Cabbage aphid
- 1.5 Sawfly
- 1.6 Tobacco caterpillar

2. Diseases

- 2.1 Black rot
- 2.2 Damping off

3. Nematodes

- 3.1 Root-knot nematode
- 3.2 Reniform nematode

4. Weeds

- 4.1 Lamb square (*Chenopodium album*)
- 4.2 Pimpernal (*Anagallis arvensis*)
- 4.3 Sweetclover (*Melilotus* spp.)
- 4.4 Fumitory (*Fumaria indica*)
- 4.5 Comsparry (*Spergula arvensis*)
- 4.6 Blue grass (*Poa annua*)
- 4.7 Canary grass (*Phalaris minor*)
- 4.8 Rabbitfoot grass (*Dactyloctenium aegyptium*)

B. Pests of Regional Significance

1. Insect Pests

- 1.1 Tomato fruit borer
- 1.2 Leaf eating caterpillar
- 1.3 Cabbage butterfly
- 1.4 Cecidomyiid fly
- 1.5 Serpentine leaf miner
- 1.6 Mustard aphid
- 1.7 Thrips
- 1.8 Cutworms

2. Diseases

- 2.1 Club root
- 2.2 Cauliflower mosaic virus
- 2.3 Ring spot
- 2.4 Cabbage yellow
- 2.5 Black leg
- 2.6 Alternaria spot
- 2.7 White rust
- 2.8 Soft rot
- 2.9 Root rot

3. Nematode

- 3.1 Stunt nematode

II. PEST MONITORING

A. Agro Ecosystem 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 inter-relationship for growing healthy crop. Such a critical analysis of the field

situations will help in taking appropriate decision on management practices. The basic components of AESA are:

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

The details of AESA are given in Annexure 1.

B. Field Scouting

AESA requires skill. 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 pests situation.

C. Pheromones

Pheromone traps with lures are commercially available for pests like *H. armigera*, *S. litura*. Install five traps with lures for each pests; keep the distance of 5 meters between the traps. Traps should be installed in the field in such a way that the position of lure is always 6-12" above the crop canopy. Replace the lures once in 15-25 days depending upon the weather conditions. The trapped moths should be collected and killed daily. ETL for *H. armigera* is 8 to 10 moths per day per trap.

D. Yellow Water Pan/Sticky Traps

Set up yellow pan/sticky traps for monitoring whitefly, thrips, aphids, jassids and whitefly @ 8-10 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.

E. Nematode

Root knot nematodes cause gall formation and reniform nematodes cause "dirty root" symptom. Their presence can be detected by using "Trypan Blue" stain in water which turns nematode egg sac dark blue in colour whereas roots remain uncoloured.

F. 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. The ETL for some of the major pests are listed below:

=====

Diamond back moth	-	1 larva/plant
Leaf webber	-	1 Larva/meter row of length.
Nematodes	-	1-2 Juveniles/gm of soil.
Spider mite	-	2 mites/leaf.
Saw fly in radish	-	1 larva/plant.

=====

III. IPM STRATEGIES FOR CRUCIFEROUS VEGETABLES

A. Cultural Practices

1. Summer ploughing to expose immature stages of insect and micro organism.
2. Follow crop rotation.
3. Select resistant and tolerant varieties.

4. Remove and destroy crop residues after harvest.
5. Crop seedlings should be timely planted in well prepared field at recommended spacing and balanced dose of fertilizer.
6. Solarization of nursery bed by covering it with polythene transparent sheet (60-100 gauge) for 15-21 days is recommended to avoid nematode problem.

B. Mechanical Control

1. Hand collection of life stages of insect pests reduces the infestation.
2. Collection and destruction of infested old leaves of cole crops regularly.
3. Roguing of borer affected cabbage/cauliflower plants.
4. Crop should be maintained weed free for 4-6 weeks after planting by resorting to timely hand hoeing/hand weeding.

C. Trap Crop Technology

Two rows are to be sown with mustard as trap crop at the beginning and after every 25 cabbage rows. Bold seeded mustard is more suited. Mustard is to be sown twice; first is at 15 days prior to cabbage transplanting, while the second one is at 25 days after cabbage planting. Thick sowing of mustard i.e. 50-60 plants per meter row is recommended. Usually, the inter-cropped cabbage is free from infection during early stages. However, there may be some incidence at later stages. For this, apply either 5% NSKE or Cartaphydrochloride 2 g per litre of water.

D. Biological Control

1. Avoiding spraying of broad spectrum pesticides to conserve the natural enemies.
2. Erect bird percher @ 50 per ha helps the birds to come and eat the insect larvae.

3. Distribute small quantity of cooked rice at different places in the field which attracts birds like yellow wage tile, gray wage tile, common swallows and Indian myna.
4. Seed treatment with *Trichoderma viride* @ 2 g per 100 g of seed.
5. Release *Trichogrammatoidea bactrae* or *T. chilonis* or *T. pretiosum* egg parasites @ 50,000 per ha., 4-5 times with interval of 5-7 days helps in controlling DBM and other lepidopteran pests.
6. Make inoculative release of *Cotesia plutellae* @5000/ha. on 10-15 days after planting to control DBM.
7. Spray commercial preparation of *Bacillus thuringiensis* var. *kurstaki* @ 500 gm/ha. after 15 days planting and should be repeated after every 15 days to control DBM and other lepidopteran pests.
8. Spray *Beauveria bassiana* (1×10^6 cfu/g) @ 2 g/litre of water after every 20 days to control lepidopteran pests.
9. Spray *Entomophthora* sp. (2×10^7 cfu/g) @ 2 g/litre of water after every 20 days to control lepidopteran pests.
10. Apply twice at 15 days interval of 5% NSKE beginning from head initiation stage.

E. Chemical control

1. Treat one kg of seeds with 100 mg of Streptocycline antibiotic solution for 15 minutes before sowing for controlling black rot infection in cabbage and cauliflower.
2. Treat the seed with 1g *carbendazim and 2 g of captan per 100 g of seeds for the control of seed and soil borne fungal pathogens.
3. Apply malathion 0.05% or endosulfan 0.07% or carbaryl 0.1% (2g/lit water) whenever population exceeds ETL.
4. Apply mancozeb 75% WP @ 1500-2000 g/ha for black rot disease management whenever disease inoculum and climatic conditions are noticed.
5. Treat the nursery bed with carbofuran 3g @ 0.3 to 0.6 g a.i./sq.m.

IV. STAGE-WISE IPM PRACTICES:

S.N	Stage	Pest	Practices
1.	Pre-sowing	Resting stages of pests Nematodes	<ul style="list-style-type: none"> - Deep summer ploughing. - Raised nursery beds. - Soil solarization. - Treat the nursery bed with carbofuran 3 G @ 0.3 to 0.6 g a.i. per sq.m.
		DBM & other pests	<ul style="list-style-type: none"> - After land preparation leave two ridges at the beginning after every 25 rows and at the end. - Sow bold mustard seeds densely in one of the ridges 15 days before cabbage planting as a trap crop.
		Weeds	<ul style="list-style-type: none"> - Apply Fluchloralin @ 0.2 to 0.67 kg a.i./ha as preplanting soil incorporation.
2.	Sowing/ Planting	Black rot	<ul style="list-style-type: none"> - Seed treatment with *Carbendazim 0.01% + 100 ppm Streptocycline sulphate. - Seed treatment with <i>T. viride</i> @ 2 gms per 100 g of seed. - Apply optimum dose of Nitrogen and Phosphorus fertilizer as basal dose. - Adopt optimum irrigation.
		Weeds	<ul style="list-style-type: none"> - Apply Alachlor 10 Gr. @ 2.5 kg a.i./ha as pre-emergence herbicide. - Timely planting, optimum spacing and balanced use of fertilizer.
3.	Vegetative	DBM	<ul style="list-style-type: none"> - 25 days after transplanting, sow bold mustard seeds densely in the second ridge at the beginning, after every 25 rows and at the end as a trap crop. - Application of <i>B. thuringiensis var. kurstaki</i> 500 g/ha. - Release <i>T. chilonis/T.priteosum</i> @ 50,000/ha 4-6 times at weekly interval. - Release <i>Cotesia plutellae</i> @ 5000/ha. Three times at weekly interval.
		Black rot and leaf spot	<ul style="list-style-type: none"> - Spray Mancozeb 75% WP @ 1500-2000gm/ha.
4.	Head Development	DBM and other lepidopteran pests	<ul style="list-style-type: none"> - Application of <i>B. thuringiensis var kurstaki</i> 500 g/ha. - Release <i>T. chilonis/T.priteosum</i> @ 50,000/ha. 4-6 times at weekly interval. - Release <i>Cotesia plutellae</i> @ 5,000/ha. three times at weekly interval. - Spray 5% NSKE. - Erect bird perchers. - Spray Cartap hydrochloride or dichlorvos 2 g per litre of water on trap crop when DBM population is recorded.

* Not as per approved usage under Insecticide Act, 1968

V. DO's AND DON'Ts IN VEGETABLE IPM

Do's	Don't
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 sun light at least for 2-3 weeks.	Do not plank or irrigate the field after ploughing, at least for 2-3 weeks, to allow desiccation of weed's bulbs and/or rhizomes of perennial weeds.
2. Grows 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 reduce 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 stages 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 imbalanced use of fertilizers.
8. Use micronutrient mixture after sowing as top dressing separately.	Do not mix micronutrients with fertilizers and incorporate into the soil.
9. 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.

10. Install pheromone traps at appropriate period.

Do not store the pheromone lures at normal room temperature (keep them in refrigerator).
 11. Release parasites only after noticing adult moth catches in the pheromone trap or as per field observation.

Do not apply chemical pesticides within seven days of release of parasites.
 12. Apply HaNPV, SINPV 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.
 13. Spray pesticides thoroughly to treat the undersurface of the leaves, particularly for mites, *Spodoptera*, *Epilachna* grubs etc.

Do not spray pesticides at midday since, most of the insects are not active during this period.
 14. Apply short persistent pesticides to avoid pesticide residue in the soil and produce.

Do not apply pesticides during preceding 10 days before harvest.
 15. Spray pesticides during the dusky hours to avoid the killing of pollinators.

Do not spray insecticides during flowering season of cucurbits to protect honeybees, which helps in cross pollination.
 16. Follow the recommended procedure of trap crop technology on tomato and Cole crops.

Do not apply long persistent pesticide on trap crop, otherwise it may not attract the pests and natural enemies.
-

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.	Malathion	Moderately toxic	Blue	Class III – Slightly 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.	Dimethoate	Highly toxic	Yellow	Class II –				

4.	Dichlorvos	Extremely toxic	Red	Moderately hazardous Class I b - Highly Hazardous		impairment of visual acuity. 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.	repeated at 5-10 minute intervals until signs of atropinization occur. 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 or phenothiazines.	
5.	Chlorpyrifos	-do-	-do-	Class II - Moderately hazardous				

							Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.
CARBAMATES							
6.	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 area. - Oxygen - Morphine, if needed. <p>Avoid theophyllin and aminophyllin or barbiturates. 2-PAM and other oximes are not harmful and in fact contra indicated for routine usatge.</p> <p>Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.</p>
7.	Carbaryl	Highly toxic	Yellow	Class II – Moderately hazardous			

FUNGICIDES

8.	Streptocyclin	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.	
9.	Carbendazim	Slightly toxic	Green	-do-				
10.	Mancozeb	Slightly toxic	Green	-do-				
11.	Streptocycline sulphate	Slightly toxic	Green	-do-				
12.	Captan	Moderately toxic	Blue	Class III – Slightly hazardous				

HERBICIDES

13.	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.	
14.	Alachlor	Moderately toxic	Blue	Class III – Slightly hazardous				
15.	Cartap hydrochloride	Moderately toxic	Blue	-do-				

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. m. 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 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 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%.
- 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 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 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 sunlight 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.
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 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 wind direction.
5. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV sprayer.
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 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 solid away from water source.
3. Never re-use empty pesticide container for any purpose.
