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IPM PACKAGE NO. 4

INTEGRATED PEST MANAGEMENT PACKAGE

FOR

SORGHUM

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 SORGHUM

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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)

ACKNOWLEDGEMENTS

The IPM Package of Practices for **Sorghum** crop was discussed and finalised in the National Workshop on IPM held at National Plant Protection Training Institute (NPPTI), Hyderabad during May 14-17, 2001. The technical input received from the following experts is thankfully acknowledged.

I. Chairman, Technical Session : Dr. AD Pawar, Director (IPM), Dte of PPQS, Faridabad

II. Coordinator, Technical Session : Dr. M.P. Misra, Dy. Director (Ent.), Dte. of PPQS, Faridabad

III. Co-chairman, Technical Session : Dr. T.P. Trivedi, Principal Scientist (Ent.) N.C.I.P.M. (ICAR), New Delhi.

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3. Dr. Rajeev Chauhan, Asst. Director, Dte of Agriculture, Bhopal.
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7. Sh. N.K. Mishra, LDC, IPM Div., Dte of PPQS, Faridabad.

IPM PACKAGE FOR SORGHUM

I. Major Pests

A. Pests of National significance.

1. Insect pests

1.1 Shoot fly (*Atherigona soccata*)
1.2 Stem Borer (*Chilo partellus*)
1.3 Midge (*Contarinia sorghicola)*
1.4 White grubs (*Holotrichia consanguinea*)

2. Diseases

2.1 Grain mold (*Fusarium* sp., *Phoma* sp., *Curvulara* sp.)
2.2 Charcoal rot (*Macrophomina phaseolina*)

B. Pests of Regional Significance

1. Insect Pests

1.1 Armyworm (*Mythimna separata*)
1.2 Cutworms (*Agrotis ipsilon*))
1.3 Grasshopper (*Hieroglyphus* sp.)
1.4 Pyrilla *(Pyrilla perpusilla)*
1.5 Shoot bug *(Perigrinus maides)*
1.6 Earhead caterpillars (*Helicoverpa armigera, Eublemma* spp., *Cryptoblabes* spp)
1.7 Earhead bug (*Calocoris angustatus)*

2. Diseases

2.1 Downy mildew (*Peronosclerospora sorghi*)
2.2 Anthracnose (*Collectorichum graminicolum*)
2.3 Loose smut (*Sphacelotheca cruenta*)
2.4 Ergot (*Sphacelia sorghi*)
2.5 Grain Smut (*Sporisorium sorghi*)
2.6 Red leaf spot (*Helminthosporium turcicum*)
2.7 Rust (*Puccinia purpuaca*)

3. **Weeds**

3.1 Dactyloctenium aegyptium
3.2 *Eleusine indica*
3.3 *Echinochloa spp.*
3.4 *Celosia argentea*
3.5 *Portulaca oleracea*
3.6 *Digera arvensis*
3.7 *Trianthema portulacastrum*
3.8 Striga sp.

4. Nematodes

4.1 Reniform (*Pratylenchus spp.)*

5. Vertibrates

5.1 Rodent
5.2 Parrot
5.3 Crow

II. Pest Monitoring

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

1. Rapid Roving Survey

In the beginning of the crop season, survey routes are required to be identified in pest and disease endemic areas to articulate rapid roving surveys (RRS). During the surveys observations are made at 5-10 km distance in the pre-selected routes at 7-10 days intervals depending a pest and disease situation. Record the incidence at pest, disease and defender population at each spot in 5 plants at random.

2. Field scouting

Based on the observations of RRS, the farmers at village level are to be mobilised to motivate for field scouting. During scanty farmers may record pest diseases and defenders population and in 7-10 days in their own fields as per the Agro Eco system Analysis (AESA). The State Deptt. of Agriculture should make all possible efforts by different media and publicity to inform farmers the need for field scouting in specific crop having indication of pest and diseases built up.

3. **Agro Eco System Analysis (AESA)**

AESA is an approach, which can be gainfully employed by extension functionaries & farmers to analysis field situations with regard to pests, defenders, soil condition, plant health, the influence of climatic factors and their inter-relationship growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices. The basic components of AESA are:

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

The details of AESA are given in Annexure I:

4. **Economic Threshold Levels (ETL)**

Pest/disease	ETL
Shoot fly	10% dead hearts
Stem borer	10% plant with damage symptoms
Midge	5 midge/earhead
Earhead caterpillar	2 larvae/earhead
White grub	1 grub/m^2 area
Grain mould	20% incidence of physiological maturity
Nematodes	1-2 nematodes/g of soil
Rodent	15 live burrows/ha.

III. INTEGRATED PEST MANAGEMENT PRACTICES

A. Cultural Practices:

1. Deep summer ploughing, followed by following helps in exposing resting stage of pests.
2. Trimming of bunds and uprooting and destruction of crop residues.
3. Selection of healthy seeds of less susceptible varieties viz. ICSV-192, ICSV-197 against midge, ICSV-745, CSV-10, 11, 13, 15; hybrids CSH-1, 5, 6, SPH 468 against downy mildew and SPV 839 (CSV 14 R) and CSH 13R against charcoal rot..
4. Early planting minimises the chances of shoot fly, midge and ear head bug damage.
5. Planting date in Kharif 7-10 days onset of monsoon and in Rabi end of September to I st week of October is ideal to escape the shoot fly.
6. Maintain plant spacing 45 cm X 15 cm.

7. Use balanced fertilizer @ 80 kg nitrogen, 40 kg K_2O.
8. Removal of grassy types and Johnson grass, is beneficial to reduce the midge population.

B. Mechanical practices :

1. Destroy thrashed sorghum heads before the onset of monsoon for borer and midge control.
2. Use light trap and pheromone traps @ 5 traps/ha.
3. Removal of dead hearts.

C. Biological Control Practices:

1. Conservation

1.1 Conserve biocontrol agents like *Trichogramma, Apanteles, Eriborus,* Carabids, lady bird beetles, *Chrysopa,* spiders, etc.

2. Augmentation

2.1 Seed treatment with *Trichoderma viridi, T. harzianum* @ 4 g/kg against soil borne diseases.

2.2 Release of *Trichogramma chilonis* @ 75,000 adults/ha/week

D. Botanical Pesticides

1. Use neem cake @ 200 kg/ha for the control of Nematode.
2. N.S.K.E @ 5% on panicle to save the damage from birds.

E. Chemical Control Measures:

Need based, judicious and safe application of pesticides are the most vital tripartite segments of chemical control measures under the ambit of IPM. It involves development of IPM skill to play safe with environment by proper crop health, monitoring and conserving natural biocontrol population before deciding in favour of use of chemical pesticides as a last resort.

1. Spraying of the Endosulfan @ 2 ml/lt at 7-14 Days after sowing minimise shoot fly.
2. Application of Malathion 10 D, Phorate 3 G @ 8-12 kg/ha at 20 and 35 days after emergence effectively control the borer.
3. Application of Carbaryl 50 SP @ 20 kg/ha or Endosulfan @472 g a.i./ha prior to flowering openings can effectively check the midge infestation.
4. Spraying of Mancozeb 0.3% or Captan 0.3% from flowering to earhead stage at 10 days interval can control grain mould.

F. **Weed Management Practices**:

1. Summer ploughing for destroying stubles and perennial weeds.
2. Timely sowing of crop to minimise crop weed competition.
3. Proper spacing to facilitate interweeding operation.
4. Two manual weeding 2-3 & 6 weeks after sowing.

G. Nematodes Management Practices

1. Deep ploughing followed by fallowing in summer.
2. Rotation of crop with non host crops
3. Destruction of crop stubbles and residues.

H. **Rodent Management Practices**

1. Bund trimming to minimise rodent harbourage.
2. Demolish the existing rodent burrows.
3. Use of indigenous traps.
4. Apply 2.5% (1:40) zinc phosphide bait preceded by one day prebaiting followed by bromodiolone (0.005%).

IV. Crop Stage wise IPM Practices

Stage	Pest	Practices
Pre-sowing	Resting stage of Insects, diseases causing spores, Nematode	- Deep summer ploughing followed by fallowing. - Adoption of crop rotation - Application of neem cake @ 200 kg/ha for Nematode control - Destruction of crop residues - Collection and destruction of white grub stages - Selection of tolerant varieties - Early planting minimising the chances of bug damage
Seedling	Shoot fly	- Spraying of Endosulfan @ 2 ml/lt at 7-14 days after sowing
Vegetative	Stem borer	- Removal and destruction of dead hearts - Release of *Trichogramma chilonis* @ 75,000 /ha/week - Application of Malathion 10 g, Carbofuran 3 G @ 8-12 kg /ha at 20-35 days after emergence.
Flowering to heading	Midge	- Application of Carbaryl 50 SP @ 20 kg/ha or Endosulfan @ 472g a.i./ha prior to flower openings - Apply NSKE 5% on panicle to save the damage from birds - Removal of Johnson grassy weed.
	Grain mould	- Spraying of Mancozeb 0.3% from flowering to earhead stage at 10 days interval
	Bird	- Use of bird scarer.

CROP: SORGHUM

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.	Malathion	Moderately toxic	Blue	Class III – Slightly 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	
3.	Phorate	Extremely toxic	Bright red	Class I a – Extremely hazardous				

							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								
4.	Carbaryl	Highly toxic	Yellow	Class II – Moderately 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								
5.	Carboxin	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.	
6.	Captan	Slightly toxic	Green	-do-				

ANNEXURE-I

Agro-Eco System Analysis (AESA)

AESA is an approach, which can be gainfully employed by extension functionaries & farmers to analysis field situations with regard to pests, defenders, soil condition, plant health, the influence of climatic factors and their inter-relationship growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices. The basic components of AESA are:

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

The methodology of AESA is as under:-

A. **Field Observations:-**

a) Enter the field at least 5 ft. away from the bund. Select a site with a dimension of 1 sq. mt. Randomly.

b) Record the visual observations in following sequence:-

   i) Flying insects (both pests & defenders)
   ii) Close observation on pests and defenders which remain on the plants.
   iii) Observe pests like *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 center on a chart. Then draw pest 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 cloour, diseased plant/leaves with yellow colour. While drawing the pests and the defenders on the chart care should be taken to draw them at appropriate part of the plant, where they are seen at the time of observation the common name of pest and defenders and their population count should also be given along with diagram. The weather factor should be reflected in the chart by drawing the diagram of sun just above the plant if the attribute is sunny. If cloudy, the clouds may be drawn in place of sun. In the case of partially sunny, the diagram of sun may be half masked with clouds.

C. **Group Discussion and decision making:**

The observations recorded in the previous and current charts should be discussed among the farmers by raising questions relating to change in pest and defender population in relation to crop stage, 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.

AESA BY EXTENSION FUNCTIONARIES:

The extension functionaries during their regular visit to the village mobilise the farmers, conduct AESA and critically analyze the various factors such as the pest population viz-a-viz defender population and their role in natural suppression of the pest, the influence of prevailing weather condition/soil conditions on the likely build up of defender/pest population, they may also take the decision based on the AESA, which IPM components like release of defenders, application of neem formulations/safe pesticides are to be used for specific pest situation. Such an exercise may be repeated by the extension functionaries during every visit to the village and motivate the farmers to adopt AESA in their fields.

AESA BY FARMERS:

After a brief exposure during IPM demonstrations/field trainings, farmers can practice AESA in their own fields. Wherever trained farmers are available their experience could be utilised in training their fellow farmers fin their own villages. There is 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.

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 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.

1. 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.

Prepare spray solution [illegible]

Do not mix granules with water.

Concentrated pesticides must not fall on hands etc. while op[illegible]

containers. Do not smell the sprayer tank.

Avoid spilling of pesticide solution while filling the sprayer tank.

. Do not eat, drink, smoke or chew while preparing solution.

1. The operator should protect his bare feet and hands with polyethylene bags.

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