IPM PACKAGE NO. 50

INTEGRATED PEST MANAGEMENT PACKAGE

FOR

RAJMAH

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 RAJMAH

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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 Progamme 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. Ragunathan)

PREFACE

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

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

I. MAJOR PESTS

A. Pests of National Significance

1. Insect pests:

1.1 Aphids

2. Diseases:

2.1 Common mosaic (Bean common mosaic potyvirus)

2.2 Root rots (*Rhizoctonia* and *Fusarium* spp.)

3. Weeds:

3.1 *Eclipta alba*

3.2 *Echinochloa spp.*

3.3 *Euphorbia sp.*

3.4 *Chenopodium album*

3.5 *Melilotus alba.*

3.6 *Dectyloctenium algyptium*

4. Nematodes:

4.1 Root knot nematodes

5. Rodents:

5.1 Smaller bandicoot

B. Pests of Regional Significance

1. Insect pests:

1.1 Stemfly, *Ophiomyia phaseoli* Tryon - Maharashtra

1.2 Leaf miner, *Melanagromyza trifolii* (Gungess) - Maharashtra, Gujrat

1.3 Blister beetle, *Mylabris macilenta* Marsh - Himachal Pradesh

1.4 Stem boring weevil, *Cypricerces marginatus* F.st. - Himanchal Pradesh

1.5 Pod borer, *Helicoverpa armigera* (Hubner) - Himanchal Pradesh

1.6 Flower beetle, *Popillia cyanea* Hope - Himanchal Pradesh

2. Diseases:

2.1 Anthracnose (*Colletrotrichum lindemuthianum*) – North Himalayan region

2.2 Rust (*Uromyces appendiculatus)* – Southern India

2.3 Angular leaf spot (*Phaeoisariopsis griseola)* – North west and north eastern Himalayan region

2.4 Stem rot (*Sclerotinia sclerotiorum)* - North west and north eastern Himalayan region and Tarai area of Uttranchal and Bihar

3. Nematodes:

1. Lesion nematode
2. *Pratylenchus sp.*

II. PEST MONITORING:

The objectives of pest monitoring is to detect the initial development of pests and also the bio-control agents in the field situations.

1. Rapid Roving Survey:

a. In the beginning of the crop season, survey routes are required to be identified in the pest and disease endemic areas to undertake Rapid Roving Surveys. During survey the observations are to be made at every 5 to 10 kms, distance in the pre-selected route at 7 to 10 days intervals depending upon pest and disease situation. Record the incidence of pests and diseases and defender population at each spot on 5 plants at random. (12 spots per ha.)

b. Root-knot nematodes diagnostic symptoms are "gall" formation on roots. Reniform nematodes produce "dirty roots system."

c. The working index for rodent pests: 25 live burrows/ha/

2. Field Scouting

Based on the observation of Rapid Roving Survey the farmers at village level are to be mobilized 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 al possible efforts by using different media mode and publicity to inform the farmers about field scouting in the specific crop areas having indication of insect 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 situation with regard to pest, 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. Pests and defenders population dynamics
4. Soil conditions

5. Climatic factors
6. Farmers' past experience

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

4. Economic Threshold Level (ETLs)

S. No.	Pest	State of the Crops	Economic Threshold Levels
INSECTS			
1.	Stem fly	Reproductive	5-10% incidence
DISEASES			
2.	Mosaic& root rot	Seedling/vegetative	5-10% plants infested
RODENTS			
3.	Working index	Seedling/vegetative	25 live burrows/ha.
4. NEMATODE			1-2 larvae/g of soil 1 small knot/gall on root system.

III. INTEGRATED PEST MANAGEMENT

A. Cultural Practices

1. Deep ploughing in summer
2. Use of tolerant/resistant varieties
3. Early and timely sowing
4. Use of certified disease free seed.
5. Removal and destruction of infected plant debris.
6. Balanced use of FYM and fertilizers.
7. Early sowing in north Indian hilly region helps reduce angular leaf spot and anthracnose.
8. Crop rotation especially for managing angular leaf spot and rust.
9. Planting in well drained soil.
10. Avoid dense planting.
11. Optimum depth of sowing (5-7cm) to avoid seed rots.
12. Weed free cultivation.
13. Adjust planting time to avoid period of maximum aphid activity in the area.

B. Mechanical Practices:

1. Seeds to be used for sowing must be free from crop residue and sclerotial admixtures.
2. Rogue out virus infected plants.
3. Remove and burn root rot affected plants.

C. Biological Control:

1. Seed treatment with *Trichoderma harzianum, T. viride* or *Gliocladium virens* for the management of seed rots and root rots.
2. Mulching with pine needles or eucalyptus leaves reduces angular leaf spot.
3. Inundative release of *Coccinella septempunctata* @ 1000 adults/4000 sqm. Two releases at 10 days intervals for the management of aphids.

Seed treatment – for Nematodes:

1. *Paecilomyces lilacinus* @ 10^8 spore (Pinch)/kg seed
2. Kalisena (*Aspergillus niger)* @ 10^8 spore (Pinch)/kg seed.

D. Chemical Control:

Insects:

Insecticides	Insects	Dose
*Carbofuran G	Stemfly	0.25 kg a.i./ha
Endosulfan EC	Stemfly	0.07%
*Chlorphyriphos (Seed treatment)	Stemfly	8 ml./ha seed
Phorate (Soil application) G	Stemfly	1.0 kg a.i./ha
*Cypermethrin EC	Stem boring weevil	0.002%
*Carbaryl EC	Stem boring weevil	0.1%
*Fenvalerate EC	Stem boring weevil	0.04%
Endosulfan EC	Stem boring weevil	0.07%
*Monocrotophos EC	Blister beetle	0.04%
*Fenitrothion EC	Blister beetle	0.05%

Diseases:

Chemical	Disease	Dose
Carbendazim	Angular leaf spot	2.5 g/kg seed (Seed Treatment) and 3 foliar sprays (0.1%) starting at the appearance of disease (5-6 weeks after sowing) at 15 days interval.
Benomyl	Do	Do
Mancozeb	Do	Seed treatment and 3 foliar sprays (0.2 – 0.25%) starting at the appearance of disease (5-6 weeks after sowing) at 15 days interval.
*Carbendazim	Seed rot/root rots	2-3 g/kg seed
*Thiram+ Carbendazim (1:2)	Seed rots/ root rots	3 g/kg seed
Mancozeb	Rust	3 foliar sprays (3-4 kg/hac in 1000lit. water), starting at the first notice of disease, at 7-10 days interval.
Sulphur	Do	3 dustings (25-30 kg/hac), starting at the first notice of disease, at 7-10 days interval.

*Carbendazim	Do	0.1 %, 3 foliar sprays, at 45, 60, 75 days after sowing, OR at 15 days interval starting at the appearance of disease
Triadimefon	Do	0.1 %, 3 foliar sprays, at 45, 60, 75 days after sowing OR at 15 days interval starting at the appearance of disease
Carbendazim	Anthracnose	2.5 g/kg seed
*Carbendazim Thiram (1:1)		2.5 g/kg seed
Carbendazim		0.1 %; 2-3 foliar sprays at 45, 60, 75 days after sowing
Ziram		0.2 %; 2-3 foliar sprays at 45, 60, 75 days after sowing
*Ferbam		Do
Mancozeb		0.25 %; 2-3 foliar sprays at 45, 60, 75 days after sowing
*Benomyl	Stem blight	0.1 %, 2-3 foliar spray starting at pre bloom or bloom stage
*Monocrotophos	Aphid vectors of BCMV	0.1 %, 3-4 foliar sprays at 15 days interval starting at 15-30 days after sowing depending on the activity of winged aphids in the area.

Nematodes:

Seed treatment

1. *Chlorpyriphos 20EC @ 0.2%
2. *Monocrotophos 30 EC @ 0.3%
3. *Trizophos 40 EC @ 1%
4. *Dimethoate 30 EC @ 0.2%
5. *Carbosulfan @ 3%

Soil application

1. Carbofuran 3 g @ 1 kg a.i./ha at sowing
2. *Phorate 10 g @ 1 kg a.i./ha

Rodents:

Bromodiolone 0.05%	Rats	10-15 g/burrow to be placed inside the live Burrows.

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* Not approved under the Insecticides Act, 1968 for this crop.

IV. CROP STAGEWISE IPM PRACTICES:

S.No.	Crop Stage	Pest	IPM Component	IPM Practices
1.	Pre-sowing	Root rot Stem rot, Nematode, Pod borer, Broad leaves weeds	Cultural	1. Deep summer ploughing 2. Sowing of pest tolerant/resistant varieties 3. Use disease free certified seeds only. 4. Early sowing. 5. Crop rotation with non-leguminous crops especially cereals. 6. Sowing in well drained soil. 7. Avoid dense planting. 8. Follow optimum sowing depth of 5-7 cm. 9. Application of FYM/Neem or Mahua cake @ 500 kg/ha. 10. Inter-cropping with mustard where nematodes are a problem.
			Biological	1. Seed treatment with *Trichoderma harzianu, T. viride or Gliocladium* virens @ 4-6 g/kg seed for the management of seed rots, root rots and stem rot diseases. 2. Seed treatment with the latex of *Calotropis (madar/AWK)* @ 1 g/kg seed, *Paecilomyces lilacinus* @ 10^8 spore/kg seed or *Aspergillus niger* @ 10^8 spore/kg seed for nematode management.
			Chemical	1. Seed treatment with *Chlorpyriphos @ 8 ml/kg seed for stem fly management or with *Monocrotophos for aphid management at early stage. 2. Seed treatment with Carbendazim/*Carbendazim + Thiram for the management of seed rots/root rots.

				3. Pre-emergence spray of *Pendimethalin @ 0.75-1.0 Kg a.i./ha for the management of weeds. 4. Soil application of *Phorate/Carbofuran @ 1 Kg a.i. /ha for those fields where podfly and nematodes are a problem.
2.	Seed and seedling	Root rots, Nematodes,Stem fly, Anthracnose, BCMV	Mechanical	Rouging of BCMV infected plants
			Cultural	1. Miling with straw/pine needles/eucalyptus leaves.
3.	Vegetative	Root rots, Nematodes, Anthracnose, Angular leaf spot, Stem rot, weeds, Leaf miner, Stem boring weevil, Aphids	Cultural	1. Weeding if required
			Biological	1. Inundative release of *Coccinella septempunctata* for aphid management. Repeat after 10 days.
			Mechanical	1. Rouging of virus infected plants
			Chemical	1. Spraying of 0.05% Carbendazim if anthracnose, angular leaf spot or stem rot infection is noticed. 2. Repeat the spray after 15 days if required. 3. Spraying of 0.07% Endosulfan/0.04% *Fenvalerate or 0.002% *Cypermethrin for stem boring weevil or leaf miner infestation if at ETL.
4.	Flowering and podding	Root rot, Nematodes, Anthracnose, Angular leaf spot, rust, Stem rot, Weeds, Blister beetle, Flower beetles, Pod borer	Cultural	1. Manual weeding
			Mechanical	1. Collect blister beetles & kill them.

			Chemical	1. Repeat the chemical sprays given at vegetative stage for insect pest and diseases management. 2. Spray 0.2% Mancozeb if rust appearance is seen.
5.	Post harvest	Seed borne fungi, Rust, White rot, Anthracnose	Mechanical	1. Collect crop residues from the field after crop harvest and burn them. 2. Clean the seed properly, remove broken or shriveled grains. 3. Dry the seeds properly and store in air light seed bins.

* Not as per approved usage under Insecticides Act, 1968.

Annexure-I

AGRO-ECOSYSTEM 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 dimension of one sq. mt. randomly.

b) Record the 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 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 in one of the selected plants, parameter 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.

e) Observe the live burrows of rodents.

f) Repeat the step (a) to (e) for other randomly selected four sites.

g) Repeat the climate factors viz. sunny, cloudy, partly cloudy, rainy etc. for the preceding week.

B. Drawing

Draw the plant 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 are their population count should also be given alongwith diagram. The weather factors should be reflected inn 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)

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

1. 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 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 mobilize 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-II

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 alongwith 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 polythin bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover head (Do not use polythin 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 purpose.
8. Avoid entry of animals and workers in the fields immediately after the spraying.
9. Anti-cogulant rodenticide should be applied deep inside the rat holes to prevent their intake by non-target animals.

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.
4. Dead rodents should be buried in the soil.