



IPM PACKAGE NO. 49



INTEGRATED PEST MANAGEMENT PACKAGE

FOR

FENNEL



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 FENNEL

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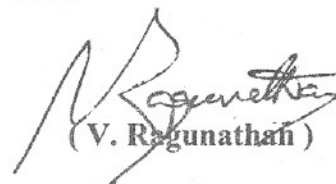
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FOREWARD

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 OF PRACTICES FOR FENNEL

I. MAJOR PESTS:

1. Insect pests:

- 1.1 Aphids (*Hyadaphis corianderi*)
- 1.2 Seed midge (*Systole albipennis*)
- 1.3 Leaf eating caterpillar (*Heliothis armigera*)
- 1.4 Thrips (*Thrips fавus*)
- 1.5 Spice beetle (*Lasioderma serricornae*, *Stagobium* sp.)
- 1.6 Mites (*Petrobia* sp.)

2. Diseases:

- 2.1 Leaf blight (*Ramularia foniculi*)
- 2.2 Alternaria blight (*Alternaria tenuis*)
- 2.3 Leaf spot blight (*Cercosporidium punctum*)
- 2.4 Damping off (*Pythium aphanidermatum*) (seedling);
- 2.5 Phytophthora leaf disease;
- 2.6 Wilt (*Fusarium equiseti*)
- 2.7 Powdery mildew (*Erysiphe polygoni*; *Leveillula taurica*)
- 2.8 Stem rot (Drooping off) (*Sclerotinia sclerotiorum*)
- 2.9 Gall (*Protomyces macrosporus*)
- 2.10 Gummosis/ Sugary secretion
- 2.11 Collar rot
- 2.12 Root rot (*Rhizoctonia solani*)

3. Nematode:

- 3.1 Rootknot nematode (*Meloidogyne* sp.)

4. Weeds:

- 4.1 Bathua (*Chenopodium album*)
- 4.2 Sanji (*Melilotus indica*)
- 4.3 Piyaji (*Asphodelus tenuifolius*)
- 4.4 Satyanasi (*Argemone maxicana*)

II. PEST MONITORING:

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

1. Rapid Roving Survey (RRS):

Survey teams should undertake regular insect pests and disease monitoring on pre-selected routes at seven days interval and assess biocontrol potential in addition to insect pest and disease situation to give early fore-warnings. Records should be kept about insect pest and disease incidence and biocontrol fauna. Aphids population should be recorded on 30 plants (100 leaves). The fields should be selected randomly after every 10 km. distance.

2. Field Scouting:

Field scouting should be undertaken by the farmers/extension functionaries to keep a close watch on the appearance of insect pests, diseases and biocontrol fauna, once in seven days to work out the ETL. For sucking pests, population should be counted on three leaves (top, middle and lower) per plant. Cut worms and defoliators percent damage assessment can be made by counting total number of plants and affected plants.

When the weather conditions become congenial (overcast sky, high humidity or intermittent rains) the fields should be monitored on alternate days for occurrence of blight and other diseases.

3. Agro Eco System Analysis (AESAs):

Based upon weekly AESA, Economic Threshold Level (ETL) and corresponding change in pest defender ratio, the extension functionaries have to take judicious decision in advising farmers for specific pest management practices. Detailed methodology for undertaking AESA exercise is given in Annexure.II .

4. Pest Monitoring Through Yellow Pan/Sticky Traps:

Set up yellow pan/sticky traps for monitoring aphids/whitefly @ 10 yellowpans/sticky traps per ha. Locally available empty yellow palmoline tins coated with grease/vaseline/castor oil on outer surface may also be used

III. IPM STRATEGIES FOR FENNEL:

A. Cultural practices:

1. Deep summer ploughing will check the pest/disease by exposing their resting stages to the sun.
2. Soil solarization by covering of moist soil with plastic sheets helps to kill the soil borne plant pathogen.
3. Follow crop rotation to reduce the disease incidence of wilt.
4. Select healthy, disease free seed material.
5. Use tolerant/resistant varieties for their particular areas (Annexure-I).
6. Select well drained field for cumin crop to avoid water stagnation.
7. Over watering should be avoided to minimize the wilt attack.
8. Stop irrigation under cloudy and high dew condition to avoid blight and sugary secretion.
9. Apply organic manure and avoid excess use of nitrogenous fertilizers.
10. Apply organic amendments viz. castor or neem cake 2-2.5 tonnes/ha against soil borne diseases and pests.
11. The harvest of the mature crop should not be delayed to avoid powdery mildew attack.
12. To avoid infestation of storage pests fennel seed should be properly dried and stored in gunny bags lined with alkathene sheet (500 micron).

B. Mechanical practices:

1. Collect and destroy disease-infected plants.
2. Collect the larvae of cut worm and leaf defoliators and kill them during the early morning or late evening to reduce the pest population.

C. Biological control:

1. Treat the seeds with *Trichoderma harzimum* or *T. viride* @ 4g/kg of seed to manage soil pathogen.

2. Conserve the parasites and predators like Coccinellides, Chrysopids and Syrphids.
3. Install the bird perchers @ 10-15/ha to promote predation of moths and larvae by birds.
4. Spray Ha NPV @ 250 LE/ha during evening hours if *Helicoverpa* population persists.

D. Chemical control:

1. Treat the seeds before sowing with Carbendazim @ 2g/kg of seeds to control stem and root rot diseases.
2. Spray Mancozeb @ 0.2% or Carbendazim @ 0.1% against Alternaria, Ramularia blight and repeat if necessary after 10-15 days.
3. Spray wettable sulphur @ 0.25% or Dinocap @0.1% during flower initiation and repeat if necessary.
4. Dusting of sulphur 300 mesh @20-25 kg/ha is effective against powdery mildew.
5. Spray Endosulfan (0.07%) or Methyl-o-demetan (0.025%) or Dimethoate (0.03%) against *Helicoverpa*, seed midge, aphids, mites and sucking pests.
6. Spray 5% NSKE against sucking pests on pest appearance.
7. Add spreaders or wetting agent @ 2ml/lit of water in insecticide spray solution.

E. Weed management:

The crop should be kept free from weeds. The fennel crop faces severe weed competition at initial crop stage. First weeding and hoeing should be done at 30 days after sowing. At the same time thinning should also be done. If required, hoeing and weeding should be repeated twice or thrice.

The recommended pesticides for this crop are not as per approved usage under Insecticides Act, 1968.

IV. CROP STAGE-WISE IPM PRACTICES IN FENNEL

Stage	Pest	Practices to be adopted
1. Pre sowing	Soil borne diseases, insects & nematodes	<ul style="list-style-type: none"> - Follow recommended crop rotation in the area - Deep summer ploughing - Soil solarization
2. Sowing	Wilt, nematodes	<ul style="list-style-type: none"> - Application of 150 kg neem cake/ha. - Treat the seed just before the sowing with <i>Trichoderma viride</i> or <i>T. harzianum</i> @ 4 g/kg seed or - Seed treatment with Carbendazim @ 2 g/kg seed. - Select healthy & disease free seed material.
	Wilt, blight, powdery mildew & aphid Weed management	<ul style="list-style-type: none"> - Use recommended tolerant/resistant varieties - Do hoeing/weeding 30 DAS.
3. Vegetative	Wilt	<ul style="list-style-type: none"> - Avoid over watering
	Blight, aphid	<ul style="list-style-type: none"> - Stop irrigation under cloudy & high dew condition - Avoid excess use of nitrogenous fertilizer. - Spray Mancozeb 0.2%
	Aphids & Sucking pests	<ul style="list-style-type: none"> - Conserve <i>Coccinellids</i>, <i>Chrysopids</i> & <i>syrphids</i>. - Spray NSKE (5%) or Azadirachtin (0.03%) @ 1 l/ha (0.5%) or - Spray Methyl demeton 0.025% or Endosulfan 0.01%, repeat if necessary.
4. Repro-ductive (Flowering stage)	Blight	<ul style="list-style-type: none"> - Spray Mancozeb 0.2%
	Powdery mildew	<ul style="list-style-type: none"> - Spray wettable sulphur 0.25% or dinocap 0.1% or dusting sulphur @ 20-25 Kg/ha. Repeat as per need.
	Aphid	<ul style="list-style-type: none"> - As sown in vegetative stage.
	Pod borer	<ul style="list-style-type: none"> - Spray HaNPV @ 250 to 400 LE/ha during evening hours.
5. Storage	Pests & diseases	<ul style="list-style-type: none"> - Store in gunny bags with moisture proof lining.

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

	Do's	Don'ts
1.	Deep ploughing is to be done on bright sunny days during summer. The field should be kept exposed to sunlight at least for 2 to 3 weeks.	Do not plank or irrigate the field after ploughing at least for 2-3 weeks, to allow desiccation of weeds bulbs and/or rhizomes of perennial weeds.
2.	Grow only recommended pest/disease tolerant/resistant varieties.	Do not grow varieties not suitable for the season or the region.
3.	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.
4.	Practice crop rotation in severely infected fields.	Don't grow in disease affected fields in subsequent years.
5.	Spray during the evening hours when honey bees activities are minimum because honey bees are major pollinators in this crop.	Don't spray insecticides which are harmful to the honey bees.
6.	Keep the crop free from the weeds.	Don't allow the weeds, the seeds of which are likely to contaminate the product.
7.	Survey the field regularly to monitor the pest and disease incidence.	Don't spray the pesticides on calendar basis. Don't use the residue leaving pesticides to promote the export of seed spices.
8.	Use cement-concrete threshing yard or tarpaulin during processing of harvesting material.	Harvested material or separated seeds should not be placed directly on the ground.
9.	Dry the seed spices to the optimum level of moisture (<10%) to check microbial growth.	Don't allow dried product to come into contact with moisture and don't store for long duration.

PEST AND DISEASE TOLERANT/RESISTANT VARIETIES OF FENNEL

S.No	Variety	Pest/disease
1.	RF-101	Moderately resistant to blight & powdery mildew.
2.	RF-125	-do-
3.	PF-35 (Guj.)	Tolerant/resistant to Sugary disease, leaf blight, leaf spot
4.	Gujarat Fennel- 1(GF-1) (VC-14-34)	Tolerant/resistant to Sugary disease, leaf blight, leaf spot
5.	S-7-9 (Guj.)	Moderately resistant to leaf blight
6.	S-16	Tolerant to aphids
7.	E-58	Tolerant to aphids
8.	UF-132	Tolerant to aphids

AGRO-ECO-SYSTEM ANALYSIS (AESA)

Agro-eco-system analysis (AESA) is a process which involves periodical (weekly) observations of plant health, plant compensation abilities, ETL, climate factors, change of pest and defenders population and their inter-relationship. AESA can be practiced by more than one group of trained farmers in a village. AESA helps in decision making on management practice required to be adopted at each crop growth stage. AESA technique may be useful in farmer to farmer IPM training programme also.

Method:

A. Field Observations:

- a) Enter the field at least 5 ft. away from the bund. Select a site with a dimensionation of one sq. mt. randomly.
- b) Record the observations in following sequence :
 - i) Flying insects (both pests and defenders)
 - ii) Close observation on pests and defenders which remain on the plants.
 - iii) Observe pests 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.
 - vi) Record species wise weed population/m²
- c) Record in one of the selected plants, parameters like number of leaves, branches, plant height and reproductive parts (plant 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.
- f) Repeat the step (a) to (d) for other randomly selected four sites.
- g) Record the climate factors viz. sunny, cloudy, partly cloudy, rainy etc. for the preceding week.

B. Drawing:

Draw the entire observations in a chart paper with the plant at the centre ; pests on the left side and defenders on the right side. Use natural colours for the drawing. Indicate common names and population of pest and defenders per plant.

C. Group Discussion and Decision Making:

The observation using the previous and current charts should be discussed among the group members by raising relating to change in pest and defenders population, crop stage, etc. The group may evolve a strategy based up on weekly AESA, ETL and corresponding change in P:D ratio and take judicious decision for specific pest management practices.

D. Strategy for Decision Making: (Example)

Some of the defenders like lady beetles, *Chrysoperla*, *Syrphids*, etc. play useful role in arriving at P:D ratio.

1. 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 utilized 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.

2. By Extension Workers:

The extension functionaries during their regular visit to the village mobilise the farmer, conduct AESA and critically analyse the various factors such as the pest population vis-à-vis 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 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.

ANNEXURE -III

BASIC PRECAUTIONS IN PESTICIDE USAGE

A. Purchase:

1. Purchase only JUST required quantity e.g. 100,250,500 or 1000 g/ml for single application in specified area.
2. Do not purchase leaking containers, loose, unsealed or torn bags.
3. Do not purchase pesticides without proper/ approved LABELS.

B. Storage:

1. Avoid storage of pesticides in the house premises.
2. Keep only in original container with intact seal.
3. Do not transfer pesticides to other container.
4. Never keep them together with food or feed/ fodder.
5. Keep away from the reach of children and livestock.
6. Do not expose to sun-light or rain water.
7. Do not store weedicides along with other pesticides.

C. Handling:

1. Never carry/ transport pesticides along with food materials.
2. Avoid carrying bulk - pesticides (dusts / granules) on head, shoulders or on the back.

D. Precautions for Preparing Spray Solution:

1. Use clean water.
2. Always protect your NOSE, EYES, MOUTH, EARS and HANDS.
3. Use hand gloves, face mask and cover your head with cap.
4. Use polyethylene bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover the head (Do not use polyethylene bag contaminated with pesticides).
5. Read the label on the container before preparing spray solution.
6. Prepare spray solution as per requirement.
7. Do not mix granules with water.
8. Concentrated pesticides must not fall on hands etc. while opening sealed containers. Do not smell the sprayer tank.
9. Avoid spilling of pesticide solution while filling the sprayer tank.
10. Do not eat, drink, smoke or chew while preparing solution.
11. The operator should protect his bare feet and hands with polyethylene bags.

E. Equipment:

1. Select right kind of equipment.
2. Do not use leaky, defective equipment.
3. Select right kind of nozzle.
4. Don't blow/clean clogged- nozzle with mouth. Use old tooth- brush tied with the sprayer and clean with water.
5. Do not use some sprayer for weedicide and insecticide.

F. Precautions for applying pesticides:

1. Apply only at recommended dose and dilution.
2. Do not apply on hot sunny day or strong windy condition.
3. Do not apply just before the rains and also after the rains.
4. Do not apply against the wind direction.
5. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV sprayer.
6. Wash the sprayer and bucket etc with soap water after spraying.
7. Containers, buckets etc. used for mixing pesticides should not be used for domestic purposes.
8. Avoid entry of animals and workers in the fields immediately after the spraying.

G. Disposal:

1. Left over spray solution should not be drained in ponds or water lines etc. Throw it in barren isolated area, if possible.
2. The used/ empty containers should be crushed with a stone / stick and buried deep into soil away from water source.
3. Never re-use empty pesticide container for any purpose.
