सत्यमेव जयते

INTEGRATED PEST MANAGEMENT PACKAGE FOR RICE

Government of India
Ministry of Agriculture, Department of Agriculture & Cooperation
Directorate of Plant Protection, Quarantine & Storage
CGO Complex, NH IV, Faridabad
Haryana- 121001

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Cover picture : Healthy crop of Rice

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FOREWORD

Intensive agricultural practices relying heavily on chemical pesticides are a major cause of wide spread ecological imbalances resulting in serious problems of insecticide resistance, pest resurgence, pest replacement and pesticide residues. There is a growing awareness world over of the need for promoting environmentally sustainable agriculture practices.

Integrated Pest Management (IPM) is a globally accepted strategy for promoting sustainable agriculture. There is a conscious shift from the reliance on economic threshold level and chemical pesticides driven approaches in the past to more ecologically sustainable Agro-Eco System Analysis (AESA) based IPM strategies. These focus on the relationship among various components of an agro-ecosystem with special focus on pest-defender dynamics, innate abilities of plant to compensate for the damages caused by the pests and the influence of abiotic factors on pest buildup. In addition, Ecological Engineering for pest management - a new paradigm to enhance the natural enemies in an agro-ecosystem, is being considered as an important strategy.The ecological approach stresses the need for relying on bio intensive strategies prior to use of chemical pesticides.

Sincere efforts have been made by resource personnel to incorporate AESA based principles and field proven technologies for guidance of the extension officers to educate, motivate and guide the farmers to adopt AESA based IPM strategies, which are environmentally sustainable. I hope that these IPM packages will be relied upon by various Central and State government functionaries involved in extension and Scientists of SAUs and ICAR institutions in their endeavour to promote environmentally sustainable agriculture practices.

A Srivastava

(Avinash K. Srivastava)

PREFACE

Pests are major biotic constraints to achieve self sufficiency in ensuring food security. Losses due to pest vary range 10-30% depending upon the genetic constituent of crop, its health and the governing environment. General national estimate of annual crop losses due to pest amounts to ₹ 260000 million per year. However, negligence of endemic areas can result in complete crop failures. In view of inefficacy of chemical pesticides and environmental problems thereof, Integrated Pest Management (IPM) has been accepted as a cardinal principle of Plant Protection in the overall Crop Protection Programme under the National Agricultural Policy of the Govt. of India. IPM being an eco-friendly approach, socially acceptable and economically viable has been widely accepted across the country. The IPM package encompasses various management strategies for pest and disease problems. Pest monitoring is also one of the important components 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 level (ETL) of important pests and diseases are also given in the package to activate appropriate control measures on standing crops.

The existing package and practices was developed way back in 2001-02 by DPPQ & S, Faridabad catering the need of extension personals in extending IPM tactics to farmers. Though these were useful, there is a need to update them in view of changing climate and its impact on pests and their protection measures.

A National Workshop on IPM for harmonization of Package of Practices was organized at the National Centre for Integrated Pest Management, New Delhi, during 25-26th Feb., 2013 with a view to provide technical knowledge to the extension functionaries and farmers in the States. The IPM package has been developed with the technical inputs from the experts from the PI (AICRIP), Indian Council of Agricultural Research (NCIPM), State Agricultural Universities, and DPPQ & S, Faridabad.

It 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. These packages will be useful for the researchers, extension workers and farmers alike who are engaged in the agricultural practices.

Editors

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1. Introduction

Integral India has the largest area under rice cultivation in the world (44.6 million hectares) and ranks second in production (104.31million tonnes in 2011-12). In India, Rice is grown under different agro ecological conditions viz., water logged, deep water, hills, high humidity, high temperatures, salinity, alkalinity and flood prone areas. The cropping intensity differs from one environment to the other with a maximum of three rice growing seasons in a year in the fertile deltaic regions due to availability of continuous irrigation. The rice crop is prone to stress throughout the crop growth period due to onslaught from different pests such as insects, nematodes, diseases, weeds and rats. Adoption of integrated pest management (IPM) strategies is the best solution to tackle the pest problems. Rice IPM provides a framework for integrating knowledge, skills and information on rice pest management. An IPM practice in rice production initiatives includes regular pest monitoring, research on the optimal use of pesticides, complementary weed control strategies, and alternative cultural and biological controls. In this regard, several efforts have been made to develop, verify, demonstrate and document location specific IPM technologies suited to different ecosystems. Since IPM is a dynamic process, therefore, it needs continuous up gradation of the technology as per the changing pest scenario. To achieve the target of increasing the productivity levels to meet the future demand, it requires adoption of modern and intensive agricultural practices by the farmers. However, concomitant with the practice of intensive agriculture, there is aggravation of biotic constraints like insect pests, diseases and weeds. More than 100 species of insects have been recorded as pest of rice, of which about a dozen are of significance in India. The co-ordinated network trials conducted at different centres in India have indicated that controlling of insect pests alone increase yield by around 1 ton /ha. The diseases of rice accounts for about 10% loss in rice production annually or approximately 2.5 million tons. Even if the average loss caused by rice disease in a year were to be only 5% of the total rice production in the country, it would amount to a great deal, and prevention of such a loss should constitute one of the important methods of augmenting our food security.

2. BIOTIC CONSTRAINTS

2.1. Major Insect Pests: National Significance

1. Yellow stem borer (*Scirpophaga incertulas* Walker)
2. Brown plant hopper (*Nilaparvata lugens* Stal) and White backed plant hopper (*Sogatella furcifera* Horváth)
3. Leaf folder (*Cnaphalocrocis medinalis* Guenée)
4. Gundhi bug (*Leptocorisa acuta* Thunberg)
5. Gall midge (*Orseolia oryzae* Wood-Mason)

2.2. Major Insect Pests: Regional Significance

1. Termite (*Odontotermes obesus* Rambur) - In rainfed upland areas, irrigated rice-wheat system.
2. Swarming caterpillar (*Spodoptera mauritia* Boisduval) - Odisha, West Bengal, Jharkhand, Chhattisgarh and Punjab.

3. Rice Hispa (*Dicladispa armigera* Oliver) - Bihar, West Bengal, Assam, Odisha, Meghalaya, Mizoram, Tripura, Punjab, Himachal Pradesh, Uttar Pradesh and Uttarakhand.
4. Climbing cutworm/Rice Ear Cutting Caterpillar/ Armyworm (*Mythimna separata* Walker) - In coastal rice growing areas, Haryana, Punjab and Uttar Pradesh.
5. Caseworm (*Nymphula depunctalis* Guenée) - In low lying and water logged areas in eastern India.
6. Thrips (*Stenchaetothrips biformis* Bagnall) - In upland rice in Odisha, Andhra Pradesh, Madhya Pradesh, Punjab, Haryana, Assam and Tamil Nadu.
7. Mealy bug (*Brevennia rehi* Lindinger) - In upland rice in Uttar Pradesh, Bihar, West Bengal, Odisha, Madhya Pradesh, Tamil Nadu, Kerala, Pondicherry and Karnataka.
8. Panicle mite (*Steneotarsonemus spinki* Smiley)-Andhra Pradesh, Odisha, West Bengal, Gujarat and Western Uttar Pradesh and Leaf mite (*Oligonychus oryzae* Hirst) –Eastern India and Andhra Pradesh.
9. Root weevil (*Echinochemus oryzae* Marshall) - Haryana, Punjab and Tamil Nadu.
10. White grub (*Holotrichia* spp.) - Hill rice.
11. Black bug (*Scotinophara coaractata* Fabricius) -Andhra Pradesh, Tamil Nadu and Kerala.
12. Blue beetle (*Leptisma pygmaea* Baly) - Kerala, Maharashtra and Tamil Nadu.

2.3. Major Diseases of National Significance

1. Rice blast (*Pyricularia oryzae* Cavara)
2. Bacterial leaf blight (*Xanthomonas campestris* pv *oryzae* (Ishiyama Swings *et al.*))
3. Sheath blight (*Rhizoctonia solani* J.G. Kühn)
4. False smut (*Ustilaginoidea virens* (Cooke) Takah)
5. Brown spot (*Helminthosporium oryzae* Hiroë)

2.4. Major Diseases of Regional Significance

1. Sheath rot (*Sarocladium oryzae* Sawada, W. Gams & D. Hawksw.)
2. Bakanae (*Gibberella fujikuroi* Nirenberg)
3. Stem rot (*Sclerotium oryzae* Catt., R.A. Krause & R.K. Webster)
4. Rice Tungro Virus

2.5. Major Nematodes of National Significance

1. Root knot nematode (*Meloidogyne graminicola* Golden & Birchfield)
2. White tip nematode (*Aphelehchoides besseyi* Christie)

2.6. Major Nematodes of Regional Significance

1. Ufra (*Dilylenchus angustus* Buther) - West Bengal, Assam and Tripura.
2. Rice root nematode (*Hirschmanniella oryzae* van brede de Haan) - Odisha, West Bengal, Bihar and Andhra Pradesh.

3. Cyst nematode (*Heterodera oryzae* Luc & Berdon) - in Kerala only.
4. Root lesion nematode (*Pratylenchus indicus* Das) - Upland and in SRI system, Odisha and Jharkhand.

2.7. Major Weeds of National Significance

1. *Echinochloa crusgalli (L.)* (Beauv)
2. *Cyperus rotundus* (L.)
3. Weedy rice (*Oryzae* spp., wild rice)

2.8. Major Weeds of Regional Significance

1. *Commelina bengalensis* (L.)
2. *Eclipta alba* (L.)
3. *Ischaemum rugosum* (Salisbury)
4. *Eleusine indica* L.(Gaertn)
5. *Amaranthus spinosus* (L.)
6. *Monochria vaginalis* (Burm.f., C.Presl ex Kunth)
7. *Digitaria sanguinalis* (Scop)
8. *Fimbristylis littoralis* (Vahl)
9. *Leersia hexandra* (Sw.)
10. *Leptochloa chinenesis* (L.)
11. *Paspalum* spp.
12. *Brachiaria* spp.
13. *Panicum* spp.
14. *Marsilea quadrifoliata* (L.)
15. *Oxalis latifolia* (Kunth)

2.9. Major Rodents of Regional Significance

1. Smaller bandicoot (*Bandicota bengalensis* Gray)
2. Soft furred field rat (*Millardia meltada* Gray)
3. Indian gerbil (*Tatera indica* Lataste)
4. Field mice (*Mus* spp.)

3. IPM Approach

There are over seventy two (72) definitions of IPM, issued by governments, research organizations, NGOs, and universities (Bajwa and Kogan, 2002). Some assume that IPM will eliminate the use of crop protection products, specially the chemical pesticides, which is most unlikely. Extreme views equating IPM with "pest free" farming will become increasingly marginalised and more balanced views will prevail. There is no reason not to support IPM as defined by the FAO International Code of Conduct on the Distribution and Use of Pesticides (Article 2): *Integrated Pest Management (IPM) means a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in a compatible manner as possible and maintains the pest populations at levels below those causing economically unacceptable damage or loss* (FAO, 1967). Thus, IPM is the best combination of cultural, biological and chemical measures that provides the most cost-effective, environmentally sound and socially acceptable method of managing diseases, insects, weeds and other pests.

IPM is a knowledge-intensive sustainable approach for managing pests by combining compatible cultural, biological, chemical, and physical tools in a way that minimizes economic, health, and environmental risks with the help of pest scouts. IPM relies heavily on knowledge of pests and crop interaction to choose the best combination of locally available pest management tools (Fig. 1). Therefore, IPM is not a single product that can be stored on shelves like pesticide, and it does not rely on single method to solve all our pest problems. Pests also co-evolve and adapt very quickly to single control tactics through natural selection, and that multiple methods used simultaneously, or an "integrated" approach, is the most effective for long-term, sustainable management programs.

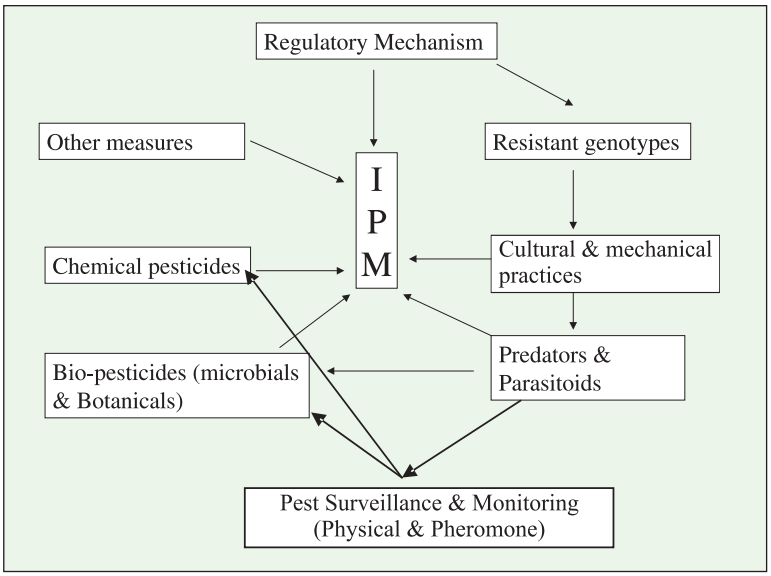


Fig 1. Diagrammatic representation of IPM components.

IPM is neither organic nor it relies solely on biological control to achieve the desired sustainable outcome. It does often try to assist and augment the efficacy of natural enemies by limiting the impact of pesticide on their populations and provide clean and safe niche. It seeks to conserve balance between the crop and the natural environment. The World Bank policy (OP 4.04 - Natural Habitats) also promotes the conservation of natural habitats, and enhancement of the environment for long-term sustainable

development. In the IPM concept, use of pesticides involves a trade-off between pest control and the risks of adverse effects on non-target organisms, such as natural enemies, pollinators, wildlife, and plants, contamination of soil and water.

3.1 Pest Monitoring:

a. Survey/Field Scouting

The objective through roving surveys is to monitor the initial development of pests in endemic areas. Therefore, in the beginning of crop season survey routes based upon the endemic areas are required to be identified to undertake roving surveys. Based upon the results of the roving surveys, the state extension functionaries have to concentrate for greater efforts at block and village levels as well as through farmers to initiate field scouting. Therefore, for field scouting farmers should be mobilised to observe the insect pest and disease occurrence at the intervals as stipulated hereunder. The plant protection measures are required to be taken only when insect pests and diseases cross Economic Threshold Level (ETL) as per results of field scouting.

1. **Roving survey:** - Undertake roving survey at every 10 km distance at 7-10 days intervals (depending upon pest population). Everyday at least 20 spots should be observed.
2. **Field scouting:** - Field scouting for pests and bio-control fauna by extension agencies and farmers once in 3-5 days should be undertaken to workout ETL.

b. Pest monitoring through pheromones/light traps etc.

Majority of insects population can be monitored by fixing and positioning of pheromones or light traps at appropriate stage of crop. The State Department of Agriculture can initiate this action at strategic locations at village level as per the following details:

1. **Pheromone trap-monitoring** - 5 traps per ha may be used to monitor yellow stem borer and moth population.
2. **Light trap** - Chinsurah light trap or any other light trap can be operated for two hours in the evening to observe photo-tropic insect pests.
3. **Sweep-nets - water pans** - Besides visual observations sweep-nets and water pans may also be used to assess the population of insect pests, and biocontrol agents to determine the type of pesticides to be recommended or used.

3.1.1. Agro Eco System Analysis (AESA)

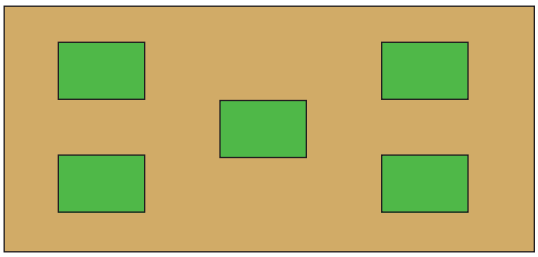
IPM has been evolving over the decades to address the deleterious impacts of synthetic chemical pesticides on environment ultimately affecting the interests of the farmers. In modern IPM (FAO, 2002) emphasis is given to Agro Eco System Analysis (AESA) where farmers take decisions based on larger range of field observations. The health of a plant is determined by its environment which includes physical factors (i.e. sun, rain, wind and soil nutrients) and biological factors (i.e. pests, diseases and weeds). All these factors can play a role in the balance which exists between herbivore insects and their natural enemies. Understanding the intricate interactions in an ecosystem can play a critical role in pest management.

It is an approach, which can be gainfully employed by extension functionaries and farmers to analyse field situations with regard to pests, defenders, soil conditions, plant health, the influence of climatic factors and their interrelationship for growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practice. The basic components of AESA are

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

AESA Methodology

Field observations on insect pests and diseases are to be initiated after 20 days of transplanting. In each field select five spots randomly as shown in the figure (four in the corner, at least 5 feet inside the border and one in the centre). At each spot select four hills randomly for recording observations (Total 20 hills/field).



Data recording

Farmers should record data in a notebook and drawing on a chart

- Keep records of what has happened
- Help us making an analysis and draw conclusions

Data to be recorded

- **Plant growth (weekly)**
  - Height of hill
  - Number of tiller per hill
  - Number of leaves
- **Crop situation (e.g. for AESA)**
  - Plant health: Observe the crop stage and deficiency symptoms etc
  - Pests, diseases, weeds: Count insect pests at different places on the plant, and identify any visible disease symptoms and severity. Observe weeds in the field and their intensity. For rats, count number of plants affected by rats.
  - Natural enemies: Count parasitoids and predators
  - Soil condition
  - Irrigation
  - Weather conditions
- **Input costs**
  - Seeds
  - Fertilizer
  - Pesticides
  - Labour
- **Harvest**
  - Yield (kg/ha)
  - Price of produce (₹/kg)

Important instructions while taking observations

- While walking in the field, manually collect insects in plastic bags. Use a sweep net to collect additional insects. Collect plant parts with disease symptoms.
- Find a shady place to sit as a group in a small circle for drawing and discussion.
- If needed, kill the insects with some chloroform (if available) on a piece of cotton.
- Each group will first identify the pests, defenders and diseases collected.
- Each group will then analyze the field situation in detail and present their observations and analysis in a drawing (the AESA drawing as shown in MODEL AESA CHART.
- Each drawing will show a plant/hill representing the field situation. The weather condition, water level, disease symptoms, etc. will be shown in the drawing. Pest insects will be drawn on one side. Defenders (beneficial insects) will be drawn on another side.
- Write the number next to each insect. Indicate the plant part where the pests and defenders were found. Try to show the interaction between pests and defenders.
- Each group will discuss the situation and make a crop management recommendation.
- The small groups then join each other and a member of each group will now present their analysis in front of all participants.
- The facilitator will facilitate the discussion by asking guiding questions and makes sure that all participants (also shy or illiterate persons) are actively involved in this process.
- Formulate a common conclusion. The whole group should support the decision on what field management is required in the AESA plot.
- Make sure that the required activities (based on the decision) will be carried out.
- Keep the drawing for comparison purpose in the following weeks.

Pest: Defender ratio (P: D ratio):

Identifying the number of pests and beneficial insects helps the farmers to make appropriate pest management decisions. Sweep net, visual counts etc. can be adopted to arrive at the numbers of pests and defenders. The P: D ratio can vary depending on the feeding potential of natural enemy as well as the type of pest. The P: D ratios for yellow stem borer are given below.

Sr. No.	Predator	Predator :YSB Ratio
1.	Carabid beetle	5 : 1
2.	Mirid bug	3 : 1
3.	Reduviid bug	6 : 1
4.	Wolf spider	15 : 1
5.	Lynx spider	2 : 1
6.	Jumping spider	8 : 1
7.	Dwarf spider	4 : 1
8.	Long jawed spider	2 : 1
9.	Long horned grass hopper	3 : 1
10.	Ear wig	20 : 1
11.	Wasp	30 : 1
12.	Preying mantid	4 : 1

Model AESA chart

Date: ..... Village: ..... Farmer:.....

Courtsey: NIPHM, Hyderabad

Soil condition :

Weather condition :

No. of insect pests :

No. of natural enemies :

Diseases types and severity :

Weeds types and intensity :

Rodent damage (if any) :

For the success of Integrated Pest Management pest monitoring, prevention (Cultural and genetic) and timely intervention (Biological or chemical) are the key components.

3.1.2. ECONOMIC THRESHOLD LEVEL (ETL) OF MAJOR PESTS OF RICE CROP STAGE WISE

Crop stage	Pest/Disease	Economic Threshold Level (ETLs)
Nursery	Yellow stem borer	1 egg-mass/m^2
	Root-knot nematode	1 nematode/g soil
	BLB: Kresek Phase	2-3 plants/m^2
Early to late tillering	Leaf-folder	2 Fully damaged leaves (FDL) with larva/hill
	Stem borer	2 egg-mass/m^2 or 10% dead heart or 1 moth/m^2 or 25 moths/ trap/week
	Gall midge	1 gall/m^2 or 10% Silver shoot
	Brown planthopper/WBPH	10-15 hoppers/hill
	Rice hispa	2 adults or 2 dead leaf /hill
	Rice caseworm	2 FDL/hill
	Swarming caterpillar	1 damaged tiller/hill or 2 larvae/ m^2
	Foliar blast	3-5 lesions/leaf
	Brown spot	2-3 spots/leaf & 2-3 infected plants/ m^2
	Sheath blight	Lesions of 5-6 mm in length & 2-3 infected plants/m^2
	Sheath-rot	Lesion length 2-3 mm on sheath & 3-5 infected plants/ m^2
	BLB	2-3 infected leaves/m^2
	Tungro	1 Tungro infected plants/m^2 & 2 GLH/hill (in fungus endemic areas)
Panicle initiation to booting	Stem borers	2 egg-mass/m^2 or 1 moth/m2 or 25 moths / trap / week
	Leaf-folders	2 FDL/hill
	BPH/WBPH	15-20 hoppers/hill
	Swarming caterpillar/cut worm	1 damaged tiller/hill or 2 larvae/ m^2
	Neck blast	2-5 neck infected plants/m^2
	Sheath-rot	5 infected plants/m^2
Flowering to milky grain	Gundhi bug	2 bugs/hill
	Rice panicle mite	No ETL[1]

1 If mite appeared in previous season, it requires prophylactic control measures in the current season.

3.2. Cultural Practices

a. Raise pre-crop *kharif* grow *Sesbania* or sunhemp and incorporate 45 days old crop in soil during land preparation wherever possible.

b. Select suitable resistant or moderately resistant variety.

c. Use disease and insect free pure seed.

d. Seed treatment (for diseases) with carbendazim 50% WP @ 2 g/kg seed or *Trichoderma/Pseudomonas* @ 5-10 g/ha of seed for seed or soil borne diseases and carbosulfan 2 g/kg of seed for root nematodes or as per local recommendations. In termites endemic areas, seed treatment with chlorpyriphos 20% EC @ 10000 ml/ha along with 10% solution of gum arabica or imidacloprid 200 SL (20%) @ 0.25 litre/100 kg seed along with 10% solution of gum Arabica in 3.75 litre of water just before sowing.

e. Timely planting/sowing.

f. Pre-sowing irrigation: Many weeds can be controlled by applying pre-sowing irrigation to area where nursery or seedlings are to be transplanted. The emerged weeds can be ploughed under.

g. Raising of healthy nursery.

h. As far as possible rice seedling should be free from weed seedlings at the time of transplanting.

i. Destruction of left over nursery, removal of weeds from field and cleaning of bunds.

j. Normal spacing with 30-36 hills/ m^2 depending on the duration of the variety.

k. 30 cm alley formations at every 2.5 to 3 m distance in plant hopper and sheath blight endemic areas.

l. Balanced use of fertilizers and micro-nutrients as per local recommendations. Proper water management (alternate wetting and drying to avoid water stagnation) in plant hopper, bacterial blight and stem rot endemic areas. Maintain a thin layer of water on soil surface to minimize weed growth.

m. In direct sown rice, the crop should be sown in lines at recommended spacing to facilitate inter-weeding operations. Mechanical methods of weed should be practiced after 2-3 weeks and second time if necessary after 4-6 weeks of sowing.

n. Harvest close to ground level to destroy insect pest present in the internodes/stubbles. This will also expose the insects to birds thus help in natural biocontrol of insect pests.

o. After harvest, the fields should be thoroughly flooded with water and ploughed with discs or rotators to kill hibernating larvae of stem borer present in the stubbles. Summer ploughing of fields also expose larvae and pupae of rice swarming or ear cutting caterpillar (climbing cutworm) hidden in the soil to birds and weather factors.

Important cultural practices reducing insect pests incidence

S. No.	Insect Pest	Cultural Practices
1.	**Caseworm** (*Nymphula depunctalis)*	• Rice fields with wider hill spacing (30 x 20 cm) usually suffers less damage from caseworm. • Early planting may escape the peak caseworm moth activity period. • Draining of fields for 5-7 days kills caseworm larvae. • Use of older seedlings reduces the duration of the susceptible stage of the crop. • Nitrogen fertilizer use at optimal dosages and split applications reduce the rice caseworm's abundance.

S. No.	Insect Pest	Cultural Practices
2.	**Whorl maggot** (*Hydrellia philippina)*	• Adult flies are more attracted to standing water. Therefore, by draining the water at 3-4 days intervals during the first 30 days after transplanting, egg lying is reduced. • Covering the water surface with Azolla and Salvinia molesta prevents rice whorl maggot infestation. • Direct-seeded rice is not as attractive to adults as a transplanted rice crop is. • Fields with higher plant density suffers less damage. • Close planting decreases oviposition and subsequent damage
3.	**Gall midge** *(Orseolia oryzae)*	• Plowing under the ratoon of previous crops can reduce infestation. • Control of grassy weeds and wild rice (alternate hosts) from surrounding areas can reduce gall midge incidence. • Draining of rice fields for 5-7 days affects midge populations. • Planting of early and using early maturing varieties may help to avoid high infestations. • Using only moderate amounts of nitrogen and potassium fertilizers and adopting split applications to reduce population growth rates. • Avoiding staggered planting (complete planting in an area within 3 weeks) to reduce infestation.
4.	**Rice hispa** *(Dicladispa armigera)*	• Clipping and destruction of the top three-fourths of the leaves of highly infested crops with eggs and grubs at the early vegetative stage can suppress populations. • Sustained collection of adults by sweep net and destruction suppress populations and reduces damage. • The removal of rice ratoons and volunteer rice during the crop-free season affects the rice hispa's survival and multiplication of over-wintering populations. • In situations of high hispa incidence, skip nitrogen fertilizer top-dressing. Note that top- dressing after the pest is controlled can enhance recovery.
5.	**Rice leaf folders** *(Cnaphalocrocis medinalis)*	• Early planting may help to avoid greater degrees of leaf damage. • Wider spacing (22.5 x 20 cm and 30 x 20 cm) and low usage of nitrogenous fertilizers decreases leaf damage. • Highly fertilized plots seem to attract females for oviposition. Therefore, it is advisable to avoid over-fertilization. • Egg predators (crickets) inhabit surrounding grass habitats and move to the field at night for predation. Maintenance of non-rice habitats might be worthwhile. • Higher damages will occur in shaded areas. Therefore, remove the causes of shading within the field.
6.	**Yellow stem borer** *(Scirpophaga incertulas)*	• Clipping the tips of seedlings before transplanting greatly reduces the carryover of eggs from the seedbed to the transplanted fields • Rice varieties with short stature and shorter growth duration periods suffer less damage than long growth duration varieties. • Rice – rice with shorter growth duration varieties suffer less damage than long duration varieties. This may be because of stem-borer mortality due to harvests occurring twice in the double cropping system. • Community-wide destruction of diapausing larvae (in stubble) through tillage after harvest, followed by flooding, reduces stem borer populations resulting in low incidence in the next crop.

S. No.	Insect Pest	Cultural Practices
		• Planting or seeding times may be delayed to avoid the peak emergence of moths from the diapausing populations. • Rice seedbeds may be used as a trap crop for moths emerging from diapause.
7.	**Green leafhoppers** *(Nephotettix cincticeps)*	• Reducing the number of rice crops to two per year and synchronized establishment across farms reduces leafhoppers and other insect vectors of rice virus or phytoplasma diseases. • Transplanting older seedlings (>3 weeks) also reduces viral disease susceptibility transmitted by leafhoppers. • Avoid planting at peak activity (shown by historical records) period to avoid infestation. • Early planting within a given planting period, particularly in the dry season, reduces the risk of insect-vector disease. • Nitrogen should be applied at an optimal level to discourage population build-up and influence plant recovery. • Good weed control in the field and on the bunds removes the preferred grassy hosts and promotes crop vigor. • Crop rotation with a non-rice crop during the dry season decreases disease reservoirs. • Upland rice intercropped with soybean reduces the incidence of leafhoppers on rice compared to rice alone.
8.	**Brown planthopper** *(Nilaparvata lugens)*	• High dosages of nitrogenous fertilizers, close spacing, and high relative humidity increases planthopper populations. • Sensible use of fertilizer by splitting nitrogen applications can also reduce chances of plant hopper outbreaks. • Draining rice fields can be effective in reducing initial infestation levels. The field should be drained for 3 - 4 days when heavy infestations occur. • Growing no more than two crops per year and using early-maturing varieties reduces planthopper abundance and damage. • Synchronous planting (planting neighboring fields within 3 weeks) and maintaining a rice-free period may be effective.
9.	**Green stinkbug** *(Nezara viridula)*	• Early-maturing varieties can be used as trap crops to protect the late maturing main crop. However, insecticides need to be applied to the trap crop for the stinkbug's control. • The green-manuring crop, *Sesbania rostrata*, can also be used as a trap crop. • Intercropping of soybean with rice can also be effective. • Adjusting the planting date allows a degree of manipulation of *N. viridula* numbers

3.3. Genetic management

Insect pest and disease resistant/ tolerant varieties mentioned below should be used:

A. Varieties resistant/tolerant to various insect pests and diseases

Insect pests	Resistant/tolerant varieties
Stem borer	Ratna, Sasyasree, Vikas, HKR 46, NDGR 21, Pantdhan 6, VLK 39, Prahlad, Birsadhan 201, Bhudeb Ainesh, Matangini, Radha, Sudha, Amulya, Bhagirathi, Jogan, Mandira, Nalini, Sabita, VL16 and VL 206.

Insect pests	Resistant/tolerant varieties
Gall midge	Bhadrakali, Pavitra, Panchami, Triguna, lndursamba, Shiva, Vasundhara, Mahamaya, Ratnagiri 3, Erra Mallelu, Kavya, Oragallu, Sneha, Bhuban, Shaktiman, Abhaya, Divya, Ruchi, Vibhava, Kshira, Lalat, MDU 3, Pothana, Suraksha, Tara, Rashmi, Karna Mahavir, Neela, Rajendradhan 202, Sarsa, Udaya, Pratap, Daya, Dhanya Lakshmi, Kunti, IR 36, Asha, Samalei, Samariddhi, Pusa, Surekha, Phalguna, Vikram, Shakti, Jyoti, Kakatiya, Kanchan and Birsa Dhan 202.
Brown plant hopper	Vijetha, Chaitanay, Krishnaveni, Pratibha, Vajram, Makom, Pavizham, Mansarovar, CO 42, Jyoti, Chandana, Nagarjuna, Sonasali, Rasmi, Neela, Annanga, Daya, Bhadra, Karthika, Aruna, Remya, Kanakam, Bharathidasan, Remya, Triguna, IET 8116, Rajendra Mahsuri-l, Pant dhan 11, Rajshree, Bhudeb and Hanseshwari .
White backed plant hopper	HKR 120, HKR 126, HKR 228, PR 108, Menher, Pant dhan 10, Pant dhan 11, Mahananda and Hanseshwari.
Green leaf hopper	Vikramarya, Nidhi, IR 24, Radha, Mahananda and Kunti.
Blast	Rasi, Vikas, Krishna Hamsa, Tulasi, IR 64, Aditya, Swarnadhan, Himalaya 1, Himalaya 2, Himalaya 2216, Pant dhan 10, HKR 228 and PNR 519.
BLB	Ajaya, IR 36, IR 64, Swarna, Bhumbleshwari, PR 111, PR 113, PR 114, PR 115, PR 116, PR 118, Rajendra Basmati, Pant dhan 11, Govind, Radha, Kamini, Pant dhan 10, Jayshree, Kanchan and improved sambha masouri.
RTD	Vikramarya, Nidhi, Amulya, Dinesh, Lakshmi and Nalini.
Sheath blight	PR 108, Bhudeb Dinesh, Jogan, Mandira, Nalini, Neeraj and Sabita.

B. Varieties with resistance to more than one pest or disease

S. No.	Variety	Released in	Resistant to*
1.	Udaya	Odisha	BPH, GM, GLH, RTD and RKN
2.	Suraksha	Andhra Pradesh, Odisha, and West Bengal	GM, BPK, WBPH and BL
3.	Vikramarya	Andhra Pradesh	GM, GLH and RTD
4.	Shaktiman	Odisha, and West Bengal	GM, BPH, WBPH and BL
5.	Rasmi	Kerala	GM, BPH and BL
6.	Daya	Odisha	GM, BPH, GLH and BLB
7.	Samalei	Odisha, and Madhya Pradesh	GM, BPH, GLH and BL
8.	Bhuban	Odisha	GM and BLB
9.	Kunti	West Bengal	GM and BL
10.	Lalat	Odisha	GM, BPH, GLH and BL
11.	Sneha	Odisha	GB and RTD

*Abbreviations

GM- Gall midge; BPH- Brown plant hopper; WBPH- White backed plant hopper; GLH- Green leafhopper; BL- Blast; RTD- Rice Tungro Disease; RKN- Root-knot nematode; GB-Gundhi bug; BLB- Bacterial leaf blight.

3.4. Mechanical Practices

- Collection of egg masses and larvae of pest to be placed in bamboo cages for conservation of biocontrol agents.
- Removal and destruction (burn) of diseased/pest infested plant parts.
- Clipping of rice seedlings tips at the time of transplanting to minimize carryover of rice hispa, case worm and stem borer infestation from seed bed to the transplanted fields.
- Use of coir rope in rice crop for dislodging case worm, cut worm and swarming caterpillar and leaf folder larvae etc. on to kerosinized water (1 L of kerosene mixed on 25 kg soil and broadcast in 1ha).

3.5. Biological Control Practices

The details of biological control practices are given below

3.5.1. Augmentation and Conservation

- *Trichogramma japonicum* and *T chilonis* may be released @ 1 lakh/ha on appearance of egg masses / moth of yellow stem borer and leaf folder in the field.
- Natural biocontrol agents such as spiders, drynids, water bugs, mirid bugs, damsel flies, dragonflies, meadow grasshoppers, staphylinid beetles, carabids, coccinellids, *Apanteles, Tetrastichus, Telenomus, Trichogramma, Bracon, Platygaster* etc. should be conserved.
- Collection of egg masses of borers and putting them in a bamboo cage-cum-percher till flowering which will permit the escape of egg parasites and trap and kill the hatching larvae. Besides, these would allow perching of predatory birds.
- Habitat management: Protection of natural habitats within the farm boundary may help in conserving natural enemies of pests. Management of farmland and rice bunds with planting of flowering weeds like marigold, sun hemp increases beneficial natural enemy population and also reduce the incidence of root knot nematodes. Provide refuge like straw bundles having charged with spiders to help in build up spider population and to provide perch for birds

Major parasitoids and predators of insect pests of rice

Natural enemy category	Natural enemy	Pest attacked and feeding potential
I. Parasitoids		
1. Egg parasitoids	*Trichogramma japonicum*	• Egg parasitoid of yellow stem borer (YSB)
	Trichogramma chilonis	• Egg parasitoid of leaf folder, • Case worm, YSB etc.
	Tetrastichus schoenobii	• Egg parasitoid of yellow and white stem borer. • At least 3 stem borer eggs are needed for development of each wasp.
	Telenomus rowani	• Egg parasitoid of yellow and white stem borer. • A female parasitizes 20-40 eggs and lives 2-4 days or longer if nectar or sugar solution is provided. • Both *Tetrastichus* and *Telenomus* may parasitize the same egg mass but not the same egg.
	Gonatocerus spp.	• Egg parasitoid of leaf and plant hoppers. • Parasitize on an average 8 eggs per day.
	Anagrus spp.	• Egg parasitoids of leaf and plant hoppers. • Parasitizes 15 to 30 eggs/day.
	Oligosita spp.	• Egg parasitoid of leaf and plant hoppers. • Consume 2 to 8 eggs per day.
	Copidosomopsis nacoleiae	• Egg parasitoid of leaf folder. • 200-300 wasps are produced from a few eggs.
2. Larval parasitoids	*Amauromorpha accepta*	• Larval parasitoid of yellow and white stem borer. • Adults are medium sized red and black in colour with white band at the abdominal tip.
	Stenobracon nicevillei	• Larval parasitoid of leaf folder. • Adult wasp has orange brown body, black head, 3 pairs of black spots on forewings. • Ovipositor is black and double the length of its body.
	Cotesia flavipes	• Larval parasitoid of stem borer and semi-looper. • Adult wasps are similar to *Cotesia antustibasis* except the antenna is short and yellow brown to red marking at the base of hind legs.
	Elasmus sp.	• Larval parasite of leaf folder. • Wasp emerges from larva or pupa. • Adults are small elongated wasps with pointed abdomen. • Thoracic segment is enlarged and disc shaped. They are black with reddish markings/bands on the abdomen.

Natural enemy category	Natural enemy	Pest attacked and feeding potential
	Haplogonatopus sp *Pseudogonatopus* spp.	• *Haplogonatopus* attack leaf hoppers and *Pseudogonatopus* attack plant hoppers and act as parasites and predators. • Adults of *Pseudogonatopus* are brown or black in colour. • Females are wingless with pincher like front claws.
	Bracon sp.	• Larval parsitoid of yellow stem borer and rice hispa.
3. Larval and pupal parasitoids	*Xanthopimpla flavolineata*	• Larval, pupal parasitoid of stem borer • Adult wasp is medium sized yellow orange in colour with black ovipositor and transparent wings.
	Brachymeria lasus, B. excarinata,	• Larval and pupal parasitoid of Rice skipper, leaf folder and green horned caterpillar. • Adults of *Brachymeria iasus* are black and have a triangular cheek and yellow markings on tip of femur and ventral half of tibia. *Brachymeria excarinata* are black with yellow markings on both ends of hind tibia and no cheek.
	Opius sp.	• Larval pupal parasitoid of whorl maggot larvae. Wasp emerges from whorl maggot pupa. • Adults are small orange brown in colour with long antennae, yellow legs and black ovipositor.
II. Predators		
4. Coccinellid beetles	*Micraspis hirashimai,* Ladybird beetles	• Preying on small hoppers, small larvae and exposed eggs
	Harmonia octamaculata	• Preying on small hoppers, small larvae and exposed eggs
5. Carabid beetle	*Ophionea nigrofasciata,* Ground beetle	• Preying leaf folder larvae and planthoppers
6. Rove beetle	*Paederus fuscipes* Rove beetle	• Preying leaf and planthoppers, eggs, and small moths
7. Spiders	*Pardosa psuedoannulata,* Wolf spider	• Prey stem borer and leaf folder moths, leaf-and plant hoppers, and whorl maggot flies.
	Oxyopes javanus, Lynx spider	• Prey moths of rice pests, adults of whorl maggots, leafhoppers and plant hoppers
	Tetragnatha maxillosa, Long-jawed spider	• Prey stem borer and leaf folder moths, leaf-and plant hoppers
	Argiope catenulata, Orb spider	• Prey moths/adults of rice pests viz. grasshoppers

3.5.2. Pest defender ratio

Pest defender ratio (P: D) 2:1 may be useful to avoid application of pesticides against plant hoppers.

3.5.3. Behavioural Control

Mass trapping of yellow stem borer male moths by installing pheromone traps @ 20 traps/ha with lures containing 10-15 mg pheromone at 20 days after transplanting.

3.6. Chemical Control Measures

The details of the chemical control measures to be adopted against insect pests and diseases are given in Generic IPM module based on vegetative stage. Resort to chemical as the last choice only after the regular pest and when pest population cross ETL.

Generic IPM module based on vegetative stage

CROP STAGE/ PEST VIS-À-VIS IPM PRACTICES

PESTS	PESTICIDES
I. INSECTS	
Nursery	
Gall midge	Carbofuran 3% CG @ 25000-66600 g/ha or carbosulfan 6% G @ 16700 g/ha or carbosulfan 25% EC @ 800-1000 ml/ha.
Stem borer	Cartap hydrochloride 4% granules @ 18750 g/ha or cartap hydrochloride 50% SP @ 1000 g/ha.
Vegetative stage	
Stem borer	Carbofuran 3% CG @ 25000-66600 g/ha or cartap hydrochloride 4% granules @ 18750 g/ha or cartap hydrochloride 50% SP @ 1000 g/ha or monocrotophos 36 % SL @ 625-1250 ml/ha.
Leaf folder	Spray cartap hydrochloride 4% granules @ 18750-25000 g/ha or cartap hydrochloride 50% SP @ 1000 g/ha or monocrotophos 36 % SL @ 625-1250 ml/ha or chlorpyrifos 1.5% DP @ 25000 g/ha.
Brown plant hopper and WBPH	Spray of imidacloprid 70% WG @ 30-35 g/ha or imidacloprid 30.5% m/m SC @ 60-75 ml/ha or ethofenoprox 10% EC @ 500-750 ml/ha or acephate 75% SP @ 666-1000 g/ha or buprofezin 25% SC @800 ml/ha.
Gall midge	Application of carbofuran 3% CG @ 25000-66600 g/ha or fipronil 0.3% GR @16670-25000 g/ha at 20 days after transplanting.
Hispa	Spray quinalphos 25% gel @ 1000 ml/ha or chlorpyrifos 20% EC @ 1250 ml/ha.
Caseworm	Spray carbaryl 10% DP @ 25000 g/ha.
Panicle initiation to booting	
Stem borer	Carbofuran 3% CG @ 25000-66600 g/ha or cartap hydrochloride 4% granules @ 18750-25000 g/ha or cartap hydrochloride 50% SP @ 1000g/ha or monocrotophos 36 % SL @ 625-1250 ml/ha.
Leaf folder	Spray cartap hydrochloride 4% granules @ 18750-25000 g/ha or cartap hydrochloride 50% SP @ 1000 g/ha or monocrotophos 36 % SL @ 625-1250 ml/ha or chlorpyrifos 1.5% DP @ 25000 g/ha.

PESTS	PESTICIDES
Brown plant hopper/White backed plant hopper	Spray of imidacloprid 70% WG @ 30-35 ml/ha or imidacloprid 30.5% m/m SC @ 60-75 ml/ha or ethofenoprox 10% EC @ 500-750 ml/ha or acephate 75% SP @ 666-1000 g/ha or buprofezin 25% SC @ 800 ml/ha.
Flowering	
Brown plant hopper/White backed plant hopper	Spray of imidacloprid 70% WG @ 30-35 ml/ha or imidacloprid 30.5% m/m SC @ 60-75 ml/ha or ethofenoprox 10% EC @ 500-750 ml/ha or acephate 75% SP @ 300-500 g/ha or buprofezin 25% SC @ 800 ml/ha.
II. DISEASES	
Nursery	
Blast	Spray carbendazim 50% WP @ 250-500 g/ha or isoprothiolan 40% EC @ 750 ml/ha or tricyclozole 75% WP @ 300-400 g/ha or tricyclazole 70% WG @ 300 g/ha.
BLB	Spray of streptomycin sulphate 9% + tetracycline hydrochloride 1% SP @ 100-150 ppm.
Vegetative	
Blast	Spray carbendazim 50% WP @ 250-500 g/ha or isoprothiolan 40% EC @ 750 ml/ha or tricyclozole 75% WP @ 300-400 g/ha or tricyclazole 70% WG @ 300 g/ha.
Bacterial leaf blight	Spray streptocycline 100 to 150 ppm solution at early root stage. Second spray, if necessary before grain set. Reduce nitrogen application and apply if needed only small dose of N in more split doses. Chemicals as recommended earlier.
Sheath blight	Apply validamycin 3% L @ 2000 g/ha or hexaconazole 5% EC @ 1000 ml/ha or propiconazole 25% EC @750 ml/ha or propiconazole 10.7% + tricyclazole 34.2% SE @ 500 ml/ha.
Panicle initiation to booting	
Blast	Spray carbendazim 50% WP @ 250-500 g/ha or isoprothiolan 40% EC @ 750 ml/ha or tricyclazole 75% WP @ 300-400 g/ha or tricyclazole 70% WG @ 300 gm/ha.
Bacterial leaf blight	Reduce nitrogen application and apply if needed only small dose of N in more split doses, chemicals as recommended earlier.
Sheath blight	Apply validamycin 3% L @ 2000 ml/ha or hexaconazole 5% EC @ 1000 ml/ha or propiconazole 25% EC @ 750 ml/ha or propiconazole 10.7% + tricyclazole 34.2% SE @ 500 ml/ha.
Flowering	
Blast	Spray ediphenphos 50% EC @ 500-600 ml/ha or isoprothiolan 40% EC @ 750 ml/ha or tricyclazole 75% WP @ 300-400 g/ha. Apply nitrogen in small dose, if needed.
Sheath blight	Apply validamycin 3% L @ 200 g/ha or hexaconazole 5% EC @ 1000 ml/ha or propiconazole 25% EC @750 ml/ha or propiconazole 10.7% + tricyclazole 34.2% SE @ 500 ml/ha.

Weeds

1. Apply cyhalofop-butyl 10% EC @ 0.75-0.80 l/ha @ 18-20 days after sowing in grassy weeds in direct seeded rice followed by one hand weeding given after 4-6 weeks.
2. Apply butachlor 50% EC @ 2.5-4 l/ha or pretilachlor 50% EC @ 1.0-1.5 l/ha or oxadiargyl 80% WP @ 0.125 kg/ha or chlorimuron ethyl 25% WP @ 24 g a.i./ha or metsufluran methyl 20% WG @ 20 gm/l or anilophos 2% G @ 20-25 kg/ha or ethoxysulfuron 15% WDG @ 83.3-100 g/ha or cinmethalin10% EC @ 0.75-1.0 l/ha as pre-emergence within 4-6 days after transplanting.

3. Apply metsulfuron methyl 10% + chlorimuron methyl 10% WP @ 20 g/ha or anilophos 24% + 2, 4-D- ethyl ester 32% EC @ 1-1.5 l/ha at 3-10 days after transplanting.

3.7. Nematode Management Practices

Important nematodes and their management approaches are as under:

1. **White tip nematode *(Aphalenchoides besseyi)***
   - 1.1 Sun drying of seeds for 6 hours for 4 days.
   - 1.2 Pre-sowing of nursery bed treatment with carbofuran 3% CG @ 50000 g/ha, if nematode population crosses the ETL.
2. **Root knot nematode *(Meloidogyne graminicola)***
   - 2.1 Rotation with the crops like sweet potato, sunflower, cowpea, sesamum, and onion.
   - 2.2 Soil application of carbofuran 3% CG @ 50000 g/ha.

3.8. Rat Management Practices

(Working Index (ETL): Fifteen live burrows per hectare)

1. Rat management need to be adopted on community basis.
2. Employment of indigenous traps preferably one month after transplantation.
3. Application of bromodiolone (0.005% a.i) in baits six weeks after transplantation.
4. The residual live burrows may be treated with second application of bromodiolone (0.005%).
5. The above control operations with rodenticides except Zinc phosphide (as rodents develop bait shyness) may be repeated if the rodent population exceeds working index.

Important:

i) Optimum period for undertaking control operation is six weeks after transplantation.

ii) Zinc phosphide (2.5%) in baits may be applied.

iii) For getting effective control, it is recommended that Zinc Phosphide with ISI mark in 10 g pouches preferably in manufacturers' package should be procured.

4. SAFETY PARAMETERS IN PESTICIDES USAGE

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

i) Basic precautions which are required to be taken as per classification of toxicity as well as hazard criteria by WHO may be seen as per Annexure – VIII & IX.

ii) The extension functionaries are to educate the farmers on safety use of pesticides with the help of colour toxicity triangle as the farming community can follow the colour and corresponding safety precautions.

iii) The symptoms of poisoning must be known to the extension functionaries to enable them to extend first aid measures to affected persons to the extent possible.

iv) Basically, the information on first aid measures and treatment of poisoning is required to be passed on by the extension functionaries to the doctors at Primary Health Centres as well as to Private Doctors in the vicinity of spraying of pesticides.

v) Extension functionaries must ensure that names of common pesticides during plant protection measures along with a copy of the leaflet which is an integral part of a pesticide container must be made available to the doctors in the vicinity of plant protection operations.

vi) Extension functionaries are to request the doctors to intervene in procurement of antidotes for different pesticides as cited under "Treatment of poisoning".

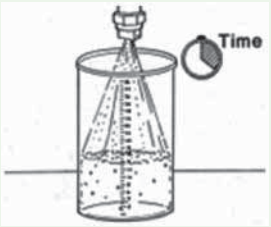
Protocol for Pesticide application techniques, equipments and nozzle specifications

Category A: Stationary, crawling pest/ disease		
Vegetative stage	Insecticides and fungicides	• Lever operated knapsack sprayer (Droplets of big size) • Hollow cone nozzle @ 35 to 40 psi • Lever operating speed = 15 to 20 strokes/min **Or** • Motorized knapsack sprayer or mist blower (Droplets of small size) • Air blast nozzle • Operating speed: 2/3rd throttle
1. For crawling and soil borne pests		
2. For small sucking leaf borne pests		
Reproductive stage	Insecticides and fungicides	• Lever operated knapsack sprayer (Droplets of big size) • Hollow cone nozzle @ 35 to 40 psi • Lever operating speed = 15 to 20 strokes/min
Category B: Field flying pest/airborne pest		
Vegetative stage	Insecticides and fungicides	• Motorized knapsack sprayer or mist blower (Droplets of small size) • Air blast nozzle • Operating speed: 2/3rd throttle **Or** • Battery operated low volume sprayer (Droplets of small size) spinning disc nozzle
Reproductive stage (Field Pests)		
Category C: Weeds		
Post-emergence application	Weedicide	• Lever operated knapsack sprayer (Droplets of big size) • Flat fan or flood jet nozzle @ 15 to 20 psi • Lever operating speed = 7 to 10 strokes/min
Pre-emergence		• Trolley mounted low volume sprayer (Droplets of small size) • Battery operated low volume sprayer (Droplets of small size)

Do's and don't's in IPM

S, No.	Do's	Don'ts
1	Deep ploughing is to be done on bright sunny days during the months of May and June. The field should be kept exposed to sun light at least for 2-3 weeks	Do not plant or irrigate the field after ploughing, at least for 2-3 weeks, to allow desiccation of weed's bulbs and/or rhizomes of perennial weeds
2	Adopt crop rotation	Avoid growing monocrop.
3	Grow only recommended varieties.	Do not grow varieties not suitable for the season or the region
4	Sow early in the season	Avoid late sowing as this may lead to reduced yields and incidence of white grubs and diseases.
5	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.
6	Sow in rows at optimum depths under proper moisture conditions for better establishment.	Do not sow seeds beyond 5-7 cm depth.
7	Apply only recommended herbicides at recommended dose, proper time as appropriate spray solution with standard equipment along with flat fan or flat jet nozzles.	Pre-emergence as well as soil incorporated herbicides should not be applied in dry soils. Do not apply herbicides along with irrigation water or by mixing with soil, sand or urea.
8	Maintain optimum and healthy crop stand which would be capable of competing with weeds at a critical stage of crop weed competition	Crops should not be exposed to moisture deficit stress at their critical growth stages.
9	Use the NPK fertilizers as per the soil test	Avoid imbalanced use of fertilizers.
10	Use micronutrient mixture after sowing based on the test recommendations.	Do not apply any micronutrient mixture after sowing without test
11	Conduct AESA weekly in the morning preferably before 9 a.m. Take decision on management practice based on AESA and P: D ratio only.	Take any management decision considering AESA and P: D ratio
12	Install pheromone traps at appropriate period.	Do not store the pheromone lures at normal room temperature (keep them in refrigerator).
13	Release egg parasitoids only after noticing adult moth catches in the pheromone trap or as pheromone trap or as per field observation	Do not apply chemical pesticides within seven days of release of parasitoids.
14	Apply short persistent pesticides to avoid pesticide residue in the soil and produce.	Do not apply pesticides during preceding 7 days before harvest.
15	Follow the recommended procedure of trap crop technology.	Do not apply long persistent on trap crop, otherwise it may not attract the pests and natural

Operational, calibration and maintenance guidelines in brief

1.	For application rate and dosage see the label and leaflet of the particular pesticide.	 
2.	It is advisable to check the output of the sprayer (calibration) before commencement of spraying under guidance of trained person.	
3.	Clean and wash the machines and nozzles and store in dry place after use.	  
4.	It is advisable to use protective clothing, face mask and gloves while preparing and applying pesticides. Do not apply pesticides without protective clothing and wash clothes immediately after spray application.	 
5.	Do not apply in hot or windy conditions.	 
6.	Operator should maintain normal walking speed while undertaking application.	
7.	Do not smoke, chew or eat while undertaking the spraying operation	 
8.	Operator should take proper bath with soap after completing spraying	
9.	Do not blow the nozzle with mouth for any blockages. Clean with water and a soft brush.	

Method for calculation of pesticides for application

(i) **Solid formulations** such as dust, wettable powder or gr anules, the active ingredient is mixed with inert material. The concentration is expressed as -
Active ingredient (%) in the total weight of commercial product

$$\text{Active ingredient (\%) in dust, WP. orgranules} = \frac{\text{Weiqht of a.i. x 100}}{\text{Total weight of W P , dust, etc.}}$$

Example. Carbendazim 50% WP means there are 50 g of carbendazim in every 100 g of commercial WP (50 % a.i.).

Calculations when recommendation is in kg a.i. per litre

For WP, dust, granules, etc.

Specification required:

1) Area to be sprayed
2) Concentration of a.i in formulation
3) Recommended rate as kg a.i. ha^{-1}.

Formula: $$\text{kg of WP/dust/granules} = \frac{\text{Recommended rate x spray area (sq.m)}}{\text{a.i (\%) in W P x 100}}$$

Example: If Carbendazim 50% WP is used at the rate of 2 kg a.i ha^{-1}, then amount of Carbendazim 50% WP required for 1 ha (10000 m^2) is:

$$\text{kg of Carbendazim 50\% WP required} = \frac{2 \times 10000}{50 \times 100} = 4 \text{ k g/ha}$$

(ii) **Liquid of formulation** Here the a.i. is dissolved in a solvent with an emulsifying agent. It is expressed as in emulsifiable concentrate (EC). The concentration can be expressed in two ways.

a) $$\text{Active ingredient (\%) in EC} = \frac{\text{Weight of a.i. x 100}}{\text{Volume of EC}}$$

b) Grams L^{-1}

Example: **Hexaconazole 5% EC** means, 100 mL of commercial product has 5 ml of pure Hexaconazole

For Emulsiflable Concentrates

Specification required:

i) Area to be treated
ii) Recommended rate as kg a.i. ha^{-1}
iii) Concentration of commercial EC as a.i (%) or kg ha^{-1}

When concentration of EC is in a.i. (%)

Formula:

$$\text{kg of EC required} = \frac{\text{Recommended rate x area } (m^2)}{\text{ai (\%) in commercial EC x 100}} \quad \text{or}$$

$$= \frac{\text{Recommended rate x area (ha)}}{\text{a.i. (\%) in commercial EC x 100}}$$

Example: Hexaconazole 5% EC to be sprayed at the rate of 2 kg a.i. ha^{-1} for 10000 m^2 and Hexaconazole 5% EC has 5 % a.i. How much liters of Hexaconazole is required?

Liters of 5 % Hexaconazole required = $\frac{2 \times 10000}{5 \times 100}$ = 40 L

When concentration expressed is in kg a.t. L^{-1}

Formula:

$$= \frac{\text{Recommended rate in kg a.i. } ha^{-1} \text{ x area (ha)}}{\text{Concentration of a.i. in product (kg } ha^{-1})}$$

Example: Acetamprid (0.01 kg a.i. L^{-1}) is to be applied at the rate of 0.05 kg a.i. ha^{-1} How much will be required for 3 ha?

Liters of Acetamprid required = $\frac{0.05 \times 3.0}{0.01}$ = 15 liters

When recommendation is based on a.i (%) in the spray fluid

i) Wettable powders (when diluted with water)

Specifications required:

1 Spray volume as L ha^{-1}
2 Concentration desired as a.i. (%) in spray
3 Concentration of commercial product as a.i. (%)

Formula :

$$WP = \frac{\text{a.i. (\%) desired x spray volume}}{\text{a.i. (\%) in commercial WP}}$$

Example: To control stem borer in a plot. 2000 L of 2% Methyl Parathion DP is to be prepared. The commercial product to be used is Methyl parathion 50% EC. How much Methyl parathion is required?

Litre of Methyl Parathion required = $\frac{2 \times 2000}{50}$ = 80 liters

ii) Emulsifiable concentrates (EC)

Specification required:

1) Spray volume as L ha^{-1}
2) Concentration as percentage of a.i desired.
3) Concentration of commercial EC as a.i. (%).

Formula:

$$\text{Liter of EC} = \frac{\text{a. i. (\%) desired} \times \text{spray volume}}{\text{a.i. (\%) in commercial EC}}$$

Example : 2000 L of 2 % Methyl Parathion spray is to be prepared. How much commercial 50 % EC is required?

$$\text{Liters of Methyl Parathion} = \frac{2 \times 2000}{50} = 80 \text{ L}$$

Annexure-I

LIST OF RECOMMENDED PESTICIDES FOR RICE (As on 15-10-2013)

Herbicides	Insecticides	Fungicides
Anilophos 2 % G	Acephate 75% SP	Aureofungin 46.15% w/v. SP
Anilofos 30% EC	Acetamiprid 20% SP	Carbendazim 50% WP
Anilofos 18% EC	Aluminum Phosphide 56% 3g tab, 10g pouch	Captan 75% WP
Azimsulfuron 50% DF	Aluminum Phosphide 15%, 12g tablet	Carpropamid 27.8% SC
Anilophos 24% + 2,4-D- ethyl ester 32% EC	Aluminium Phosphide 77.5% GR	Copper Hydroxide 77% WP
Anilophos 24% + 2, 4-D- ethyl ester 32% EC	Azadirachtin 0.15%W/Wmin. Neem seed kernel based EC	Copper oxychloride 50% WP
Bensulfuron Methyl 60% DF	Azadirachtin 0.03% min. Neem oil based EC Containing	Difenoconazole 25% EC
Bispyribac Sodium 10% SC	Azadirachtin 5%W/W min. Neem extract concentrate containing	Ediphenphos 50% EC
Butachlor 50% EC	*Bacillus thuringiensis* var. *galleriae*	Flusilazole 40% EC
Chlorimuron Ethyl 25% WP	*Bacillus thuringiensis* var. *kurstaki*, serotype H-39, 3B, strain Z-52	Hexaconazole 5% EC
Clomazone 50%EC	Buprofezin 25% SC	Hexaconazole 5 % SC
Cyhalofop-butyl 10% EC	Bifenthrin 10% EC	Iprodione 50% WP
2,4-D Ethyl Ester 38 % EC (having 2,4-D acid 34 % w/w)	Bromadiolone 0.25% CB	Isoprothiolan 40% EC
2,4-D Ethyl Ester 4.5 % GR (having 2,4-D acid 4 % w/w)	Bromadiolone 0.005% RB	Kasugamycin 3% SL
Ethoxysulfuron 15% WDG	Carbaryl 10% DP	Kitazin 48% EC
Fenoxaprop-p-ethyl 9.3% w/w EC (9% w/v)	Carbaryl 5% DP	Kresoxim-methyl 44.3% SC
Fenoxaprop-p-ethyl 6.7% w/w EC	Carbaryl 50% WP	Mancozeb 75% WP
Flufenacet 60% DF	Carbaryl 85% WP	Pencycuron 22.9% SC
MCPA, Amine salt 40% WSC	Carbofuran 3% CG	Propiconazole 10.7% + tricyclazole 34.2% SE
Metsufluran methyl 20% WG	Cartap hydrochloride 50% SP	Propiconazole 25% EC
Metsulfuron Methyl 20% WP	Chlorantraniliprole 18.5% SC	Propineb 70% WP
Metsulfuron methyl 10% + Chlorimuron methyl 10% WP	Chlorantraniliprole 0.4% GR	Streptomycin sulphate 9% + tetracycline hydrochloride 1% SP
Oxadiargyl 80% WP	Chlorpyrifos 10% G	Tebuconazole 25.9% m/m EC
Orthosulfamuron 50% WG	Chlorpyrifos 50% EC	Thifluzamide 24% SC
Oxadiargyl 6% EC	Chromafenozide 80% WP	Thiram 75% WS

Herbicides	Insecticides	Fungicides
Oxadiazon 25% EC	Clothianidin 50% WDG	Trichoderma viride 1% WP
Oxyflourfen 0.35% GR	Chlorpyrifos 1.5% DP	Tricyclazole 70% WG
Oxyflourfen 23.5% EC	Chlorpyrifos 20% EC	Tricyclazole 75% WP
Pendimethalin 30% EC	Deltamethrin 11% W/WEC	Validamycin 3% L
Pendimethalin 5 % G	Deltamethrin 1.8% EC	Zineb 75% WP
Pretilachlor 37% EW	Deltamethrin 2.5% WP	Carbendazim 12% + Mancozeb 63% WP
Paraquat dichloride 24% SL	Dichlorvos 76% EC	Iprodione 25% + Carbendazim 25% WP
Pyrazosulfuron Ethyl 10% WP	Dinotefuran 20% SG	Propiconazole 13.9% + Difenoconazole 13.9% EC
Pretilachlor 50% EC	Endosulfan 35% EC	Tebuconazole 50% + Trifloxystrobin 25% WG
Bensulfuron methyl 0.6% + Pretilachlor 6% GR	Endosulfan 4% DP	
Clomazone 20% + 2,4-D EE 30% EC	Ethofenoprox 10% EC	
	Ethiprole 40 + Imidacloprid 40% WG	
	Ethylene Dichloride + CarbonTetrachloride 3:1	
	Fipronil 0.3% GR	
	Fenobucarb (BPMC) 50% EC	
	Fenpropathrin 30% EC	
	Fipronil 5% SC	
	Fipronil 80% WG	
	Flonicamid 50% WG	
	Flubendiamide 20% WG	
	Flubendiamide 39.35% m/m SC	
	Imidacloprid 30.5% m/m SC	
	Imidacloprid 70% WG	
	Imidacloprid 17.8% SL	
	Imidacloprid 0.3% GR	
	Indoxacarb 15.8% EC	
	Lambda-cyhalothrin 4.9% CS	
	Lambda-cyhalothrin 2.5% EC	
	Lambda-cyhalothrin 5% EC	
	Malathion 5% DP	
	Malathion 50% EC	

Herbicides	Insecticides	Fungicides
	Metaldehyde	
	Methyl Bromide 98% W/W	
	Monocrotophos 36 % SL	
	Oxydemeton–methyl 25% EC	
	Phenthoate 50% EC	
	Phorate 10% CG	
	Phosalone 35% EC	
	Phosphamidon 40% SL	
	Quinalphos 5% granule	
	Quinalphos 20% AF	
	Quinalphos 25% EC	
	Quinalphos 1.5% DP	
	Quinalphos 25% Gel	
	Thiacloprid 21.7% SC	
	Thiamethoxam 25% WG	
	Triazophos 20% EC	
	Triazophos 40% EC	
	Chlorpyrifos 50% + Cypermethrin 5% EC	
	Deltamethrin 0.72% W/W+ Buprofezin 5.65% W/W EC	
	Phosphamidon 40% + Imidacloprid 2% SP	
	Acetamiprid 0.4% + Chlorpyriphos 20% EC	

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Annexure-II

Commonly Available Formulations of Pesticides for Agricultural Use

Class	Type	Abbre-viation	Description
Dry	Dust	D	• Ready to use, off shelf available • Low percentage of active ingredients, • Very fine dry inert carrier made from tale, chalk, clay, or ash • Prone to high level of pesticide drift • Granule particles are larger and heavier
	Granule	G	• Granule particles are larger and heavier • Used for soil treatment and broadcasting to manage nematodes, weeds and insect pests
	Wettable	WP	• Finely grounded power
	Powder	W	• Finely grounded power
	Micro encapsulated	M	• Mixed with water for spray application
Liquid	Emulsifiable concentrate	EC	• Particles of active ingredients (liquid or dry) surrounded by a plastic coating
	Concentrate solution	C LC	• Liquid active ingredients, dissolved in petroleum based solvents • Easily absorbed through skin
		ULV	• Diluted with a liquid solvent before being applied
		F L	• Very high percentage of active ingredient • Used before dilution or diluted with small quantities of solvent
Fumi-gants	Pellets liquids		• Finely grounded solid active ingredients suspended in the liquid with inert materials • Solid or liquid that releases/vaporized into toxic gasses

Annexure-III

Pesticides and their Mode of Action

Type of pesticide	Mode of action	How it works
Insecticides and nematicides	Contact	Act through cuticle
	Ingestion	Act upon digestive track
	Systemic	Absorbed and translocated to affected portions
	Fumigants	Penetrates as a into cryptic parts
Herbicide	Contact	Act through cuticle and translocation
	Systemic	Absorbed through soil and translocated to different parts
Fungicide	Superficial protectants	Contact pathogen reproductive propagules
	Systemic	Absorbed through roots from soil, leaf and translocated to different parts

Annexure-IV

Mechanisms of Actions of Major Pesticides

Type of pesticide	Target tissue or organ	Mechanism
Insecticide	Central nervous	Interfere with electron system of nervous system Inhibit acetyl cholinesterase the enzyme responsible for the regulating biological activity
	Cuticle	Inhibit growth and prevent cuticle formulations
	Endocrine system	Disrupts hormonal metabolic system
Herbicide	Seed	Disrupts protein synthesis and inhibits germination
	Leaf, stem,	Prevent photosynthesis
	Leaf, stem, root	Interferes with the mitosis process
	Leaf, stem, root	Affects cell respiration and ATP synthesis
Fungicide	Seed, leaf, stem	Inhibits liquid synthesis affecting cell wall and membrane
	Root	Inhibits synthesis of essential ribosomal proteins Inhibits mitosis, osmoregulation and mitochondrial respiration

Annexure-V

General Guidelines for Management of Resistance

The general guidelines if adopted can prevent development of resistance by various pests in most of the agricultural situations. The general approaches to avoid them are as follows:

Insecticides

- Maintain good plant health,
- Delay the spray of insecticide as far as possible.
- Monitor populations and use economic thresholds
- Use all available tactics for management of a particular arthropod (insect or mite)
- Limit selection pressure throughout the season and remember spraying for one pest may influences another
- Limit use of one chemical molecule at a time and rotate chemical molecule and/or modes of action, and Use appropriate rates

Fungicides

- Avoid growing large areas of highly susceptible varieties in endemic areas. Resistant varieties should be used to reduce reliance on chemical pesticides.
- Make full use of non-fungicidal control measures e.g., dispose of crop debris and control collateral and alternate host, which harbor disease.
- Monitor crops regularly for disease and treat before the infection becomes established.
- Use fungicides only in the unavoidable situations where the risk of disease warrants treatment. Make full use of effective fungicides with different modes of action as alternate sprays. Mixtures of eradicant fungicides with protectants materials offer the most flexibility as well as reducing resistance risk.
- While formulating spray programmes, take into account any earlier use of fungicides groups as seed treatment.
- Do not exceed the maximum recommended numbers of applications to each crop for any particular fungicide group. Avoid repeated applications of very low doses.

Annexure-VI

Pesticides / formulations banned in India (As on 1st Jan, 2014)

A.	**Pesticides Banned for manufacture, import and use.**	
	1.	Aldicarb
	2.	Aldrin
	3.	Benzene Hexachloride
	4.	Calcium Cyanide
	5.	Chlorbenzilate
	6.	Chlordane
	7.	Chlorofenvinphos
	8.	Copper Acetoarsenite
	9.	Dibromochloropropane
	10.	Dieldrin
	11.	Endrin
	12.	Ethyl Mercury Chloride
	13.	Ethyl Parathion
	14.	Ethylene Dibromide
	15.	Heptachlor
	16.	Lindane (Gamma-HCH) (Banned vide Gazette Notification No S.O. 637(E) Dated 25/03/2011)-Banned for Manufecture,Import or Formulate w.e.f. 25th March,2011 and banned for use w.e.f. 25th March,2013.
	17.	Maleic Hydrazide
	18.	Menazon
	19.	Metoxuron
	20.	Nitrofen
	21.	Paraquat Dimethyl Sulphate
	22.	Pentachloro Nitrobenzene
	23.	Pentachlorophenol
	24.	Phenyl Mercury Acetate
	25.	Sodium Methane Arsonate
	26.	TCA (Trichloro acetic acid)
	27.	Tetradifon
	28.	Toxaphene(Camphechlor)
B.	**Pesticide formulations banned for import, manufacture and use**	
	1.	Carbofuron 50% SP
	2.	Methomyl 12.5% L
	3.	Methomyl 24% formulation
	4.	Phosphamidon 85% SL
C.	**Pesticide / Pesticide formulations banned for use but continued to manufacture for export**	
	1.	Captafol 80% Powder
	2.	Nicotin Sulfate
D.	**Pesticides Withdrawn**	
		(Withdrawal may become inoperative as soon as required complete data as per the guidelines is generated and submitted by the Pesticides Industry to the Government and accepted by the Registration Committee. (S.O 915(E) dated 15th Jun,2006)
	1.	Dalapon
	2.	Ferbam
	3.	Formothion
	4.	Nickel Chloride
	5.	Paradichlorobenzene (PDCB)
	6.	Simazine
	7.	Warfarin

Source: www.cibrc.nic.in

Annexure-VII

Pesticides Restricted for Use in the Country (As on 1st Jan, 2014)

S.No.	Name of Pesticides	Details of Restrictions
1.	Aluminium Phosphide	The Pest Control Operations with Aluminium Phosphide may be undertaken only by Govt./Govt. undertakings / Govt. Organizations / pest control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India except 1. Aluminium Phosphide 15 % 12 g tablet and 2. Aluminum Phosphide 6 % tablet.
2.	Captafol	The use of Captafol as foliar spray is banned. Captafol shall be used only as seed dresser. The manufacture of Captafol 80 % powder for dry seed treatment (DS) is banned for use in the country except manufacture for export. (S.O.679 (E) dated 17thJuly, 2001)
3.	Cypermethrin	Cypermethrin 3 % Smoke Generator, is to be used only through Pest Control Operators and not allowed to be used by the General Public.
4.	Dazomet	The use of Dazomet is not permitted on Tea.
5.	Diazinon	Diazinon is banned for use in agriculture except for household use.
6.	Dichloro Diphenyl Trichloroethane (DDT)	The use of DDT for the domestic Public Health Programme is restricted up to 10,000 Metric Tonnes per annum, except in case of any major outbreak of epidemic. M/s Hindustan Insecticides Ltd., the sole manufacturer of DDT in the country may manufacture DDT for export to other countries for use in vector control for public health purpose. The export of DDT to Parties and State non-Parties shall be strictly in accordance with the paragraph 2(b) article 3 of the Stockholm Convention on Persistent Organic Pollutants (POPs).
7.	Fenitrothion	The use of Fenitrothion is banned in Agriculture except for locust control in scheduled desert area and public health.
8.	Fenthion	The use of Fenthion is banned in Agriculture except for locust control, household and public health.
9.	Methoxy Ethyl Mercuric Chloride (MEMC)	The use of MEMC is banned completely except for seed treatment of potato and sugarcane.
10.	Methyl Bromide	Methyl Bromide may be used only by Govt./Govt. undertakings/Govt. Organizations / Pest control operators under the strict supervision of Govt. Experts or Experts whose expertise is approved by the Plant Protection Advisor to Govt. of India.
11.	Methyl Parathion	Methyl Parathion 50 % EC and 2% DP formulations are banned for use on fruits and vegetables.
12.	Monocrotophos	Monocrotophos is banned for use on vegetables.
13.	Sodium Cyanide	The use of Sodium Cyanide shall be restricted for Fumigation of Cotton bales under expert supervision approved by the Plant Protection Advisor to Govt. of India.

Source: www.cibrc.nic.in

Annexure-VIII

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

Safe use of Pesticides
कीटनाशकों का सुरक्षित इस्तेमाल


कीटनाशकों को पदार्थों के साथ यहाँ–वहाँ न ले जाएं


ताला चाबी लगा कर रखें


बच्चों की पहुच से दूर रखें


मूल पैकिंग वाले कीटनाशक ही खरीदे


इस्तेमाल से पहले लेबल और पुस्तिका पढे


सुरक्षात्मक कपड़े पहने।


सुझाई गई मात्रा को सही–सही प्रमाण में इस्तेमाल करे।


लकड़ी या पैडल से पानी को अच्छी तरह मिलाए


कुप्पी का इस्तेमाल करते हुए बिना गिराए भरे।


खाद्य पदार्थों या पानी के संग्रह के लिए कीटनाशक के डिब्बें का इस्तेमाल न करे।


हवा की दिशा में ही छिड़काव करें


नौजल को साफ करने के लिए मुंह से हवा भीतर न डालें


छिड़काव करते समय कुछ खाए–पीएं नहीं तथा न ही धुम्रपान करें


रिसाव वाले स्प्रेयर व डस्टर का प्रयोग न करें


यदि गलती से कपड़े व शरीर पर लग जाए तो दूषित कपड़े व शरीर के हिस्से को अच्छी तरह धो डालें


बच्चों को छिड़काव न करने दें


इस्तेमाल किए जाने वाले स्थान पर खाद्य वस्तु न रखें


खाने–पीने या धुम्रपान करने के पहले हाथ व मुंह को धो लें।


विषैला असर दिखाई देने पर प्राथमिक उपचार व डॉक्टर को बुलाए।


डॉक्टर को डिब्बा व पुस्तिका बताएं


तुरंत विशेष चिकित्सा प्राप्त करें


खाली डिब्बें को तोड़–फोड़ कर नष्ट कर दें तथा गाड़ दे


इस्तेमाल के बाद स्नान करे व कपड़े धो लें


वातावरण को दूषित न होने दें


उपचार किए गए खेतों में चेतावनी सूचना लगा दें

कीटनाशकों की विषाक्तता की श्रेणियों के पहचान-चिह्न

अत्यंत विषैला

अत्यधिक विषैला

सामान्य रूप से विषैला

थोड़ा से विषैला

भारत सरकार
कृषि मंत्रालय
कृषि एवं सहकारिता विभाग
वनस्पति संरक्षण, संगरोध एवं संग्रह निदेशालय
केंद्रीय एकीकृत नाशीजीव प्रबंधन केंद्र
एन. एच. – 4, फरीदाबाद – 121001 हरियाणा

Symptoms of poisoning and the treatment of poisoning for different pesticides

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
INSECTICIDES							
ORGANOPHOSPHATE INSECTICIDES							
1.	Quinalphos	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) Indigestion – 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 doctor/ Primary Health Centre immediately along with the original container, leaflet and label.	Nausea, vomiting, restlessness, tremor, apprehension, convulsions, coma, respiratory failure and death 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 – diarrhea, pinpoint and non-reactive pupils, respiratory difficulty, pulmonary edema, cyanosis, loss of sphincter control, convulsions, coma and heart block.	- Gastric lavage with 2-4 L. tap water. Catharsis with 30 gm (10 oz) sodium sulphate in the 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 (19% in 10 ml Ampules) intravenously every four hours. 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 (eye wash with isotonic saline). Wear rubber gloves while washing contact areas. In addition to atropine give 2-PAM (2- pyridine aldoxime methiodide) 1g 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, theophylline, aminophyllin, barbituarates ofrphenothiazines. Do not give atropine to a cyanotic patients. Give artificial respiration first then administer atropine.
2.	Monocrotophos	Extremely toxic	Bright red	Class I b Highly hazardous			
3.	Acephate	Moderately toxic	Blue	Class III Slightly Hazardous			
4.	Chlorpyriphos	Highly toxic	Yellow	Class II Moderately Hazardous			
5.	Ediphenphos	Highly toxic	Yellow	Class I b -Highly hazardous			
6.	Phorate	Extremely toxic	Red	Class Ia-Extremely hazardous			

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	
CARBAMATES								
7.	Carbofuran	Extremely toxic	Red	Class I b Highly hazardous Class II Moderately Hazardous Class II Moderately Hazardous Class II Moderately Hazardous		Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhea, epigastric pain, tightness in chest.	- Atropine injection 1 to 4 mg, Repeat 2 mg when toxic symptoms begin to occur (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, larvae 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. - Oxygen - Morphine, if needed. Avoid theophyllin and aminophyllin or barbituarates. 2-PAM and other oximes are not harmful and in fact contra indicated for routine usage. Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.	
8.	Carbaryl	Highly toxic	Yellow					
9.	Cartap	Highly toxic	Yellow					
FUNGICIDES								
10.	Mancozeb	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.	
11.	Hexaconazole	Slightly toxic	Green	Class III Slightly Hazardous				
12.	Propiconazole	Moderately toxic	Blue	Table 5 – Unlikely to present acute hazard in normal use				

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	
13.	Validamycin	Slightly toxic	Green	Table 5 – Unlikely to present acute hazard in normal use				
14.	Tricyclazole	Highly toxic	Yellow	Class II Moderately Hazardous				
15.	Iprobenphos	Moderately toxic	Blue	Class III Slightly Hazardous				
16.	Thiophanate methyl	Slightly toxic	Green	Table 5 – Unlikely to present acute hazard in normal use				
17.	Carbendazim	-do-	-do-	-do-				
18.	Kasugamycin	-do-	-do-	-do-				
HERBICIDES								
19.	Cyhalofopbutyl	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.	
20.	Butachlor	Moderately toxic	Blue	-do-				
21.	Pretilachlor	Slightly toxic	Green	Table 5 – Unlikely to present acute hazard in normal use				
22.	Chlorymuramethyl	Moderately toxic	Blue	-do-				
OTHER								
23.	Fipronil	Highly toxic	Yellow	Class II Moderately Hazardous		Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat, eyes and skin etc.	No specific antidote, Treatment is essentially symptomatic.	
24.	Imidacloprid	-do-	-do-	-do-				

Plate-1:

Symptoms of important diseases of rice

Bakanae

Bacterial leaf blight

Brown spot

Leaf Blast

Nodal Blast

Sheath Blight

False smut on rice panicles

Plate 2:

Important insect pests of rice

YSB Moth

White ear head due to YSB

Leaf folder moth

Folder leaf with larva

BPH adult and nymph (upper) and hopper burn (lower)

Gall midge adult (upper) and its damage i.e. silver shoot

Thrips damage


Gundhi bug adult

Plate 3:

Key parasitoids and predators of rice insect pests

Egg parasitoid emerging from YSB egg mass

Egg parasitoid, *Trichogramma chilonis*

Cocoons of larval parasitoid, *Cotesia flavipes*

Coccinella septumpunctata

Micraspis hirashimai

Cheilomenes sexmaculatus

Damselfly
(Agriocnemis femina femina)

Dragonlfly

Meadow grasshopper
(Conocephalus longipennis)

Wolf spider with egg sac

Orb spider
(Argiope catenulata)

Oxyopes sp.

Wolf Spider
(*Hogna aspersa*)

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