सत्यमेव जयते

INTEGRATED PEST MANAGEMENT PACKAGE FOR SOYBEAN

NATIONAL IPM PROGRAMME

राव स्वाप्रसं NIPHM

NCIPM

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 Pods of Soyabean

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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.

(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

CONTENTS

Title **Page No.**

Plates

1. INTRODUCTION

In India, soybean (*Glycine max* (L.) Merrill) has been the number one oilseed crop in terms of both area and production since 2005. The crop has shown unparallel growth over the last four decades; from an area of only 30,000 ha and production of 14,000 ton in 1970, the area reached 9.95 million ha with total production of 12.57 million ton in 2011, with an average national yield of 1264 kg/ha. The area has increased to about 10.69 million ha, and estimated production has reached to 12.68 million ton, respectively. Soybeans occupied 42% of India's total oilseeds and 25% of edible oil production. The crop currently earns about Rs. 6976 crores of foreign exchange through exports of defatted oil cake. The feasibility of growing soybean crop with minimum input/management lead to the rapid expansion in area and production with the result that India now ranks 4th in terms of global soybean area sown and 5th in terms of soybean production after USA, Brazil, Argentina and China. In India, soybean is mainly grown in the states of Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh, Chattisgarh, Nagaland and Gujarat as a rainfed crop during the rainy (Kharif) season. Over the years, cultivation of the crop has been instrumental in improving the socioeconomic conditions of large numbers of small and marginal farmers in the rainfed agro-ecosystems of central and peninsular India. The crop has potential of mitigating rampant protein energy malnutrition as well as becoming ideal food of the country on account of a number of nutraceutical and functional compounds. Initially, the soybean was free of diseases and insects in India. However, its continuous cultivation with simultaneous increase in area has led to increase in disease, insect and weed incidence. Currently, soybean is severely attacked about half a dozen major diseases, a dozen of insect pest and several major weeds. Yield losses due to individual disease/insect/weed species ranges from 20 to 100 per cent. However, with integrated pestmanagement schedule, 30-35 per cent additional yield can be obtained.

2. BIOTIC CONSTRAINTS

2.1. Major Insect Pests of National Significance

1. Stem fly (*Melanagromyza sojae* Zehntner)
2. Tobacco caterpillar (*Spodoptera litura* Fabricius)
3. Green semiloopers (*Chrysodeixis acuta* Walker, *Gesonia gemma* and *Diachrysia orichalcea* Fabriciussensu Hübner)
4. Girdle beetle (*Obereopsis brevis* Gahan)
5. Pod borer (*Helicoverpa armigera* Hubner)
6. White fly (*Bemisia tabaci* Gennadius)

2.2 Major Insect Pests of Regional Significance

1. Blue beetle (*Cneorane* spp. Jacoby) - Western MP
2. Leaf miner (*Aproaerema modicella* Deventer) - Maharashtra, Karnataka
3. Cotton grey weevil (*Myllocerus* spp.Weevil) - Delhi, Punjab
4. Bihar hairy caterpillar (*Spilosoma oblique* Walker) - Tarai region of Uttarakhand, Western MP
5. Leaf folder (*Hedylepta indicate* Fabricius) - Karnataka, Maharashtra, MP
6. Pink pod borer (*Cydiaptychora* sp. Meyr) - Northern Karnataka
7. Leaf defoliator (*Spodoptera exigua* Hübner) - Central and Western MP

2.3. Major Diseases of National and Regional Importance

S. No.	Disease	Pathogen	Scouting	Yield loss (%)	Distribution
1.	Rust	*Phakopsora pachyrhizi* H. Sydow & Sydow	Flowering to pod filling stage	30-100	Maharashtra, Karnataka, M.P, NE states, Kerala, Rajasthan, A.P. and Tamil Nadu (regularly occurring in Maharashtra, Karnataka, and NEH region)
2.	Yellow mosaic	Mungbean yellow mosaic virus Nariani	Early vegetative stage to physiological maturity stage	15-75	Uttarakhand, M.P., U. P., Delhi, Rajasthan, Haryana, Punjab, Himachal Pradesh, Karnataka and NE states
3.	Soybean mosaic	Soybean mosaic virus	Late vegetative stage	25-50	Uttarakhand, M.P., Rajasthan, U.P., Karnataka, Delhi, A.P., Maharashtra, Haryana, Punjab, Himachal Pradesh, Jharkhand and NE states
4.	Collar rot or Sclerotium blight	*Sclerotium rolfsii* Curzi	1-4 week after planting & mid to late flowering	30-40	Delhi, Uttarakhand, M.P., Maharashtra, Rajasthan, Karnataka and NE states
5.	Charcoal rot	*Macrophomina phaseolina (Rhizoctonia bataticola)* (Tassi) Goid	Mid to late flowering	77	Uttarakhand, M.P., Delhi, Rajasthan, Maharashtra, Karnataka and NE states
6.	Rhizoctonia root rot and aerial blight	*Rhizoctonia solani (Thanatephorus cucumeris)* Julius Kuhn	1-4 week after planting & mid flowering to pod formation following rain.	35	Uttarakhand, M.P, Delhi, Maharashtra, Jharkhand, Chattisgarh and NE states
7.	Bacterial pustule	*Xanthomonas campestris pv.glycines* Pammel	35 days after sowing to throughout the season	20	Uttarakhand, M.P., Rajasthan, Karnataka, A.P., Maharashtra, Himachal Pradesh, Jharkhand and NE states

8.	Anthracnose	*Colletotrichum dematium* f. sp. *truncatum* (Pers.) *Colletotrichum truncatum* (Schwein.) Andrus & W.D. Moore	All season	16-25	Uttarakhand, M.P., Rajasthan, Karnataka, A.P., Maharashtra, Himachal Pradesh, Tamil Nadu, Kerala, NEH states, Delhi and Chattisgarh,
9.	Myrothecium leaf spot	*Myrothecium roridum* Tode	Flowering to pod filling stage	20-40	M.P., Rajasthan, Karnataka, A.P., Maharashtra and Uttarakhand
10.	Alternaria leaf spot	*Alternaria alternata* (Fr.) Keiss & *A. tenuissima* (Kunze) Wiltshire	Post flowering stage	15	Uttarakhand, M.P, Karnataka, Delhi and NE states
11.	Indian bud blight	A strain of Groundnut bud necrosis virus	Late vegetative to pod filling stage	22	M.P., Rajasthan, Delhi, Karnataka, Maharashtra and Chattisgarh
12.	Purple seed stain	*Cercospora kikuchii* T. Matsumoto &Tomoy	Beginning of seed set to throughout	15-30	M.P, Maharashtra, Delhi, Karnataka and NE states
13.	Brown spot	*Septoria glycines*	Mid & late flowering to seed set	8-15	Uttarakhand, M.P., Rajasthan, Maharashtra, Himachal Pradesh and NE states
14.	Frog eye leaf spot	*Cercospora sojina* K.Hara	Flowering to seed set	22	Himachal Pradesh, M.P., Karnataka, Uttarakhand, U.P., Rajasthan and NE states
15.	Target leaf spot	*Corynespora cassiicola* (Berk. & M.A. Curtis) C.T.	Mid & late flowering to seed set	18-32	Himachal Pradesh, Uttarakhand, Chhatisgarh and NE states
16.	No-podding/ Phyllody/Bud proliferation	Etiology not known	Flowering to pod set	20-30	M.P., Karnataka, Himachal Pradesh and Maharashtra
17.	*Fusarium* seedling /collar rot	*Fusarium equiseti* Corda	All season	64	Delhi and M.P.
18.	Nematode	*Rotylenchulus reniformis* Linford and Oliveira, *Meloidogyne* spp. Goldiand *Pratylenchus* spp.	Pre sowing/ soil samples	6-17	M.P., Rajasthan and Maharashtra

2.4. Major Weeds of National and Regional Importance

2.4.1. Broad leaved weeds

Amaranthus viridis L.
Cyperus iria L., *Cleome viscosa* L.
Trianthema portulacastrum L.
Euphorbia geniculata

2.4.2. Grassy weeds

Dactyloctenium aegyptium (L.)Willd
Echinochloa spp. (L.) Beauv
Eleusine indica (L.) Gaten
Setaria glauca (L.) Beauv

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.

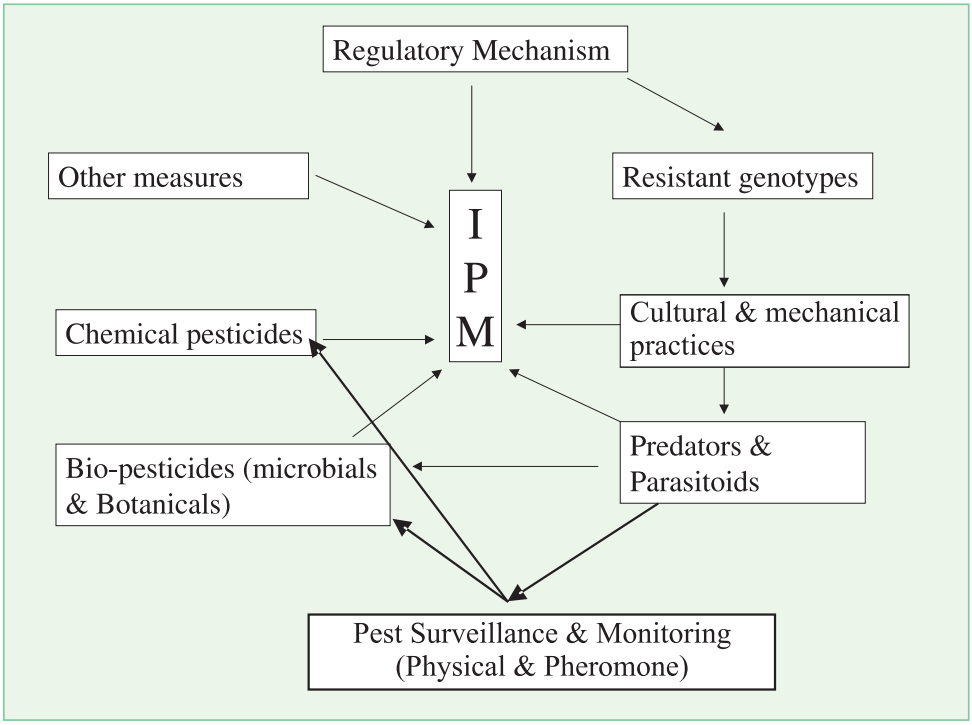


Fig 1. Diagrammatic representation of IPM components.

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 of 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 here under. 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:** - Survey teams should undertake regular insect pest and disease monitoring on pre-selected routes at 15 days interval and assess bio-control potential in addition to insect pest and disease situation to give early forewarnings. Record should be kept about insect pest and disease incidence and bio-potential fauna on 5 plants per spot selected randomly at 10 spots per ha. After every 10 km distance install sex pheromone trap for early deduction of *S. litura* @ 10 traps/ ha for mass trapping.
2. **Field scouting:** Field scouting should be undertaken by the farmers/ extension functionaries to keep a close watch on the appearance of insect pest, disease and bio-control fauna.

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.

Pheromone trap-monitoring - 5 traps/ha may be used to monitor *Helicoverpa/Spodoptera* population.

Disease monitoring

Surveillance on disease incidence and severity in the main field should be done along with insect-pest just after crop sowing/transplanting and at weekly intervals thereafter. In each of the field select 20 plants diagonally and observe, stem, leaves, fruits, etc. for disease symptoms & severity.

For root rot and crown rot diseases

Count the total number of plants showing the disease symptoms with severity. Uproot the plants and observe the roots/ crown rot to see the plant disease is because of any biotic (pathogen, nematode, insect damage etc.) or an abiotic factor (drought, excess moisture, physical damage etc).

For leaf spot and blight diseases

Observe five leaves from each plant (lower, middle and upper parts) and observe the symptoms. Count the total number of infected leaves and calculate the severity.

For viral diseases

Count the total number of plant showing the disease symptoms with severity (top, middle & lower portion). Observe distinguish viral disease symptoms on leaves, stems, flowers, fruits etc. Presence of vectors (aphids, hoppers, thrips, etc.) should also be observed carefully.

Nematode sampling

Collect 100 to 300 cm^3 (200-300 g) soil sample. Mix soil sample and pass through a coarse sieve to remove rocks, roots etc. Take a 600 cc sub sample of soil, pack lightly into a beaker uniformly. Place soil

in one of the buckets or pans half filled with water. Mix soil and water by stirring with paddle; allow to stand until water almost stops swirling. Pour all but heavy sediment through 20-mesh sieve into second bucket; discard residue in first bucket; discard material caught on sieve. Stir material in second bucket; allow to stand until water almost stops swirling. Pour all but heavy sediment through 200-mesh sieve into first bucket; discard residue in second bucket. Backwash material adhered on 200-mesh sieve (which includes large nematodes) into 250 ml beaker. Stir material in first bucket; allow to stand until water almost stops swirling. Pour all but heavy sediment through 325-mesh sieve into second bucket; discard residue in first bucket. Backwash material adhered on 325-mesh sieve (which includes small to mid-sized nematodes and silty material) into 250 ml beaker. More than 90% of the live nematodes are recovered in the first 5-8 mm of water drawn from the rubber tubing and the sample is placed in a shallow dish for examination.

3.1.1. Agro Eco System Analysis (AESA)

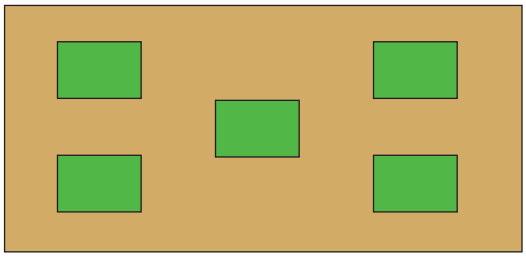
IPM has been evolving over the decades to address the deleterious impacts of synthetic chemical pesticides on environment ultimately affecting the interests of the farmers. In modern IPM (FAO, 2002) emphasis is given to Agro Eco System Analysis (AESA) where farmers take decisions based on larger range 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 sowing. 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.



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 plant
  - Number of dead plants
  - 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.
  - 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 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

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.

Model agro-ecosystem analysis chart

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

Courtsey: NIPHM, Hyderabad

Decision taken based on the analysis of field situation

Soil condition :

Weather condition :

Diseases types and severity :

Weeds types and intensity :

Rodent damage (if any) :

No. of insect pests :

No. of natural enemies :

Feeding/egg laying potential of different parasitoids/predators

Predators/ Parasitoids	Feeding potential/ Egg laying capacity
Ladybird beetle	Predatory rate of adult coccinellid on aphids is 50 aphids per day. It also feeds on the Lepidopteran species eggs.
Green lacewing	Larva can consume 100 aphids, 329 pupa of whitefly and 288 nymphs of jassids. It also feeds on Lepidopteran species eggs
Bracon hebetor	Egg laying capacity is 100-200 eggs/female. 1-8 eggs/larva.
Trichogramma spp.	Egg laying capacity is 20-200 eggs/female
Spiders	2-3 moths per day

Ecological Engineering for Pest Management

Ecological engineering for pest management has recently emerged as a paradigm for considering pest management approaches that rely on the use of cultural techniques to effect habitat manipulation and to enhance biological control. The cultural practices are reformed by ecological knowledge rather than on high technology approaches such as synthetic pesticides and genetically engineered crops.

Natural enemies may require

1. Food in the form of pollen and nectar for adult natural enemies.
2. Shelters such as overwintering sites, moderate microclimate and alternate host etc.

Ecological Engineering for Pest Management – Above ground

- Raising the flowering plants such as sunflower, sesame, okra, chrysanthemum, marigold, onion, coriander, carrot, mustard, radish, etc. compatible cash crops along the field border by arranging shorter plants towards main crop and taller plants towards the border to attract natural enemies as well as to avoid immigrating pest population.
- Do not apply chemical pesticides, when the P: D is favourable. The plant compensation ability should also be considered before applying chemical pesticides.

Ecological Engineering for Pest Management – Below ground

- Crop rotations with cereal crops which will break the continuity of soil borne pests as well as attract beneficial insects and predatory birds.
- Keep soils covered year-round with living vegetation and/or crop residue.
- Add organic matter in the form of FYM, vermicompost, decomposed crop residue which enhance below ground biodiversity.
- Reduce tillage intensity so that hibernating natural enemies can be saved.
- Apply balanced dose of biofertilizers and nutrients.
- Apply mychorrhiza and PGPR

- Apply *Trichoderma / Pseudomonas fluorescens* as seed, nursery treatment and soil application (if commercial products are used, check for label claim. However, biopesticides produced by farmers for own consumption in their fields, registration is not required).

3.2. Cultural practices

a. Cleaning of infected stubbles followed by deep summer ploughing, optimal fertilizer application, timely sowing, proper seedbed conditions and depth of sowing, optimum seeding rate and plant population, regular scouting, rogueing and destruction of infected crop/plant parts, elimination of collateral/alternate and reservoir hosts, crop rotation and intercropping, cultivation of soybean in rainy season only and avoidance of mono varietal culture. Inter-cropping soybean either with asa-fetida (early maturing variety) or maize or sorghum in the sequence of 4 rows of soybean with 2 rows of intercrop should be practiced. Such bio-diversity will help in build up and conservation of natural bio control fauna viz., coccinellid beetles, Chrysoperla etc. In girdle beetle and semilooper endemic areas, intercropping with maize or sorghum should be avoided.

b. Fertilizer dose

NPK and S at the rate of 20:60-80: 30-40:20 kg/ ha should be applied.

c. Seed treatment

Seed treatment by *Trichoderma viride* @ 5g or thiram 37.5% + carboxin 37.5% DS @ 3 g/kg seed for the management of seed, seedling and seed borne foliar diseases. This should be followed by seed treatment with *Bradyrhizobium* and Phosphate Solubilizing Bacteria (PSB) @ 5 + 5 gm / kg seed.

d. Sowing time

Sowing should be done timely when soil moisture is sufficient (8-12 cm depth) to ensure proper germination.

e. Seed rate and sowing

Optimum seed rate (65-75 kg/ ha) should be used depending upon seed size. After every 15 rows, a gap of one row should be given to provide moving space for spraying in standing crop.

3.3 Genetic Management

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

Insect pest resistant/ tolerant varieties

Insect pest	Resistant/tolerant varieties
Stem fly	JS 335, PK 262, NRC 12, NRC 37, MACS 124 and MAUS 2, MAUS 47
Tobacco caterpillar	JS 81-21, PS 564 and PK 472
Green semilooper	NRC 7, NRC 37, PUSA 16, PUSA 20, PUSA 24, JS 93-05, JS 97-52, MAUS 47 and JS 80-21
Girdle beetle	JS 71-05, NRC 7, JS 97-52, MAUS 32 and Indira Soya 9

Disease resistant/ tolerant varieties

Disease	Resistant/tolerant varieties
Rust	PK 1024, PK 1029, JS 80-21, Indira soybean 9 and MAUS 61-2
Sclerotium blight	NRC 37
Charcoal rot	NRC 2, NRC 37, JS 71 05, LSb 1, MACS 13 and JS 97-52
Rhizoctonia aerial blight	PK 472, PK 1042, PK 564 and SL 295
Anthracnose & pod blight	Bragg, Himso 1563, PK 472, JS 80-21, Pusa 37, VLS 21 and NRC 12
Bacterial pustule	PK 1029, PK 1042, JS 71-05, JS 90-41, Bragg, Himso 1563, Indira soya 9, KHSb 2, MAUS 32, NRC 7, NRC 37 and VLS 2
Yellow mosaic	PK 416, PK 472, PS 564, PK 1024, PK 1029, PK 1042, Pusa 37, SL 295, SL 525, SL 688 and JS 97 52
Soybean mosaic	JS 71-05, KHSb 2, LSb 1, MACS 58, MACS 124, Punjab 1 and VLS 2
Myrothecium leaf spot	JS 71-05, JS 335, MACS 13, MACS 124, MAUS 47 and NRC 7
Purple seed stain	JS 80-21 and Bragg
Frog eye leaf spot	Bragg, JS 80-21, KHSb 2 and VLS 21
Alternaria leaf spot	KHSb 2, NRC 2, PK 327, PK 1042, Himso 1563, JS 80-21, Pusa 37 and VLS 21

3.4. Mechanical Practices

- Collection and destruction of girdle beetle infested plant parts, egg masses and gregariously feeding larvae of hairy caterpillar and tobacco caterpillar should be done. Rogueing of *Sclerotium* affected seedlings and yellow mosaic affected plants should be undertaken.
- Erection of bird perches @ 10-12/ha.
- Installation of pheromone traps for monitoring incidence of *S. litura* and *H. armigera*.
- Use of Castor as trap crop for *tobacco* caterpillar and *Dhaincha* for girdle beetle.

3.5. Biological Control

3.5.1. Biological Control: Insects

- Conserve spiders, coccinellid beetles, tachinid fly, praying mantids, dragon fly, damsel fly, Chrysoperla and meadow grass hoppers through minimum use of broad spectrum pesticides, so as to exploit maximum potential of bio-control fauna.
- Release *Telenomus remus* @ 50000/ha against *S. litura.*
- Spray *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 @ 0.75 to 1.0 kg/ha for the management of semilooper complex (*Chrysodeixis acuta, Gessonia gemma, Diachrysia orichalcea* and defoliators).
- Spray SlNPV @ 250 LE/ha
- Spray of NSKE @ 5% for management of early stage larvae and sucking pest.

Major parasitoids of insect pests of soybean

Host: stem borers and green semilooper. Black small wasps but stout with clear wings and short antennae. Base of the hind leg is brown yellow to red. Female lays 1-20 eggs in each host larva. Immature parasites feed inside the host. Parasite larvae emerge from sides of the dead host and develop white overlapping cocoons near or below the host.

S.No.	Natural enemy category	Natural enemy	Pest attacked and feeding potential
1	Egg parasitoid	*Trichogramma chilonis*	Egg parasitoid of *Spodoptera* and *Helicoverpa*
		Tetrastichus	Egg parasitoid of *Spodoptera* and *Helicoverpa*
		Telenomus	• Egg parasitoid of *Spodoptera* and *Helicoverpa*, 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.
2	Larval parasitoid	*Ichneumon* promissorius	Larva parasitoid of *Spodoptera* and *Helicoverpa*
		Carcelia spp	Larval parasitoid of *Spodoptera* and *Helicoverpa*
		Diglyphus isaea	Larva parasitoid of *Spodoptera* and *Helicoverpa*
3.	Larval and pupal parasitoid	*Xanthopimpla flavolineata*	Larval borer Adult wasp is medium sized yellow orange in colour with black ovipositor
4.	Pupal parasitoids	*Encarsia formosa*	Pupal Parasitoids of white fly
		Eretmocerus spp	Pupal Parasitoids of white fly
		Lissopimpla excels	Pupal Parasitoids of *Helicoverpa*

Courtsy: NIPHM, Hyderabad

3.5.2. Biological Control: Diseases

- Seed soaking in mixture of cow urine (1:10) + asafoetida (0.01%) for 1 minute followed by two sprays of cow urine at 30 and 45 DAS or seed soaking in cow urine (1:10) for 1 minute for the management of collar rot.
- Three sprays of raw Neem oil @ 1.0% at 30, 45 and 60 DAS for the management of rust or sprays of cow milk at 50, 60 and 70 DAS or seed soaking in a mixture of cow urine (1:10) + asafoetida (0.01%) for 1 minute followed by sprays of cow urine at 50, 60 and 70 DAS for the management of rust.
- Seed soaking in mixture of cow urine (1:10) + asafoetida (0.01%) followed by two sprays of cow urine (1:10) at 30 and 45 DAS for the management of *Rhizoctonia* aerial blight.

- Seed soaking in mixture of cow urine (1:10) + asafoetida (0.01%) for 1 minute or above seed soaking followed by sprays of cow urine or only sprays of cow milk at 30 and 45 DAS for the management of Myrothecium leaf spot.
- Seed soaking in mixture of cow urine (1:10) + asafoetida (0.01%) or in cow urine alone for 1 minute for the management of bacterial pustule.

3.6 Chemical Control

Application of pesticides should only be resorted if pest population crosses the economic threshold levels as under:

Pest	Crop stage	Population/ meter
Blue beetle	Seedling	4 beetles
Green semilooper	Flowering	2 larvae
Tobacco caterpillar	Flowering	4 larvae
Girdle beetle	Flowering	10 % infestation
Helicoverpa armigera	Podding	3 larvae

Depending on insect infesting the crop use one of the following insecticides with recommended doses:

Insect	Insecticides and dose
Defoliators (*Spodoptera litura)* *(Helicoverpa armigera)*	Chlorantraniliprole 18.5% SC @ 150 ml/ha. Indoxacarb 15.8% EC @ 333 ml/ha *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 (Bt) @ 0.75 to 1.0 Kg/ha Quinalphos 25 EC @ 1000 ml/ha
White fly (*Bemisia tabaci*)	Thiamethoxam 30% FS @ 10 Kg/hg
Stem fly (*Melanogromyza sojae*)	Thiamethoxam 30% FS @ 10 Kg/hg Chlorantraniliprole 18.5% SC @ 150 ml/ha.
Pod borer (*Helicoverpa armigera* and *Cydia ptychora*)	Indoxacarb 15.8% EC @ 333 ml/ha *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 (Bt) @ 0.75 to 1.0 Kg/ha
Girdle beetle (*Obereopsis brevis*)	Triazophos 40 EC @ 625 ml/ha Chlorantraniliprole 18.5% SC @ 150 ml/ha.
Blue beetle (*Cneorane* spp.)	Indoxacarb 15.8% EC @ 333 ml/ha

Depending on disease incidence on the crop use one of the following fungicides with recommended doses:

Disease	Fungicide Dose
Charcoal rot, Collar rot and Rhizoctonia root rot	Thiram @ 3g or Thiram 37.5% DS + Carboxin 37.5% (a combi product) @ 3 g/kg seed.
Rhizoctonia aerial blight, Anthracnose and pod blight, Myrothecium leaf spot, Alternaria leaf spot, Purple seed stain, Brown spot, Frog eye leaf spot and Target leaf spot	Thiram @ 3g or Thiram 37.5% DS + Carboxin 37.5% (a combination product) @ 3 g/kg seed
Rust	Two to three sprays of Hexaconazole 5% EC @ 100 ml/ 100 l or Propiconazole 25% EC @ 500 g/ha at the interval of 10-15 days for the management of rust.
Yellow Mosaic and Soybean Mosaic	Seed treatment by Thiamethoxam 30% FS @ 10 ml/ha.
Nematode	Seed treatment with Carbofuran 3% CG @ 50000 ml/ha

- Poison baiting with 2% zinc phosphide at podding and green seed stage, preceded by 1 day pre-baiting or application of bromadiolone 0.005% ready to use at green seed stage for the control of rodents.

3.7 Weed management

The crop should be maintained weed free initially for 30 to 45 days by resorting two hand weeding or by pre-emergence application of Pendimethalin 30% EC @ 2.5-3.3 l/ha or Pendimethalin 38.7% CS @1500-1750 ml/ha or Pendimethalin 30%+ Imazethapyr 2% EC @ 2.5-3.0 l/ha or Metolachlor 50% EC @ 2 l/ha mainly for controlling grassy weeds and/or Fluchloralin 45% EC @ 2.22-3.33 l/ha for broad leaved weeds and/or Imazethapyr 10% SL @ 1.0 l/ha or Quizalofop ethyl 5% EC 0.75-1.0 l/ha or Quizalofop-p-tefuryl l4.41% EC 750-1000 ml/ha or Fenaxaprop-p-ethyl 9.3% w/w EC (9% w/v) @ 1111 ml/ha at 15-20 DAS and Fluchloralin 45% EC @ 2.22-3.33 l/ha should be incorporated into the soil immediately after sowing.

4.0 Generic IPM module based on vegetative stage

CROP STAGE/ PEST VIS-À-VIS IPM PRACTICES

S. No	Crop stage/pest	IPM practices
1	**PRE-SOWING**	
		Cultural practices 1. Deep ploughing in summer to expose soil-borne pathogens, nematodes and insect-pests, rhizomes and bulbs of perennial weeds. 2. Pre-monsoon sowing must be avoided. Sowing should be done when soil moisture is sufficient to ensure proper germination **Chemical control** 1. Fluchloralin 45% EC @ 2.22-3.33 l/ha should be incorporated into the soil for controlling broad leaved weeds.

2	**SEED & SEEDLING**	
	Insects and diseases	**Cultural practices** 1. Use insect/disease tolerant varieties. 2. Use recommended seed rate (65-75 kg/ha) 3. N.P.K. and S should be applied @ 20:60-80:20:20 kg/ha **Chemical control** 1. Seed treatment with Thiamethoxam 30% FS @ 10 ml/ha to prevent seedling mortality due to stem fly maggots and also to control white fly transmitting YMV. 2. Seed treatment with Thiram 75% DS @ 3 g/kg seed should be done. This should be followed by seed treatment with *Bradyrhizo bium japonicum* and Phosphate Solubilizing Bacteria (PSB) @ 5+5 g/kg seed. **Mechanical practice** 1. Rogue out collar rot affected seedlings. Crop should be maintained weed free initially for 4-6 weeks by resorting to timely inter-culture and hand picking and use of pre-emergence weedicides. Remove plants infested with gregarious *S. litura* or *Spilarctia obliqua*.
	Weeds	1. Crop should be maintained weed-free initially for 30-45 days be resorting to two hand hoeing/weedings. 2. Pre-emergence application of Alachlor 50% EC @ 5 l/ha or Alachlor 10% GR @ 15-25 kg/ha or Metolachlor 50% EC @ 2 l/ha for grassy weeds and/or Pendimethalin 38.7% CS @ 1500-1750 ml/ha or Metribuzin 70% WP @ 0.5-0.75 kg/ha for controlling both grassy and broad leaved weeds.
3.	**VEGETATIVE STAGE**	
	Girdle beetle, tobacco Caterpillar and hairy Caterpillar	**Mechanical practices** Collect and destroy girdle beetle infested plant parts, egg masses and gregariously feeding larvae of hairy caterpillar and tobacco caterpillar.
	Green semiloopers and girdle beetle	**Chemical control** Apply Triazophos 40% EC @ 625 ml/ha or Chlorantraniliprole 18.5% SC @ 150 ml/ha for controlling defoliators, tobacco caterpillars, stem fly and girdle beetle.
	Foliar diseases and rust	Two sprays of Hexaconazole 5% EC @ 100 ml/100 lit for the management of rust.
4.	**FLOWERING STAGE**	
	Green semilooper and Girdle beetle	**Chemical control** Apply Triazophos 40% EC @ 625 ml/ha or Chlorantraniliprole 18.5% SC @ 150 ml/ha. for controlling defoliators, tobacco caterpillars, stem fly and girdle beetle.
5.	**PODDING STAGE**	
	Rats	**Chemical control** Poison baiting with 2% Zinc phosphide at podding and green seed stage preceded by one day pre-baiting or application of Bromadiolone 0.005% ready to use at green stage for the control of rodents.

5.0 Advisories for different probable situations of Insect-pest incidence in Soybean

S.No.	Situation	Advisory
		Short
1	Girdle beetle infestation initiated in early crop stage	Watch for drooping and drying of leaves. Manually remove the infested plants or plant parts from below the girdles. Alternatively, spray Triazophos 40% EC @ 625 ml/ha. Spray of this insecticide will be effective if used within 7-10 days of girdling symptoms are noticed.
2	Girdle beetle infestation continues and observed during flowering and podding stages also.	Spray Triazophos 40% EC @ 625 ml/ha or Chlorantraniliprole 18.5% SC @ 150 ml/ha.
3	Girdle beetle infestation observed after crop growth is completed, i.e. after about 75 to 80 days of sowing.	No need to spray any insecticide. Crop is nearing maturity.
4	2-3 small larvae (1-3 instar) of green semilooper are observed in one m row length during early crop stage.	Spray *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 @ 0.75-1.0 g/ha if RH is more than 75 %.
5	4-6 small green semilooper larvae observed at flowering stage	If RH is > 75 % spray the crop with *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 @ 0.75-1.0 g/ha.
6	2-4 big sized green semilooper larvae (3rd instar onwards) observed at flowering stage	If population of big sized larvae is less than 4 larvae/ meter row and RH is more than 75%, spray the crop with *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 @ 0.75-1.0 g/ha. The spray may be repeated after 10 - 15 days. Spray with Chlorantraniliprole 18.5% SC @ 150 ml/ha or Triazophos 40% EC @ 625 ml/ha.
7	Crop history shows infestation by Spodoptera in previous years	Install pheromone traps @ 10/ha containing Spodoptera litura (Sl) lure and observe for egg masses and gregarious larvae. Do not handle pheromone septa with bare hands. Use clean cloth or cotton. Remove the egg masses and gregarious larvae.
8	Initial population of gregarious larvae / egg masses of Spodoptera observed.	Install bird perches @ 8-10 per acre. Spray *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 @ 0.75-1.0 g/ha if RH is more than 75 %. Do not spray if there is forecast of heavy rains in next 1-2 days.
9	Incidence of Spodoptera coincides with flowering stage of crop	Watch for egg masses and gregarious phase; remove and destroy them. In case of heavy incidence, spray the crop with Indoxacarb 15.8% EC @ 333 ml/ha. Do not spray if there is forecast of heavy rains in next 1-2 days.
10	Even one big sized (4th instar) Spodoptera larva/plant is observed at flowering stage	Immediately spray Indoxacarb 15.8% EC @ 333 ml/ha. Same insecticide should not be repeated for second spray. If needed, another insecticide should be used after 15-20 days if larval population is still observed damaging the crop. Spray operation should be carried out either in morning or late evening hours, as during day time larvae of Spodoptera hide in the soil crevices. This will also avoid adverse effect on parasitoids and predators.

11	Crop history shows infestation by *Helicoverpa* in previous years	Install pheromone traps @ 10/ha containing *Helicoverpa armigera* (Ha) lure. If 20-25 adult moths per trap are observed then spray Ha NPV@ 100 LE/acre along with one tea spoon of indigo and sticker. Do not spray if there is forecast of heavy rains in next 1-2 days.
12	Big sized larvae of *Helicoverpa* noticed feeding on pods.	Immediately spray Indoxacarb 15.8% EC @ 333 ml/ha.
13	Mixed population of green semilooper, *Spodoptera* and *Helicoverpa* is observed during flowering or early pod formation stage.	Immediately spray with Chlorantraniliprole 18.5% SC @ 150 ml/ha. Indoxacarb 15.8% EC @ 333 ml/ha.
14	Larval mortality of caterpillars due to infection of *Beauveria bassiana* is noticed.	Watch for increase in mortality. Spray of chemical insecticide can be postponed for some time. If dry spell prevails after infection of *Beauveria* on leaf eating caterpillars, then start application of chemical insecticides as stated above.
15	More than 4 adults of blue beetle seen at seedling stage	Spray Triazophos 40% EC @ 625 ml/ha. Repeat spray of Triazophos 40% EC @ 625 ml/ha if the population continues to increase.
16	Heavy seedling mortality due to stem fly infestation experienced in previous years	Spray with Thiamethoxam 30% FS @ 10 l/ha at 10-15 days after germination
17	Any unforeseen situation in Soybean Crop experienced.	Contact nearest Agricultural Officer, Agricultural University of Maharashtra State or DSR, Indore.

6.0 Zone wise IPM Recommendations

(I) North Plain Zone (Punjab, Haryana, Delhi and Uttarakhand)

Use of YMV resistant varieties, seed treatment with Thiamethoxam 30% FS @ 10 l/ha at 7-10 days after germination; spray of Triazophos 40% EC @ 625 ml/ha; manual removal of girdle beetle/Bihar hairy caterpillar/tobacco caterpillar infested plants.

(II) Central Zone (M.P., Rajasthan and North Maharashtra)

Installation of bird perches

Installation of Pheromone traps

Foliar spray of *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 @ 0.75-1.0 g/ha.

Need based application of Triazophos 40% EC @ 625 ml/ha.

(III) Southern Zone (South Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu)

Installation of bird perches

Installation of pheromone traps

Manual removal tobacco caterpillar infested plants

Spray of *Bacillus thuringiensis* var. *kurstaki*, Serotype H-39, 3b, Strain Z-52 @ 0.75-1.0 g/ha

Need based application of chemical insecticide e.g., Triazophos 40% EC @ 625 ml/ha

7.0 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 –VII.

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	Pesticides	• 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
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)

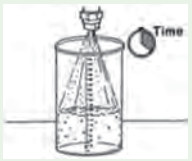
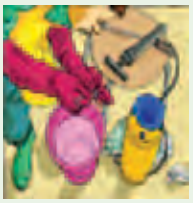
Courtsy: NIPHM, Hyderabad

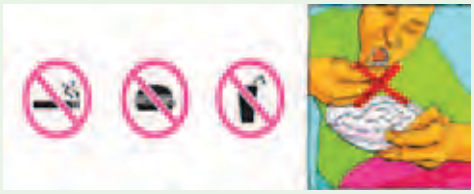
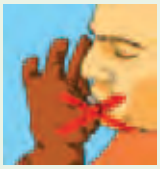
Do's and don't's in IPM

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-emergent 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 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.	Do not take any management decision without 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	Spray pesticides thoroughly to treat the undersurface of the leaves, particularly for mites, whiteflies, *Spodoptera* etc.	Do not spray pesticides only on the upper surface of leaves.
15	Apply short persistent pesticides to avoid pesticide residue in the soil and produce.	Do not apply pesticides during preceding 7 days before harvest.
16	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.	 Do not spray dust into the wind
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.	

Courtsy: NIPHM, Hyderabad

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 ha. For W P, 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}.

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

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) 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 L^{-1}

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

Formula:

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

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

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 = $\frac{2 \text{ x } 10000}{5 \text{ x } 100}$ = 40 L

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

Formula:

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

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 = $\frac{0.05 \text{ x } 3.0}{0.01}$ = 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 :

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

Example: To control *Spodoptera* 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?

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

ii) Emulsifiable concentrates (EC)

Specification required:

1) Spray volume as L ha^{-1}

2) Concentration as percentage of a.i desired.

Concentration of commercial EC as a.i. (%).

Formula:

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

Example: 2000 L of 2 % Quinalphos 25% EC spray is to be prepared. How much commercial 25 % EC is required?

$$\text{Liters of Methyl parathion} = \frac{2 \times 2000}{25} = 160 \text{ L}$$

Annexure-I

List of Recommended Pesticides for Soybean (As on 15-10-2013, CIBRC)

Herbicides	Insecticides	Fungicides
Alachlor 50% EC	Carbofuran 3% CG	Hexaconazole 5% EC
Alachlor 10% GR	Chlorantraniliprole 18.5% SC	Triadimefon 25% WP
Anilofos 30% EC	Dichlorvos 76% EC	Carboxin 37.5% + Thiram 37.5% DS
Chlorimuron Ethyl 25% WP	Ethion 50% EC	
Clomazone 50%EC	Imidacloprid 48% FS	
Fenoxaprop-p-ethyl 9.3% /w EC (9% w/v)	Indoxacarb 15.8% EC	
Fluazifop-p-butyl 13.4% EC	Malathion 50% EC	
Fluchloralin 45% EC	Methyl Parathion 2% DP	
Imazethapyr 10% SL	Phorate 10% CG	
Metolachlor 50% EC	Profenofos 50%	
Metribuzin 70% WP	Quinalphos 25% EC	
Pendimethalin 30% EC	Quinalphos 1.5 DP	
Pendimethalin 38.7% CS	Thiacloprid 21.7% SC	
Propaquizafop 10% EC	Thiamethoxam 30% FS	
Quizalofop-ethyl 5% EC	Triazophos 40% EC	
Quizalofop –p-tefuryl 4.41% EC		
Imazamox 35% + Imazethapyr 35% WG		

Source: www.cibrc.nic.in

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
Fumigants	Pellets		• Finely grounded solid active ingredients suspended in the liquid with inert materials
liquids			• 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.
1.3	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. Equipments

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 pestiside

Safe use of Pesticides
कीटनाशकों का सुरक्षित इस्तेमाल

कीटनाशकों की विषाक्तता की श्रेणियों के पहचान-चिह्न

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 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					

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	
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				
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.		Moderately toxic	Blue	-do-				

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	
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 I. Important insect pests of soybean

Spodoptera litura

Gridle beetle

Semilooper

Plate II. Important diseases of soybean


Alternaria leaf spot


Bacterial pustule


Rhizoctonia aerial blight


Rhizoctonia root rot


Frog eye leaf spot

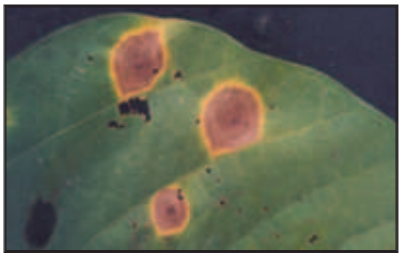

Myrothecium leaf spot


Sclerotium root rot


Charcoal rot


Pod blight


Septoria root rot


Target leaf spot


Yellow mosaic

NOTES

NOTES

NOTES

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