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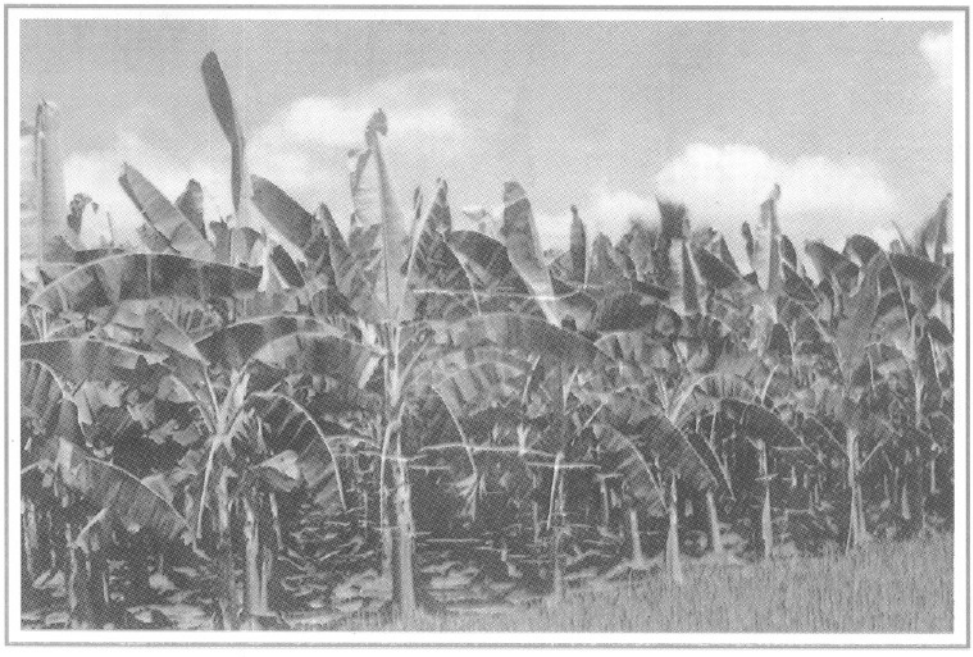
IPM PACKAGE NO. 36

INTEGRATED PEST MANAGEMENT PACKAGE

FOR

BANANA



Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation
Directorate of Plant Protection, Quarantine & Storage
N. H. IV, Faridabad - 121 001.

IPM PACKAGE FOR BANANA

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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 BANANA

I. MAJOR PESTS:

A. Pests of National Significance

1. Insect Pests

1.1 Banana stem weevil, *Odoiporus longicollis*

1.2 Banana corm weevil, *Cosmopolites sordidus*

1.3 Banana leaf and fruit scarring beetle, *Basilepta subcostatum.*

1.4 Banana aphid, *Pentalonia nigronervosa*

1.5 Banana leaf eating caterpillar, *Spodoptera litura*

1.6 Banana lacewing bug, *Stephanitis typicus*

2. Nematodes:

2.1 Burrowing nematode, *Radopholus similis*

2.2 Root-lesion nematode, *Pratylenchus coffeae*

2.3 Spiral nematode, *Helicotylenchus multicinctus*

2.4 Root-knot nematode, *Meloidogyne incognita*

3. Weeds:

3.1 Purple nut sedge/nut grass, *Cyperus rotundus*

3.2 Bermuda grass/Hariyali, *Cynodon dactylon*

3.3 Spiny pigweed, *Amaranthus spionosus*

3.4 Slender pigweed, *Amaranthus viridis*

3.5 Rag weed, *Parthenium hysterophorus*

3.6 Common Purslane, *Portulaca spp.*

3.7 Tridax, *Tridax procumbens*

B. Pests of Regional Significance

1. Insect Pests

1.1 Banana leaf thrips, *Helionothrips kadaliphilus*

1.2 Banana rust thrips, *Chaetanaphothrips signipennis*

1.3 Banana flower thrips, *Thrips hawaiiensis*

1.4 Bagworm, *Kophene cuprea*

2. Nematodes:

2.1 Spiral nematode, *Helicotylenchus dihystera*

2.2 Root-knot nematode, *Meloidogyne javanica*

2.3 Cyst nematode, *Heterodera oryzicola*

3. Weeds:

3.1 Water grass/Barnyard grass, *Echinochloa crusgalli*

3.2 Goose grass, *Eleusine indica*

3.3 Copper leaf, *Acalypha indica*

3.4 Prickly chaff flower, *Achyranthes aspera*

3.5 Mexican prickly poppy, *Argemone mexicana*

3.6 White cockscomb, *Celosia argentea*

3.7 Field bind weed, *Convolvulus arvensis*

3.8 Amaranthus, *Digera arvensis*

3.9 Garden spurge, *Euphorbia hirta*

3.10 Gripe weed, *Phyllanthus niruri*

3.11 Touch-me-not,*Mimosa pudica*

3.12 Cocklebur, *Xanthium strumarium*

C. Diseases of National and Regional importance

1. Fungal diseases

1.1 Wilt (*Fusarium oxysporum* fsp. cubense)

1.2 Mycosphaerella leaf spot diseases

1.3 Yellow sigatoka (*Mycosphaerella musicola)*

1.4 Black sigatoka (*Mycosphaerella fijiensis)*

1.5 Anthracnose (*Colletrotrichum musae)*

2. Bacterial disease

2.1 Tip over or bacterial soft rot (*Erwinia carotovora)*

3. Viral diseases

3.1 Banana bunchy top disease

3.2 Banana bract mosaic

3.3 Banana streak

3.4 Infectious chlorosis

II. PEST MONITORING:

A. Agro-Eco System Analysis (AESA)

The basic components of AESA are:

- Plant health at different stages
- Pest and defender population dynamics
- Soil conditions
- Climatic factors

B. Survey/field scouting

The objective of surveys through roving surveys is to monitor the initial development of pest and diseases in endemic areas. For field scouting farmers should be mobilised to observe the pest and diseases occurrence at the intervals as stipulated. The plant protection measures are required to be taken only when pests and disease cross E.T.L. as per results of field scouting.

- **Roving Survey:** Undertake roving survey in different banana growing areas. In each garden observe 20-25 plants at random. Record the symptoms and damage.

- **Field Scouting:** The State Department of Horticulture should make all possible efforts by using different media, mode and publicity to inform the farmers for field scouting in the specific areas having indication of pest or disease build up.

C. Pest monitoring through traps

The incidence of banana pests can be monitored by keeping/positioning pheromone/pseudostem traps to monitor the pest activity. Therefore, the State Deptt. of Horticulture is to initiate action for laying traps based upon the results of roving survey as well as in new areas. Since the concept needs to be popularised amongst farming community, the State Department of Horticulture is to take greater initiatives for pest monitoring through pheromone trap/pseudostem trap methods.

Pseudostem trap

Longitudinal split pseudostems of thirty cm length can be placed at the banana gardens @ 20 to 350 plants. The split portion should face the ground. After one week, collect the trapped weevil and kill. Renew the trap material weekly. Similarly, disc-on stump can also be tried. This can be kept on the already harvested plants. Cut the pseudostem one foot above the ground level and keep a pseudostem disc over the stump (i.e.) cut portion. Keep few pebbles in between so that entryway is made for weevil. These traps attack both banana corm weevil as well as banana stem weevil. These traps work for monitoring as well as for trapping.

Pheromone trap

Pheromone lure ('Cosmolure') can be used for monitoring as well as trapping of banana corm weevil (BCW). Installing traps at a low trap density (4/ha), would lead to a reduction in corm damage and increase in yields in plantain and banana. Initially placed in a line of 10 metres from a border and 20 metres apart, move the traps 20 metres each month along an axis perpendicular to the trap line in a manner that the existing traps are within the trapping plots.

D. Economic Threshold Levels (ETL's)

Based upon the results of survey/field scouting etc., the extension functionaries are to determine the ETL's for different pests to advise farmers to initiate pest management practices

accordingly. The ETL's for major pests have not been worked out, however, the value mentioned below will help to take up necessary control measures.

S.No.	Insect pest	ETL
1.	Banana Stem Weevil	5% infested plants
2.	Banana Corm Weevil	4 Weevil/trap

III. INTEGRATED PEST MANAGEMENT STRATEGIES:

1. Insect Pest Management:

A. Cultural Practices:

1. Deep ploughing to expose soil inhabiting/stages of insects, pathogens and nematode population.
2. Growing banana after banana should be avoided. Adopt proper crop rotation.
3. Select healthy suckers from infestation free areas.
4. Paring and pralinage.
5. Sucker treatment.
6. Crop should be free from weed upto 3 months.
7. Use trap crops for nematodes (i.e. *Tagetes)*
8. Remove and destroy post-harvest residues.
9. Uproot the corm and cut the corm and pseudostem into larger piece so that the adults and grubs will be killed.

B. Mechanical Practices:

1. Install pheromone and other traps.
2. Check the traps laid and collect the trapped weevil and destroy.
3. Remove the old and dried leaves to avoid population build up of weevils.

C. Chemical Control:

(i) Banana stem weevil:

1. Swabbing of insecticide over the pseudostem with Monocrotophos @ 2ml/litre during 6th and 7th month of planting.
2. If the feeding damage is noticed after 7 months of planting, give stem injection of Monocrotophos (150 ml in 350 ml water) solution @ of 2 ml/plant using stem injector at 30^0 angle in two places, one at two feet height from the ground and the second at four feet, above the ground level.

(ii) Banana corm weevil

1. Soil application of Carbofuran @ 20g/plant during 3rd, 5th & 7th month after planting.

(iii) Banana leaf eating caterpillar

1. Spray Endosulfan @ 1.5 ml/litre.

2. Nematode management:

(i) Burrowing nematode

A. Cultural methods:

1. Fallowing for three months after banana harvest effectively suppressed the burrowing nematode population, while flood fallowing for five months destroyed not only burrowing nematode but also *Fusarium* sp.
2. Oil cakes of Neem, Mahua, Castor, Karanji etc. have shown special potential in reducing the nematodes.
3. Application of neem cake @ 400g/plant one at planting and second after four months reduced the population of *R. similis* and increased the bunch weight.
4. Crop rotation with paddy, sugarcane, green gram, cotton or turmeric suppressed the nematode population and increased he yield.
5. Leaf extracts of *Glyricidia maculata, Ricinus communis, Crotalaria juncea, Glycosmis pentaphylla, Azadiracta indica, Kalanchoe pinnata, Piper betle* and *Moringa oleifera* were lethal to *R. similis*.

6. Inter-cropping of banana with *Crotalaria juncea* was found to reduce *R. similis* with better growth and yield of banana in India.

B. Physical methods

1. Paring the planting material by trimming away necrotic lesions and immersing it in hot water at 50-55^0 C for 30 minutes were effective to render the planting material nematode free.

C. Biocontrol methods

1. The promising biological agents such as *Paecilomyces lilacinus*, VA mycorrhiza, *Glomus fasciculatum* and bacterium, *Pasteuria penetrans* are effective in reducing nematode population in soil and root.
2. Application of neem cake @ 500 g per plant with *G. mosseae* was found to be most effective in reducing the nematode population both in soil and roots of banana.

D. Host plant resistance

1. Pisang batuau, Pisang Jari Buaya , Pisang Edor Kuda, Prata, Mysore, Hybrid SH-3142 (derived from PJB H-15 x SH-1734), Kadali (AA), Pedalimoongil (AAB), Kunnan (AAB), Ey Kunnan (AAB), Ayriankai Poovan (AB), Pisang Seribu (AA), Tongat (AA), Venettu Kunnan (AB), Anaikomban, Yelakkibale, Ayirankai Poovan, Karpuravally and Palayankodan are found to be moderately resistant to nematode infestation.

E. Chemical methods:

1. Paring and treating with Carbofuran @ 1.2g(a.i.)/sucker resulted in low incidence of *R. similis* and highest yield.
2. Sucker dip treatment with Neem oil @ 0.1 and 0.2 per cent for 10 minutes before planting resulted in maximum reduction of nematode population next to paring and pralinage.

3. Application of Carbofuran @ 1 g (a.i)/plant at planting and two more applications at an interval of three months.
4. Complete disinfection is achieved by double paring followed by a dip in *Monocrotophos solution at 0.5% for 30 minutes and drying under shade for 72 hours before planting.

(ii) **Root lesion nematode:**

1. Since both *P. coffeae* and *R. similis* have similar life cycles, feeding habits as well as symptoms produced on roots, control measures suggested for *R. similis* may be followed for *P. coffeae* except in varietal resistance.
2. Application of carbofuran @ 50 g/plant one at the time of planting and two applications at 3 months intervals in cv. Nendran was found to be very effective in reducing the nematode population.
3. Cultivars such as Kunnan, Vennettu Kunnan, Tongat, Pey Kunnan, Then Kunnan, Nattu Poovan, Karpuravalli, Pidi Monthan, Chirapunji and hybrids 74 (Nali x Pisang Lilin), H.21, H.55, H.59, H.5, H. 84, H.89, H.109, H.110 were found tolerant/resistant to P.*coffeae*.

(iii) **Spiral nematode**

1. The control measures of both chemical and non-chemical methods suggested for the control of R. *Similis* may be followed for H.*multicinctus* and *H.dihystera* except the use of varieties.
2. The banana hybrids H.74 (Matti x Pisang Lilin), H.94 (Matti x Tongat), H.100, H. 106, H. 109 (All Matti x Tongat) & cultivars such as Ney Vannan, sirumalai, Peyan, Gross Michel, Karpuravalli, Robusta, Rasthali, Kunnan, Kullan, Vennettu Kunnan are reported to be tolerant/resisant to *H. multicinctus*.
3. Cultivars Pat Kapuria Mendhi, Kathia and Athiakol were reported to be resistant to *H. dihystera* in North Eastern States.

(iv) **Root-knot nematode**

1. The nematode can be controlled by treatment of suckers either by using hot water or chemical before planting as suggested for the control of *R. similis*.
2. The varieties viz. Alaswe, Dakadakan, Inambak, Pastilan, Pugpogon, Miamauli, Paa Dalaga, Sinker, viente Cohol, Patkkapura, Mendi and Kothia were recorded as tolerant/resistnat to *M. incognita*.

(v) **Cyst nematode**

1. Management practices suggested for *R. similis* may be followed.

3. Disease Management

(i) **Wilt**

1. Varieties susceptible to wilt are Rasthali, Karpuravlli, Monthan, Kadalii, Rasakdali, Ney Poovan, Virupakshi etc. Avoid growing these varieties.
2. Growing of paddy or sugarcane once or twice followed by banana for 2-3 cycles
3. Selection of resistant/tolerant varieties such as Robusta, Nendran and Poova for planting in endemic areas.
4. Planting of healthy suckers extracted from healthy plantation.
5. Restricting the movement of infected suckers to clean or non-infested areas.
6. Paring (removal of roots and outer skin of corms) and dipping the suckers for 30 minutes in solution containing *Carbendazim(0.2%) and 0.05% Monocrotophos (2 g of Bavistin + 14 ml of Monocrotophos/litre of water).
7. Uprooting the infected plants and destroying it by burning.
8. Cleaning of implements used in the infested field before using it in other non infested fields to prevent the spread of inoculum to other areas.
9. Providing good drainage facilities during rainy season
10. Drenching of Carbendazim 0.2% solution around the pseudostem at bimonthly intervals starting from five months after planting or injection of corm with 3 ml of 2% *Carbendazim solution (20 g/lit of water) or embedding 50 mg of Carbendazim in a capsule in corm at 5^{th}, 7^{th} and 9^{th} month after planting.

11. Application of powder formualtion of bioagents such as *Trichoderma spp., Pseudomonas fluorescens* and *Bacillus subtilis* @ 15 grams for 4 times once at the time of planting in the planting pits and remaining doses at 3rd, 5th and 7th months after planting around the plants.

(ii) Sigatoka leaf spot

1. Removal and destruction of leaf spot infected leaves.
2. Intercultural operations such as timely removal of sucker, weed free cultivation, improving the drainage conditions and adopting optium fertilizer application decreases the disease severity significantly.
3. Spraying with systemic fungicides like *Propiconazole at 0.05% or with *Carbendazim + Calixin (0.1%) along with few drops of stickers (teepol) during the period of severe diseased condition was found effective in controlling the disease.

(iii) Anthracnose

1. The disease can be effectively managed by avoiding injury to the peel, adopting good cultural practices including removal of dead leaves from the plants, refrigeration of fruits, transporting the fruits in poly ethylene bags and field spraying with 0.2% *Chlorothalonil or 0.15% Prochloroz or *Carbendazim at 0.1% four times at 15 days interval.

(iv) Corm rot/head rot/tip over

1. Generally the disease attack the young plants and causes rotting leading to poor establishment mostly in Cavendish (AAA) and diploid (AA) group of bananas. It occurs in severe form in high rainfall areas and also in alluvial soils.
2. Drenching the soil around the plant with either bleaching powder @ 2g/lit or Emissan @ 1g/lit at an interval of 10-15 days found effective in controlling the disease.

(v) Viral Diseases

The following preventive strategies may contain the spread of disease from infected areas to uninfected areas

1. Selection and planting of disease-free vigorous suckers.
2. Explants used for propagation should be indexed.
3. Production and supply of virus-free plants to banana growers.
4. Rogueing and destruction of virus-infested plants as soon as the symptoms are noticed.
5. Keeping the banana fields and surrounding areas weed free, as certain weeds normally harbour the viruses.
6. Spraying the banana field with systemic insecticides at regular intervals to control the insect vectors.
7. It is necessary to enforce legal restrictions on intra state movement in order to avoid spread of the new banana bract mosaic disease. Presently this disease is widely prevalent in Southern States viz. Tamil Nadu, Kerala, Karnataka and Andhra pradesh. In other states, the incidence is very minimum.

4. Weed management:

A. Cultural practices

1. Repeated deep ploughing, uprooting, drying and collection of weeds at the time of field preparation.
2. Growing of short duration inter crops like legumes during early stages of growth,
3. Mulching of inter spaces with chopped banana leaves, stem and other mulches like black polythene sheets.
4. Effective manual digging operation at monthly intervals can effectively control the weed population during the initial six months of growth.

B. Chemical practices

1. Pre-emergence application of Alachlor @ 9 litres (a.i.)/ha and Gramoxone @ 1.8 litres/ha or Glyphosate @ 1.5 litres/ha after weed emergence will effectively control the monocot weeds.

2. Diuron spray @ 3kg/ha in 1200 litres of water when the plants are 1 or 2 months old is recommended for monocot weeds.

3. Diuron spray @ 3kg/ha in 1200 litres of water when the plants are 1 or 2 months old followed by application of Glyphosate/Gramaxone @ 1.5 litres/ha in 1200 litres of water after 6 months, when the weeds are 2 to 3 inches tall is recommended to control the dicot weeds effectively.

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* Not as per the approved usage under Insecticide Act, 1968

V. STAGE-WISE IPM PRACTICES TO BE ADOPTED FOR BANANA

Pests/diseases	Stage	IPM practices to be adopted
1. Banana stem weevil :	5th month	Install longitudinal split pseudostem (30 cm length) trap to monitor the weevil.
	6th month	Swabbing of insecticide over the pseudostem with *monocrotophos (2ml/litre)
	7th month	If the feeding damage is noticed, give stem injection of *monocrotophos (150 ml in 350 ml water) solution @ 2ml/plant using stem injector at 30^0 angle in two places, one at two feet height from the ground and the second at four feet, above the ground level.
	Post-harvest	Cut the pseudostem into pieces and destroy crop residue. Up root the sucker and cut into pieces and place them in the soil to attack weevil as well as to dry the crop residue.
2. Banana corm weevil :	Pre-planting	Select healthy, infestation free suckers
	Planting	Paring and pralinage. Hot water treatment @ 50-55^0 C for 30 minutes. Dipping sucker in 0.5% *monocrotophos solution for 30 minutes and later drying under shade for 72 hours before planting to kill eggs and grubs of weevil.
	3rd month	Install 'Cosmolure' trap @ 4/ha or Pseudostem, longitudinal split and disc on stump trap
	3rd, 5th & 7th month	Soil application of carbofuran @ 20 g/plant
3. Banana leaf eating caterpillar	3rd - 5th month	Hand pick the eggs mass and destroy
4. Nematodes	Pre-planting	Select healthy, infestation free suckers
	Planting	Paring and pralinage and hot water treatment of suckers
	3rd month	Apply carbofuran @ 40g/plant
	6/7th month	Apply Neem cake @ 500 g/plant

5. Common Diseases	Pre-planting	Selection of wilt and virus free suckers and paring of corms
	At the time of planting	Dipping of pared suckers in *cabendazim (0.2%) for 30-45 minutes
	After planting	Application of biocontrol agents viz., *Trichoderma sp.* @ 15 gm/pit.
	3rd and 6th month after planting	Application of carbofuran granules @ 40 gm/plant.
6. Wilt and viral diseases	Before planting	Select and plant disease-free vigorous suckers.
	After planting	As soon as the symptoms are noticed the affected plants should be uprooted and burnt.
7. Weeds	Before planting	Clean cultivation practices like deep ploughing and uprooting of weeds.
	After planting	Application of pre-emergence weedicide like alachlor @ 9 lit (a.i.)/ha.
	1st month after planting	Growing of legumes like cowpea.
	2nd month after planting	Diuron spray @ 3kg/ha in 1200 lit of water.
		Green manuring of legumes within the field.
	3rd-5th month after planting	Spray of Glyphosate/Gramaxone @ 1.5 litres/ha in 1200 lit of water.
	6th month after planting	Spraying of Glyphosate/Gramaxone @ 1.5 lit/ha in 1200 lit of water.
		Mechanical digging or hoeing.
		No need for weed control due to heavy shade by the leaves.

*Not as per the approved usage under Insecticide Act, 1968

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CROP: BANANA

V. 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	Remove the person from the contaminated environment. 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. Medical aid: Take the patient to the docotr/Primary Health Centre immediately along with the original container, leaflet and label.	Nausea, vomiting, restlessness, tremor, apprehension, convulsions, coma, respiratory failure and death	- 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) intra-venously every four hours.	

ORGANOPHOSPHATE PESTICIDES								
2.	Monocrotophos	Extremely toxic	Bright red	Class I b – Highly hazardous		Mild – anorexia, headache, dizziness, weakness, anxiety, tremors of tongue and eyelids, miosis, 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.	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. 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 ofr phenothiazines. Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.	
CARBAMATES								
3.	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.	- 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. Avoid theophyllin and aminophyllin or barbiturates. 2-PAM and other oximes are not harmful and in fact contra indicated for routine usatge. Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.	
FUNGICIDES								
4.	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.	
5.	Bavistin	Slightly toxic	Green	-do-				
6.	Propiconazole	Moderately toxic	Blue	-do-				
7.	Chlorothalonil	Slightly toxic	Green	-do-				
8.	Prochloraz	Moderately toxic	Blue	Class III – Slightly hazardous				

HERBICIDES								
9.	Alachlor	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.	
10.	Glyphosate	Moderately toxic	Blue	Table 5 – Unlikely to present acute hazard in normal use				
11.	Diuron	Moderately toxic	Blue	-do-				
OTHERS								
12.	Emissan					Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin etc.,	No specific antidote. Treatment is essentially symptomatic.	
13.	Grammaxone							

ANNEXURE - I

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 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 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 burried deep into soil away from water source.
3. Never re-use empty pesticide container for any purpose.

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