



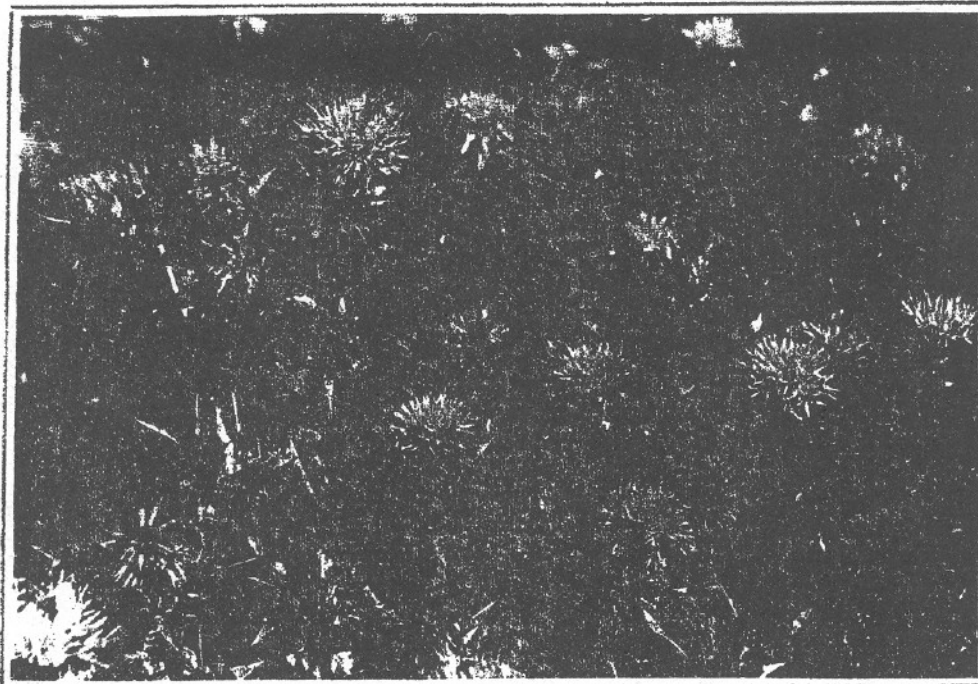
IPM PACKAGE NO. 13



INTEGRATED PEST MANAGEMENT PACKAGE

FOR

SAFFLOWER



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 SAFFLOWER

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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)

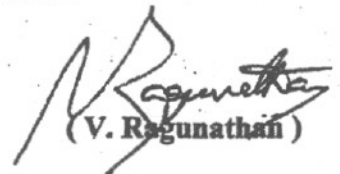
DR. V. RAGUNATHAN
Plant Protection Adviser
To the Government of India

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. R. Raghunathan)

P R E F A C E

In order to minimize 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)

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IPM PACKAGE FOR SAFFLOWER

I. MAJOR PESTS

A. Pests of National Significance

1. INSECT PEST

1.1 Aphid

2. DISEASES

2.1 Wilt

2.2 Alternaria leaf spot

3. WEEDS

3.1 Wild onion (*Asphodelus tenuifolius*)

3.2 Field bind weed (*Convolvulus arvensis*)

3.3 Wild safflower (*Carthamus oxycantha*)

3.4 Nut sedge (*Cyperus rotundus*)

3.5 Spurge (*Euphorbia spp*)

3.6 Camel Thorn (*Alhagi camelorum*)

B. Pests of Regional Significance

1. INSECT PESTS

1.1 Capsule borers (Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu).

1.2 White grubs (Andhra Pradesh)

1.3 Termite (Maharashtra, Andhra Pradesh)

1.4 Spider mite (Maharashtra)

2. DISEASES

2.1 Ramularia leaf spot (Maharashtra, Andhra Pradesh, Karnataka)

2.2 Rust (Maharashtra, Andhra Pradesh, Karnataka)

2.3 Root rot (Maharashtra, Andhra Pradesh, Karnataka)

II. PEST MONITORING

1. Rapid Roving Survey (RRS)

In the beginning of the crop season, survey routes are required to be identified in the pest & disease endemic areas to undertake Rapid Roving Surveys (RRS). During survey the observations are to be made at every 10 kms. distance in the pre-selected route at 7 to 10 days intervals depending upon pest and disease situation. Record the incidence of pest, disease and defender population at each spot in 5 plants at random and 10 spots per 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 populations once in 7 to 10 days in their own fields as per Agro Eco System Analysis (AESA) approach. The State Departments of Agriculture should make all possible efforts by using different media, mode and publicity to inform the farmers the need for field scouting in the specific crop areas having indication of pest or disease build up.

3. 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 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 condition
5. Climatic factors
6. Farmers past experience

The details of the AESA are given in Annexure - 1

4. Pheromone trap - Monitoring

Use pheromone traps for monitoring *Spodoptera* and *Helicoverpa*. Install pheromone traps at a distance of 50 m. @ one trap per ha. for each insect pest. Use specific lure for each insect pest species and change it after every 15 to 20 days. Trapped moths should be removed daily.

5. Economic Threshold Levels (ETLs)

S. No.	Pest	Economic Threshold Levels
1.	Aphid	50-70 nymphs/adults per plant (5 cm apical twig)
2.	Capsule borer	0.5 larva/plant
3.	Wilt	5-10% damaged plants
4.	Alternaria leaf spots	5% leaf infected

III. INTEGRATED PEST MANAGEMENT STRATEGIES

A. Cultural practices

1. Use resistant/tolerant varieties viz., Bheema, A-1 and C-438 (Manjira), etc.
2. Deep summer, ploughing for the protection of soil borne diseases and other hibernating defoliators immature stages and nematodes.
3. Spacing - 30x20 cm minimises the disease incidence.
4. Early sowing i.e., 1st week of October to avoid insect pest attack particularly safflower aphid and disease incidence.
5. Inter-cropping for different regions under rainfed conditions are as under :-

State / Region	Suggested Inter-cropping	Row proportion of main and inter-crop
Maharashtra	Chickpea + Safflower	3 : 1 or 2 : 1
	Wheat + Safflower	3 : 1 or 2 : 1
	Linseed + Safflower	3 : 1 or 4 : 2
	Coriander + Safflower	3 : 1
Karnataka	Chickpea + Safflower	3 : 1
	Coriander + Safflower	3 : 1 or 2 : 1
	Wheat + Safflower	3 : 1 or 5 : 1
Andhra Pradesh	Chickpea + Safflower	3 : 1 or 2 : 1
	Wheat + Safflower	3 : 1 or 2 : 1
	Coriander + Safflower	3 : 1 or 2 : 1
	Linseed + Safflower	3 : 1 or 2 : 1

6. Clean cultivation - Proper crop sanitation be maintained. Rogue out the diseased plants and unwanted plants in and around the crop field.

B. Mechanical practices

1. Collection and destruction of Capsule borer larvae.
2. Erection of bird perchers @ 10-12/ha.

C. Biological Control Practices

1. Seed treatment with *Trichoderma viride* @ 4 g/kg. seed for controlling wilt and root rot diseases.
2. Conserve the natural biocontrol population especially Coccinellids, spiders, etc. (Annexure - II).
3. Monitor the incidence of sucking pests and release *Chrysoperla carnea* @ 1-2 grubs/plant (2 releases at 15 days interval).
4. Use NPV (*Helicoverpa/Spodoptera*) 6×10^9 /L.E. @ 250 to 500 L.E./ha. For the management of capsule borers.

D. Chemical Control Practices:

1. Seed treatment with *Carbendazim @ 2 g/kg seed against wilt and root-rot diseases.
2. Use of Thiram or *Mancozeb @ 0.2 per cent against root-rot.
3. Spraying of *Mancozeb @ 0.25 per cent against leaf spot diseases.
4. Use Botanicals viz., neem seed kernel extract @ 5 per cent.

E. Integrated Weed Management:

Weed Management:

1. Crop should be sown timely at proper moisture by using recommended seed rate, balanced doses of fertilizers for achieving optimum plant population and healthy crop stand which would be capable of competing with weeds at initial stages of crop growth.
2. Crop should be maintained weed free up to 45 days after sowing by resorting two hand hoeings/weedings at 20 and 35 days after sowing.

*Not as per approved usage under Insecticide Act, 1968

IV. CROP STAGE/PEST VIZ-A-VIZ IPM PRACTICES:

Crop stage/pest	IPM component	IPM practices
1. Pre-sowing	Cultural Practices	1. Deep ploughing in summer to expose soil borne pathogens and immature stages of hibernating defoliators. 2. Early sowing to avoid damage due to insect-pests.
	Mechanical practices	1. Collection and destruction of foliage feeders.
	Wilt & Root rot	Biological control practices Seed treatment with <i>Trichoderma viride</i> @ 4 gm/kg seed. Chemical control practices - Seed treatment with *Carbendazim @ 2 gm/kg seed or - Thiram or *Mancozeb @ 2%.
2. Post - Sowing		
Aphid	Biological control	Release of <i>Chrysoperla</i> eggs/grubs @ 1-2/plant
	Chemical control	Spraying of Endosulfan @ 0.05% or Dichlorovos @ 0.05% or Fenitrothion @ 0.05% or Dimethoate 0.03%.
Alternaria Leaf spot		*Mancozeb (0.25%)
Ramularia Leaf spot & Rust		- do -

*Not as per approved usage under Insecticide Act, 1968

V. DO's AND DON'T's IN SAFFLOWER IPM

S. No.	Do's	Don'ts
1.	Grow only recommended varieties	Don't grow pest susceptible varieties
2.	Agronomic practices (a) Sowing time Sow the crop during early October	Avoid late sowing
	(b) Judicious use of fertilizers Always use recommended NPK fertilizers in balanced proportion based on soil testing report	Don't use under, over or imbalanced fertilizer application which might result in poor plant health, plant stands and reduced resistance to major insect-pests and diseases.
	(c) Proper crop sanitation be maintained. Rogue out the diseased plant to avoid the disease spread.	
3.	Pest Management (a) Regular Surveillance be ensured timely by scouting/ monitoring Threshold Levels. This is very essential for need based application of control measures against major insect pests.	
	(b) (i) Select very effective, economical, & eco-friendly pesticides with right dosages at right time.	Do not go for blanket sprays without field inspection.
	(ii) Use only recommended pesticides.	Don't use unrecommended mixture of pesticides in any case. Don't use the pesticides over/lesser dosages than the

S. No.	Do's	Don'ts
		recommended ones which may lead to
		(a) Chemical control failure (b) Quick development of resistance among insect pests and disease to various pesticides. (c) Resurgence of minor important pests and diseases. (c) Human health / living flora hazards and environmental pollution.
	(c) Spray technology	
	Always follow the recommended Spray technology by using adequate spray material	Don't use substandard nozzles with high discharge rate which lead to improper coverage of the target site.
	(d) Spray pesticides properly so as to cover entire crop foliage	Don't use pesticides which are not recommended and their expiry date is over.
		Don't purchase pesticides without cash memo/bills indicating batch number and dated.
	(e) Consult expert of the field of plant protection before use of pesticides.	

VI. SAFETY PARAMETERS

The safety parameters inter-alia classification of toxicity as per insecticides Rules, 1971, WHO Classification of hazards, colour of toxicity triangle, first aid measures, symptoms of poisoning and treatment of poisoning, the extension functionaries of the State Department of Agriculture have to make use of this information as under :

- i) Basic precautions which are required to be taken as per classification of toxicity as well as hazards criteria by WHO may be seen as per Annexure.
- ii) The extension functionaries are to educate the farmers on safety use of pesticides with the help of colour toxicity triangle as the farming community can follow the colour and corresponding safety precautions.
- iii) The symptom of poisoning must be known to the extension functionaries to enable them to extend first aid measures to affected persons to the extent possible.
- iv) Basically, the information on first aid measures and treatment of poisoning is required to be passed on by the extension functionaries to the doctors at primary health centres as well as to the Private Doctors in the vicinity of spraying of pesticides.
- v) Extension functionaries must ensure that names of common pesticides during plant protection measures along with a copy of the leaflet which is an integral part of a pesticide container must be made available to the doctors in the vicinity of plant protection operations.
- vi) Extension functionaries are to request the doctors to intervene in procurement of antidotes for different pesticides as cited under "Treatment of poisoning".

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. 	21

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)
ORGANOPHOSPHATE PESTICIDES								
2.	Chlorpyrifos	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.	N.A
3.	Dichlorovos	Extremely Toxic	Red	Class I a - Extremely Hazardous		Moderate- nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis.	Speed is imperative	07
4.	Dimethoate	Highly toxic	Yellow	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.	- 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.	16
5.	Methyl-Oxydemeton	Highly toxic	Yellow	Class I b - Moderately Hazardous				N.A

								<p>In addition to atropine give 2-PAM (2-pyridine aldoxime methiodide). 1 g and 0.25 g for infants intravenously at a slow rate over a period of 5 minutes and administer again periodically as indicated. More than one injection may be required.</p> <p>Avoid morphine, theophyllin, aminophyllin, barbiturates or phenothiazines.</p> <p>Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.</p>
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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)
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.	N.A
7.	Mancozeb	Slightly toxic	Green					N.A
8.	Thiram	Moderately toxic	Blue	Class III - Slightly hazardous				N.A

AGRO ECO SYSTEM ANALYSIS (AESAs)

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 condition.
5. Climatic factors.
6. Farmers past experience.

The methodology of AESA is as under:

A. Field Observations

- a) Enter the field at least 1.5 m away from the bund. Select a site with a dimension of 1 sq. m randomly.
- b) Record the visual observation in following sequence :-
 - i) Flying insects (both pests & defenders)
 - ii) Close observation on pests and defenders which remain on the plants (aphids).
 - 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 centre on a chart. Then draw pest on left side and defender on the right side. Indicate the soil conditions, weed population, rodent damage etc. Give natural colour to all the drawing, for instance, draw healthy plant with green colour, diseased plant/leaves with yellow colour., While drawing the pests and the defenders on the chart care should be taken to draw them at appropriate part of the plant, where they are seen at the time of observation. The common name of pest and defenders and their population count should also be given alongwith diagram. The weather factor should be reflected in the chart by drawing the diagram of sun just above the plant if the attribute is sunny. If cloudy, the clouds may be drawn in place of sun. In the case of partially sunny, the diagram of sun may be half masked with clouds.

C. Group Discussion and decision making

The observations recorded in the previous and current charts should be discussed among the farmers by raising questions relating to change in pest and defender population in relation to crop stages, soil condition, weather factors such as rainy, cloudy or sunny, etc. The group may evolve a strategy based upon weekly AESA, ETL and corresponding change in P:D ratio and take judicious decision for specific pest management practices.

D. Strategy for Decision making (Examples)

- i) When large number of egg masses and early instar larvae of *Spodoptera/Helicoverpa* are observed, the group may conclude application of NPV.
- ii) Some of the defenders like lady beetles, groundnut beetles, rove beetles, wasps play useful role in arriving at P:D ratio. Detailed list is at Annexure-II.

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, applications 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 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.

POTENTIAL NATURAL ENEMIES OF SAFFLOWER INSECT PESTS

S. No.	Name of the defender	Hosts	Stage attacked
1.	Flower bugs (Anthocorids)	Thrips, Mites Aphids, Lepidoptera	1. Eggs & small larvae of Lepidoptera 2. Adults and nymph of Aphids, Mites & Thrips.
2.	Shield bugs (Predatory Pentatomid)	Lepidoptera, Bugs	Immature and adult stage
3.	Lady bird beetles (Coccinellids)	Aphids, Mealy bugs Jassids, Thrips, Lepidoptera	Nymphal and adult stage Small larvae of Lepidoptera
4.	Ground beetle (Carabids)	Soft bodied Insect	Larvae and adults
5.	Rove beetle (Staphilinids)	Soft bodied insects	Larvae and adults
6.	Praying mantis	All insects (including grasshoppers)	All stages
7.	Hover flies (Syrphids)	Aphids	All stages
8.	Robar fly	<i>Helicoverpa</i> <i>Spodoptera</i> Grasshopper	Larvae & adult stage
9.	Ants	Soft bodied insects	Eggs & larvae
10.	Green lace wing (Chrysopids)	Lepidoptera Aphids	Eggs & larvae All stages
11.	Long horned grasshopper (Tettigonids)	<i>Spodoptera</i>	Egg masses
12.	Predatory crickets (Gryllids)	Lepidoptera	Eggs

S. No.	Name of the defender	Hosts	Stage attacked
13.	Earwig (Carcinophorids)	Lepidoptera	Larvae
14.	Spiders	All Insects	All stages preferably moving stage
15.	Braconids/Ichneumonid wasps	Lepidoptera/ Coleoptera	Immature stage
16.	Damsel flies / Dragon flies	All insects including jassids, <i>H. armigera</i> <i>S. litura</i>	Larval & adult stage
17.	Trichogrammatids	Lepidoptera Coleoptera	Egg stage
18.	NPV	Lepidoptera Coleoptera	Larval stage
19.	Green muscardine fungus	Jassids, Lepidoptera Coleoptera	Larval stage

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. Ever 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 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 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 polyethylene bags.

E. Equipment

1. Select right kind of equipment.
2. Do not use leaky, defective equipment.
3. Select right kind of nozzle.

4. Do not 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 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 purpose.
8. Avoid entry of animals and workers in the fields immediately after the spraying.

G. Disposal

1. Left over spray solution 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.

H. Other Precautions

1. Seed Treatment

- 1.1 For seed dressing, use either metal seed dress/earthen pots or polythene bags.
- 1.2 After seed treatment, do not open lid/cover of the polybag/earthen pot immediately to avoid inhalation of pesticide/fungicide.
- 1.3 Do not use left over treated seeds either for human consumption or as animal feed.

2. Cautions during spraying

- 2.1 If operator feels giddiness; uneasy, he must discontinue spraying/dusting at once.
 - 2.2 Operator should not spray/dust more than 4 hours at a stretch in a day.
 - 2.3 Operator should not take up spray/dusting work with empty stomach.
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