



IPM PACKAGE NO. 27



INTEGRATED PEST MANAGEMENT PACKAGE

FOR

TOBACCO



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

IPM PACKAGE FOR TOBACCO

CONTENTS

Subject	Page No.
Foreward	i
Preface	ii
Acknowledgements	iii
I. Major Pests :	
A. Pests of National Significance	1
B. Pests of Regional Significance	2
II. Pest Monitoring :	
A. Agro Eco System Analysis (AESA)	2
B. Survey / Field Scouting	3
C. Pest Monitoring through Pheromone / Yellow Pan/Sticky traps etc.	3
D. Economic Threshold levels (ETLs)	4
III. Integrated Pest Management Strategies :	
A. Cultural Practices	4
B. Mechanical Practices	4
C. Biological Control Practices	5
D. Botanical Pesticides	5
E. Chemical Control Measures	5
F. Weed Management Practices	6
G. Nematode Management Practices	6
IV. Stage-wise IPM Practices to be adopted in Tobacco cultivation	7-10
V. Do's and Don'ts in tobacco IPM	11
VI. Safety parameters	12-15
Annexures -I to III	16-22



Government of India
Ministry of Agriculture
(Department of Agriculture & Cooperation)
DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE
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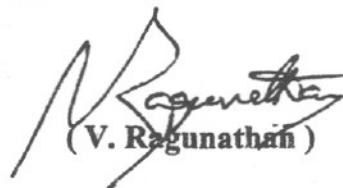
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FOR E W A R D

Integrated Pest management (IPM) approach has been globally accepted for achieving sustainability in agriculture. It has become more relevant due to a number of advantages like safety to environment, pesticide-free food commodities, low input based Crop Production Programme etc. Though IPM approach has been taken up since 1981, its impact has not been felt until 1994. Human Resource Development has helped to sensitise extension functionaries and farmers about the usefulness of IPM.

For successful implementation of IPM, the scattered information on various components of this eco-friendly approach forms basic necessity. In this direction, initial attempts were made in 1992 to harmonise the IPM Package of Practices of various crops. Subsequently concerted efforts were made in 1998, 2001 and 2002 to update and develop IPM package of practices for agricultural and horticultural crops. Presently, IPM package of practices for 51 crops have been finalised to help the extension workers and farmers to manage the pests/ diseases and to minimise the over use/ misuse of chemical pesticides. Efforts have been made to incorporate the relevant available technical input provided by the scientists of ICAR Institutes/ SAUs and State Departments of Agriculture. However, suggestions for further improvement in future publication/ revision will be of immense help. Hopefully, these IPM Package of Practices will be useful for the Researchers, Plant Protection Workers and Farmers alike.

April 1, 2002


(V. Ragnathan)

P R E F A C E

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

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

IPM technology manages the pest population in such a manner that economic loss is avoided and adverse side effects of chemical pesticides are minimized. The IPM packages encompasses various management strategies for containing the pest and disease problems. Pest monitoring is also one of the important component of IPM to take proper decision to manage any pest problem. It can be done through Agro-Ecosystem Analysis (AESA), field scouting, light, pheromone, sticky/yellow pan traps. The economic threshold levels (ETL) of important pests and diseases are also given in the packages to take appropriate control measures when pest population crosses ETL.

These IPM packages developed with the technical inputs from experts from Indian Council of Agriculture Research, State Agricultural Universities, Central Directorate of Plant Protection, Pesticide Industries and State Departments of Agriculture/Horticulture will provide technical backup in the management of pests, diseases, weeds, nematodes and rodents in the Indian Agriculture and Horticulture. These will also be useful in reducing the pesticide residues in exportable agricultural commodities and would also help in the management of pests/diseases/weeds/nematodes which may get inadvertently introduced in the country.

IPM Package of Practices for Agricultural and Horticultural crops will be helpful to minimize the ill effects of chemical pesticides to promote the IPM for sustainable production. These packages will be useful for the researchers, extension workers and farmers alike who are engaged in the agricultural practices.

April 1, 2002



(A.D. Pawar)
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IPM PACKAGE FOR TOBACCO

I. MAJOR PESTS

A. Pests of National Significance:

1. Insect pests

- | | | |
|-----|---------------------------------|--------------------------------|
| 1.1 | Tobacco leaf eating caterpillar | <i>(Spodoptera litura)</i> |
| 1.2 | White fly | <i>(Bemisia tabaci)</i> |
| 1.3 | Stem borer | <i>(Scrobipalpa heliopa)</i> |
| 1.4 | Ground beetle | <i>(Mesomorphus villiger)</i> |
| 1.5 | Tobacco bud worm | <i>(Helicoverpa armigera)</i> |
| 1.6 | Tobacco aphid | <i>(Myzus nicotianae)</i> |
| 1.7 | Cigarette beetle | <i>(Lasioderma serricorne)</i> |

2. Diseases

Nursery

- | | | |
|-----|---------------|--|
| 2.1 | Damping off | <i>(Pythium aphanidermatum)</i> |
| 2.2 | Leaf blight | <i>(Phytophthora parasitica varnicotianae)</i> |
| 2.3 | Anthracnose | <i>(Colletotrichum tabacum)</i> |
| 2.4 | Frog eye spot | <i>(Cercospora nicotianae)</i> |

Field

- | | | |
|-----|-------------------------|---|
| 2.5 | Black shank | <i>(Phytophthora paasitica varnicotianae)</i> |
| 2.6 | Tobacco mosaic virus | <i>(Marmor tabaci)</i> |
| 2.7 | Tobacco leaf curl virus | <i>(Ruga tabaci)</i> |
| 2.8 | Root knot nematode | <i>(Meloidogyne spp.)</i> |
| 2.9 | Brown spot | <i>(Alternaria alternata)</i> |

3. Weeds

- | | |
|-----|-----------------------------------|
| 3.1 | <i>Orabanche spp.</i> |
| 3.2 | <i>Cyperus rotundus</i> |
| 3.3 | <i>Medicago denticulata</i> |
| 3.4 | <i>Euphorbia spp.</i> |
| 3.5 | <i>Agropyron repens</i> |
| 3.6 | <i>Trianthium portulacastrum.</i> |

B. PESTS OF REGIONAL SIGNIFICANCE

1. Insect Pests

- | | | |
|-----|-----------------|---------------------------------|
| 1.1 | White grub | (<i>Holotrichia spp.</i>) |
| 1.2 | Root bug | (<i>Stibaropus tabulatus</i>) |
| 1.3 | Green stink bug | (<i>Nezara viridula</i>) |
| 1.4 | Rove beetle | (<i>Bledius latiusculus</i>) |
| 1.5 | Male cricuctus | (<i>Gryllotalpa african</i>) |
| 1.6 | Gran hannus | (<i>Acrida exultala</i>) |

2. Diseases

- | | | |
|-----|--------------------------------------|----------------------------------|
| 2.1 | Collar rot | (<i>Sclerotium roffsii</i>) |
| 2.2 | Fusarium wilt | (<i>Fusarium oxysporum</i>) |
| 2.3 | Powdery mildew | (<i>Erysipha cihoracearum</i>) |
| 2.4 | Sore shin | (<i>Rhizoctonia solani</i>) |
| 2.5 | Cucumber mosaic virus | - |
| 2.6 | Tobacco etch virus | - |
| 2.7 | Tobacco vein necrosis
Virus (PVY) | - |

II. PEST MONITORING

A. Agro Eco System Analysis (AESA)

AESA 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 practices. 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.

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

B. Survey/Field Scouting

The objective of surveys through roving surveys is to monitor the initial development of pest and diseases in endemic areas. Therefore, in the beginning of crop season survey routes based upon the endemic areas are required to be identified 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 observed the pest and disease occurrence at the intervals as stipulated here under. The plant protection measures are required to be taken only when pests and diseases cross ETL as per results of field scouting.

1. **Roving survey:** Undertake roving survey at every 10 km distance initially at weekly intervals and thereafter at 10 days intervals (depending upon pest population). Record incidence of bollworms on all host crops of the locality. Observe at each spot 20 plants at random. Record the population of sucking pests on these plants. Record population potential of different biocontrol fauna. Record the major disease and their intensity.

2. **Field scouting:** Field scouting for pests and biocontrol fauna by extension agencies and farmers once in 3-5 days should be undertaken to workout ETL. For sucking pests, population should be counted on three leaves (top & middle portion) per plant. For budworm eggs terminal leaves/buds should be observed. Observe larvae on buds and leaves per plant. For per cent incidence count total and affected buds/leaves on the plant and work out the per cent infestation. The State Department of Agriculture should make all possible efforts by using different media, mode and publicity to inform the farmers for field scouting in the specific crop areas having indication of pest or disease build up.

C. Pest Monitoring through Pheromones/Yellow Pan/Sticky Traps etc.

Certain pests require positioning of various kinds of traps like pheromones, yellow pan, sticky traps to monitor the initial pest build up. Therefore, the State Department of Agriculture is to initiate action for positioning of different kinds of traps based upon the result of roving surveys at the strategic locations at village level. While the concepts need to be popularise amongst farming community, the State department of Agriculture is to take greater initiative for pest monitoring through specific pheromone trapping methods as per following details :

i) **Pheromone trap monitoring-** Use pheromone trap for monitoring of tobacco caterpillar and bud worm. Install pheromone at a distance of 50 m @ 10 traps/ha for each insect pest. Use specific lure for each insect pest species and change it after every 20 days. Trapped moths should be removed daily.

- ii) **Yellow pan/sticky traps** : Set up yellow pan/sticky traps for monitoring white fly @ 12 yellow pan/sticky traps per ha. locality available empty palmoline tins coated with grease/vasline/castor oil on outer surface may also be used.

D. Economic Threshold Levels (ETLs):

- | | | | |
|----|------------------------|---|--|
| 1. | Tobacco caterpillar | - | Nursery- 6 Seedling damaged/m ² |
| 2. | Nursery Tobacco aphid- | | 2% plants infested |
| 3. | Tobacco bud worm | - | 10% plants infested |

III. INTEGRATED PEST MANAGEMENT STRATEGIES:

A. Cultural practices.

1. Deep summer ploughing to expose soil inhabiting/resting stages of insects, pathogens, nematode population and weeds.
2. Rabbing the seed beds with paddy husk/straw.
3. Soil solarization of seed beds with white alkathene sheet (50-100 G) for 4-6 weeks.
4. Destruction of crop residues viz. left over nurseries, Stalks and dried leaf trash.
5. Selection of healthy seedlings for planting.
6. Use of disease resistant/tolerant varieties for management of black shank and TMV.
7. Raised beds with proper drainage for management of nursery diseases.
8. Use optimum/recommended seed rate.
9. Use optimum fertilizers.
10. Timely harvest of mature leaves.
11. Growing of trap crops like castor (for tobacco caterpillar); Targets (bud worm); gomgelly, jowar, green grams and chillies (for orobanche).
12. Growing non-host crops like Cotton, marigold, chillies and Redgram (for root-knot nematode).
13. Follow crop rotation.
14. Periodical hand weeding of young shoots (for Orobanche).
15. Phytosanitary measures to prevent spread of TMV in field.

B. Mechanical Practices :

1. Collection and destruction of egg masses and tiny caterpillars from trap as well as main crop.
2. Removal and destruction of leaf curl infected plants if they are more than 2% in the transplanted crop.
3. Remove stem borer infested seedlings and destroy them at the time of planting.
4. Hand picking of bud worms on 30-50 days old crop.

C. Biological Control :

1. Conservation :

- a) *Aphidius* sp., *Bracon* sp. and predators like coccinellids, syrphids are to be conserved by avoiding unnecessary insecticidal sprays.
- b) Grow castor and Targets as trap crops on the bunds to conserve natural enemy fauna.
- c) Install bird percher @ 20/ha.

2. Augmentation

- a) Inundative release of *Telenomus remus* @ 40,000/ha. thrice at weekly intervals commencing the first release three weeks after sowing in the nursery against tobacco caterpillar.
- b) Spray SLNPV twice @ 250 LE/ha. for management of *S. litura* .
- c) Spray HANPV twice between 30-50 days in field crops @ 500 LE/ha. for the management of bud worm.
- d) Spray *Bacillus thuringiensis* Var. *kurstaki*, commercial preparation @ 1.5 kg/ha. against bud worm.
- e) Incorporation of bio-agent *Trichoderma harzianum* @ 100 g/m².

D. Botanical pesticide

- a) 1% neem seed kernel suspension (NSKS) spray on 3 week old seedlings; 2% NSKS on 4 week old seedlings and 5% NSKS in field crop for management of tobacco caterpillar.
- b) Apply pongamia cake or neem cake powder @ 5 g mixed with 25 g of sand at plant base for management of ground beetle.

E. Chemical Control.

- a) Chemical pesticides should be used on need basis as a last resort. Only when pest population intensity crossed economic threshold level, the safer pesticides should be applied judiciously.
- b) Foliar spray of endosulfan 0.05% or chlorpyrifos 0.075% for management of tobacco caterpillar based on ETL.
- c) Application of endosulfan 0.05% or chlorpyrifos 0.05% @ 75 ml solution/plant in planting hole for management of ground beetle.
- d) In white fly endemic areas adopt the following schedule commencing from 4 weeks after germination in the nursery and 10 days after planting in the field at weekly intervals.

1st spray	-	Chlorpyrifos 0.05%
2 nd spray	-	*Acephate 0.075%
3 rd spray	-	*Monocrotophos 0.05%
4 th spray	-	Oxydemeton methyl 0.04%

- e) Application of endosulfan @ 20 ml/10 l water at 30 and 40 days after germination and before pulling out the seedlings in the nursery. Spray endosulfan @ 20 ml/10 l. of water or *fenvalerate @ 5 ml/10 l water at 20 and 30 days after planting in the field for the management of stem borer.
- f) ETL based application of endosulfan 0.07% for management of bud worm (*H. armigera*).
- g) Application of Copper oxychloride 0.2%, Bordeaux mixture 0.4% and systemic fungicide like Metalaxyl 8%+Mancozeb 64% WP @ 5kg/ha for the management of damping off, leaf blight and frog eye spot in nursery.
- h) Application of Carbendazim 50% W.P. @ 225g/ha for the control of anthracnose in tobacco nursery.
- i) Spray/drench the plants with Copper oxychloride 50%WP @2.5kg/ha or Metalaxyl 8%+Mancozeb 64% WP @ 5kg/ha for the management of black shank in the field.

F. Weed mangement practices.

- i) Deep summer ploughing of nursery and field trapping and rabbing the nursery area and interculture.
- ii) For the management of Orobanche in the field, the practices to be followed are-
- deep summer ploughing
 - growing of trap crops like gingelly, jowar, green gram and chillies
 - periodical hand weeding of young shoots (unflowered) with spear
 - crop rotation with Sorghum/maize/groundnut helps the suppression of weeds.

G. Nematode management practices.

- deep summer ploughing of nursery
- growing non-host crops like Cotton, marigold, chillies and redgram.
- removal and destruction of weeds
- rabbing of nursery beds
- Application of Basamid G @ 30 g/m² in nursery beds 15 days before sowing.

IV. STAGEWISE IPM PRACTICE TO BE ADOPTED IN TOBACCO CULTIVATION.

Crop stage/pests	IPM practices to be adopted
1. Pre-sowing	<ol style="list-style-type: none"> 1. Deep summer ploughing of nursery. 2. Preparation of raised nursery beds with proper drainage. 3. Rabbing with paddy husk/straw. 4. Soil solarization by wrapping with alkathene sheets (50-100 G) for 4-6 weeks. 5. Growing non-host crops like Cotton, marigold, chillies and redgram in root knot nematode endemic areas. 6. Adopt proper crop rotation. 7. Incorporation of bioagent <i>Trichoderma harzianum</i> 100 g/m² bed). 8. Mixing of endosulfan 4% dust @ 40 kg/ha in top soil or drenching with chlorpyrifos 0.04% one day before sowing to control subterranean insects.
2. Seedling stage	<ol style="list-style-type: none"> 1. Foliar spray of Copper oxychoride 0.2%, Bordeaux mixture 0.4% and Systemic fungicide like Metalaxyl 8%+Mancozeb 64% @ 5kg/ha for the management of damping off, leaf blight, frog eye spot and collar rot. 2. Foliar spray of Carbendazim 50% W.P. @225g/ha for the management of anthracnose.
1. Nursery diseases	
3. Insect pest of nursery	<ol style="list-style-type: none"> 1. Growing castor as ovipositional trap crop around the nursery and collection and destruction of egg masses and tiny larvae. 2. Installation of pheromone traps @ 10/ha. 3. Spray NSKS 1% on 3 week old seedlings and 2% NSKS on 4 week old seedlings or SLNPV @ 250 LE or B.t @ 1 kg/ha. 4. Application of endosulfan 0.025% or chlorpyrifos 0.05% or acephate 0.075% insecticides when the pest reaches ETL. 5. Application of insecticide bait Jaggery 6.25 kg+ rice bran 25 kg + insecticide @ /ha @ endosulfan 2 L or chlorpyrifos 2 L during outbreak situation and cyclonic weather.
a) Tobacco caterpillar	
b) Stem borer	<ol style="list-style-type: none"> 1. Deep plough left over nurseries to prevent carry over. 2. Spray endosulfan @ 20 ml/10 L of water at 30 and 40 days after germination and just before pulling the seedlings.

c) Whitefly

1. Removal and destruction of alternate weed hosts.
2. Avoid cultivation of brinjal and sunflower in the vicinity of tobacco nurseries.
3. Adopting the schedule

1st spray	-Chlorpyriphos 0.05%
2 nd spray	-*Acephate 0.075%
3 rd spray	-*Monocrotophos 0.05%
4 th spray	-Oxydemeton methyl 0.04%

commencing from 4 weeks after germination at weekly intervals.

4..Planted/Field crops

a) Ground beetle

1. Apply pongamia cake or neem cake powder @ 5 g mixed with 25 g of sand at plant base or keeping grass heaps in between plant rows after sprinkling water on the soil at a distance of 6 m apart to attract the beetles and dusting with 5% *Carbaryl @ 10 kg/ha or *Chlorpyriphos 1.5% @ 20 kg/ha next day or application of insecticides in bait form viz. endosulfan @ 1 lit or chlorpyriphos @ 1 L mixed with 16.5 kg jaggery and 66 kg rice bran/ha or apply endosulfan 20 ml, chlorpyriphos 25 ml @ 75 ml/plant in the planting hole.

b) Whitefly

1. Removal and destruction of alternate weed hosts.
2. Avoid cultivation of brinjal and sunflower in the vicinity of the field.
3. Avoid leaf curl infected seedlings for transplanting.
4. Removal and destruction of leaf curl infected plants if they are less than 2%.
5. Setting up of yellow sticky traps @ 12/ha.
6. Adopting the schedule

1st spray	-Chlorpyriphos 0.05%
2 nd spray	-*Acephate 0.075%
3 rd spray	-*Monocrotophos 0.05%
4 th spray	-Oxydemeton methyl 0.04%

commencing from 10 days after planting in whitefly endemic areas at weekly intervals

c) Stem borer

1. Removal and destruction of borer infested seedlings at the time of planting.
2. Removal and destruction of stubbles after harvest to prevent carry over
3. Spray endosulfan @ 20 ml/10 l of water at 20 and 30 days after planting in the field.

-
- d) Tobacco caterpillar
1. Install 10 lure pheromone traps/ha. 20 days after planting.
 2. Collection and destruction of egg masses and tiny caterpillar.
 3. Spraying of hot spots thoroughly with 5% N\$KS or NPV 250 LE/ha or Endosulphan/Chlorpyriphos @ 0.05% or *Monocrotophos 0.054% or *Acephate 0.075% or *Methomyl 0.038%.
- e) Tobacco bud worm
1. Monitoring the pest from 4 weeks after planting by pheromone traps
 2. Growing marigold as trap crop around tobacco
 3. Spray Ha NPV @ 500 LE/ha or *Bacillus thuringiensis* var. kurstaki 1 kg/ha.
 4. ETL based application of insecticides viz. Monocrotophos @ 25 ml or *Fenvalerate @ 10 ml/10 l of water.
- f) Tobacco aphid
1. Give one prophylactic spray in early winter with acephate 75 g a.i. or acetamiprid @ 50 g a.i./ha. Subsequent spray should be given only on infested plants at 10-15 days interval with any of the above insecticides.
- g) Black shank
1. Spray/drench the plants with copper oxychloride 50% WP @ 2.5 kg/ha or metalaxyl 8% + mancozeb 64% WP @ 5 kg/ha in the field and use varieties viz., MC-Nair-12, CM-12 CA and K-326 (tolerant variety) resistant.
- h) Brown spot
1. Depending upon the extent of infection, spray of *mancozeb @ 0.2% or *propeconazole @ 0.1% after each harvest or after every two harvests.
 2. Early destruction of crop residues such as stalks and dried leaf trash to avoid primary source of inoculum.
 3. Fields having past history of disease epiphytotics should be avoided.
 4. Timely harvest after disease appearance helps in reducing secondary inoculum.
- i) Leaf curl
1. Regular weeding in the field should be done to check white fly build up.
 2. Roguing of the plants if the infected plants are less than 2%.
 3. Use recommended insecticides for vector (whitefly) control.
-

j) Tobacco mosaic virus

1. Use of resistant varieties viz. Hema MR Jayasree MR Godavari Spl and L-1158 in endemic areas.
2. Follow Phytosanitary measures like washing hands and implements before and after field operations and roguing the diseased plants early in the season.
3. Prophylactic sprays with various inhibitors of plant origin like *Basella alba* and *Bougainvillea spectabilis* and neem leaf extracts @ 1% on 30th, 40th and 50th day of planting tobacco.

4. Post harvest

a) Cigarette beetle

1. Keep the godown and surroundings clean by removing tobacco bits and dust to avoid breeding of the pest.
2. Cover the doors and windows with wire mesh (20 mesh screen to 2.54 cm.) to prevent entry of beetles into the godown.
3. Redry FCV tobacco at 77^oC.
4. Spray the godown with *malathion 50 EC @ 20 ml/10 l of water before storing of tobacco as prophylactic treatment.
5. Store tobacco at 16-18^oC in the ware house.
6. Treat the tobacco with insect growth regulator methoprene (Kabat) @ 10 ppm.
7. Treat the tobacco seed with *malathion 50% EC @ 1 l/1 tonne of seed for protecting it from Cigarette beetle.

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

V. DO's AND DON'Ts IN TOBACCO IPM.

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 exposed to sun light at least for 2-3 weeks.	Do not blank or irrigate the field after ploughing at least 2-3 weeks to allow desiccation of weeds' bulb and rhizomes of perennial weeds
2. Grow only recommended varieties for a particular region.	Do not grow varieties which are not recommended for a particular area of which have become susceptible to diseases/pests in general
3. Use recommended insecticides (Annexure-2).	Do not use banned insecticides (Annexure-2).
4. Use recommended insecticides at appropriate time and dose.	Do not use insecticides one week before harvest.
5. Use recommended dose of fungicides for the control of Pythium and leaf blight in tobacco nursery.	Same sprays should not exceed more than two and to be applied only 3 weeks after sowing.
6. Use NPV in the evening hours.	Do not spray NPV in bright sunlight as it inactivates the virus.
7. Exercise judicious phytosanitary measures for the management of tobacco mosaic virus.	Precautions should be exercised during agronomical operation i.e. avoid mechanical contact of plants and careful use of agricultural implements.

VI. SAFETY PARAMETERS IN PESTICIDES USAGE

S. No	Name of pesticide	Classification as per Insecticides Rules, 1971	Colour of Toxicity Triangle	WHO classification by hazard	First aid measures	Symptoms of poisoning	Treatment of poisoning	Waiting period (No. of days)
INSECTICIDES								
ORGANOCHLORINE PESTICIDES								
1.	Endosulfan	Highly toxic	Yellow	Class II - Moderately Hazardous	<p>Remove the person from the contaminated environment.</p> <p>In case of (a) Skin contact - Remove all contaminated clothings and immediately wash with lot of water and soap; (b) Eye contamination - Wash the eyes with plenty of cool and clean water, (c) Inhalation - Carry the person to the open fresh air, loosen the clothings around neck and chest, and (d) Ingestion - If the victim is fully conscious, induce vomiting by tickling back of the throat. Do not administer milk, alcohol and fatty substances. In case the person is unconscious make sure the breathing passage is kept clear without any obstruction. Victim's head should be little lowered and face should be turned to one side in the lying down position. In case of breathing difficulty, give mouth to mouth or mouth to nose breathing.</p> <p>Medical aid: Take the patient to the doocotr/Primary Health Centre immediately along with the original container, leaflet and label.</p>	Nausea, vomiting, restlessness, tremor, apprehension, convulsions, coma, respiratory failure and death	<ul style="list-style-type: none"> - Gastric lavage with 2-4 L. tap water - Catharsis with 30 gm. (10 oz) sodium sulphate in one cup of water - Barbiturates in appropriate dosages repeated as necessary for restlessness or convulsions - Watch breathing closely, aspirate, oxygen and/or artificial respiration, if needed. - Avoid oils, oil laxatives and epinephrine (Adrenalin) - do not give stimulants. - Give calcium gluconate (10% in 10 ml. Ampules) intravenously every four hours. 	
ORGANOPHOSPHATE PESTICIDES								
	Chlorpyriphos	Highly toxic	Yellow	Class II - Moderately Hazardous		Mild - anorexia, headache, dizziness, weakness, anxiety,	For extreme symptoms of O.P poisoning, injection of atropine (2-4 mg., for	

3.	Monocrotophos	Extremely toxic	Bright red	Class I b - Highly hazardous		tremors of tongue and eyelids, miosis, impairment of visual acuity.	adults, 0.5-1.0 mg for children) is recommended, repeated at 5-10 minute intervals until signs of atropinization occur.
4.	Acephate	Moderately toxic	Blue	Class III - Slightly hazardous		Moderate- nausea, salivation, lacrimation, abdominal cramp, vomiting, sweating, slow pulse, muscular tremors, miosis.	Speed is imperative
5.	Oxydemeton methyl	Highly toxic	Yellow	Class I b - Highly Hazardous			- 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;
6.	Malathion	Moderately toxic	Blue	Class III - Slightly hazardous		Severe - diarrhoea, pinpoint and non-reactive pupils, respiratory difficulty, pulmonary edema, cyanosis, loss of sphincter control, convulsions, coma and heart block.	- Keep airways open, Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed. - For ingestion lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact, wash with soap and water (eyes- wash with isotonic saline). Wear rubber gloves while washing contact areas. In addition to atropine give 2-PAM (2-pyridine aldoxime methiodide). 1 g and 0.25 g for infants intravenously at a slow rate over a period of 5 minutes and administer again periodically as indicated. More than one injection may be required.
							Avoid morphine,

							<p>theophyllin, aminophyllin, barbiturates or phenothiazines.</p> <p>Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.</p>
CARBAMATES							
7.	Carbaryl	Highly toxic	Yellow	Class II - Moderately hazardous		<p>Constriction of pupils, salivation, profuse sweating, lassitude, muscle incoordination, nausea, vomiting, diarrhoea, epigastric pain, tightness in chest.</p>	<ul style="list-style-type: none"> - Atropine injection 1 to 4 mg. Repeat 2 mg when toxic symptoms begin to recur (15-60 minute intervals). - Excessive salivation - good sign, more atropine needed. - Keep airway open. Aspirate, use oxygen, insert endotracheal tube. Do tracheotomy and give artificial respiration as needed. - For ingestion, lavage stomach with 5% sodium bicarbonate, if not vomiting. For skin contact was with soap and water (eyes - wash with isotonic saline). Wear rubber gloves while washing contact area. - Oxygen - Morphine, if needed. <p>Avoid theophyllin and aminophyllin or barbiturates. 2-PAM and other oximes are not harmful and in fact contra indicated for routine usage.</p>

							Do not give atropine to a cyanotic patient. Give artificial respiration first then administer atropine.	
FUNGICIDES								
8.	Copper oxychloride	Moderately toxic	Blue	Class III - Slightly hazardous		Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin etc.,	No specific antidote. Treatment is essentially symptomatic.	
9.	Metalaxyl	-do-	-do-	-do-				
10.	Carbendazim	Slightly toxic	Green	Table 5 - Unlikely to present acute hazard in normal use.				
RODENTICIDES								
11.	Aluminium phosphide	Extremely toxic	Bright red	Class I a - Extremely hazardous		Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and Skin etc.	No specific antidote. Treatment is essentially symptomatic.	

SYNTHETIC PYRETHROIDS								
12.	Fenvalerate	Highly Toxic	Yellow	Class II - Moderately Hazardous		Headache, palpitation, nausea, vomiting, flushed face, irritation of nose, throat eyes and skin, allergic manifestations etc.,	No specific antidote. Treatment is essentially symptomatic.	

AGRO ECO SYSTEM ANALYSIS (AESA)

AESA 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 inter-relationship for growing healthy crop. Such a critical analysis of the field situations will help in taking appropriate decision on management practices. The basic components of AESA are :

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

The methodology of AESA is as under :-

A. Field Observation:-

- a) Enter the field at least 5ft. away from the bund. Select a site with a dimension of 1 sq. mt. randomly.
- b) Record the visual observations in following sequence :-
 - i) Flying insects (both pests & defenders)
 - ii) Close observation on pests and defenders which remain on the plants.
 - iii) Observe pests like *S. litrura* and defenders like ground beetle /rove beetle /earwigs by scrapping the soil surface around the plants.
 - iv) Record disease and its intensity.
 - v) Record insect damage in percentage.
- c. Record parameters like number of leaves, branches plant height and reproductive parts of the selected plants which should be flagged for making observation in the following weeks.

- d) Record the types of weeds, their size and population density in relation to crop plant.
- e) Record soil conditions viz. flooded, wet or dry.
- f) Observe rodent live burrows
- g) Repeat the step (a) to (f) in four sites randomly selected.
- h) Record the climatic factors viz. sunny, partially sunny, cloudy, rainy etc. for the preceding week.

B. Drawing :

First draw the plant with actual number of branches/leaves etc. at the centre on a chart. Then draw pests on left side and defender on the right side. Indicate the soil condition, weed population, rodent damage etc. Give natural colours to all the drawing for instance, draw healthy plant with green colour, diseased plant/leaves with yellow colour, White drawing the pests and the defenders on the chart care should be taken to draw them at appropriate part of the plant, where they are seen at the time of observation. the common name of pest and defenders and their population count should also be given alongwith diagram. The weather factor should be reflected in the chart by drawing the diagram of sun just above the plant if the attribute is sunny. If cloudy , the clouds may be drawn in place of sun. In the case of partially sunny, the diagram of sun may be half masked with clouds.

C. Group discussion and decision making :

The observations recorded in the previous and current charts should be discussed among the farmers by raising questions relating to change in pest and defender population in relation to crop stages, soil condition, whether factors such as rainy, cloudy or sunny, etc. The group may evolve a strategy based upon weekly AESA, ETL and corresponding change in P : D ratio and take judicious decision for specific pest management practices.

AESA BY EXTENSION FUNCTIONARIES :

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

AESA BY FARMERS :-

After a brief exposure during IPM demonstrations/field trainings, farmers can practice AESA in their own fields. Wherever trained farmers are available their experiences could be utilised in training their fellow farmers in their own villages. Thus a large group of farmers could be made proficiently competent in undertaking weekly AESA thereby empowering themselves in decision making on any specific pest situations. Farmers -to-farmers training approach will go a long way in practicing IPM on a large area on sustainable basis.

INSECTICIDES RECOMMENDED AND BANNED ON TOBACCO

RECOMMENDED	BANNED
<ul style="list-style-type: none"> ● Endosulfan ● Chlorpyrifos ● *Monocrotophos ● *Acephate ● *Methomyl ● Oxydemeton methyl ● Carbaryl ● *Fenvalerate ● NSKS ● NPV ● <i>Bacillus thuringiensis</i> 	<ul style="list-style-type: none"> ● Endrin ● B.H.C. ● Lindane ● Toxaphene ● Aldrin ● Dieldrin ● DDT ● Heptachlor ● Chloradane ● Parathion Dust ● All insecticides in dust form on Foliage

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

BASIC PRECAUTIONS IN PESTICIDE USAGE**A. Purchase:**

1. Purchase only JUST required quantity e.g. 100,250,500 or 1000 g/ml for single application in specified area.
2. Do not purchase leaking containers, loose, unsealed or torn bags.
3. Do not purchase pesticides without proper/ approved LABELS.

B. Storage:

1. Avoid storage of pesticides in the house premises.
2. Keep only in original container with intact seal.
3. Do not transfer pesticides to other container.
4. Never keep them together with food or feed/ fodder.
5. Keep away from the reach of children and livestock.
6. Do not expose to sun-light or rain water.
7. Do not store weedicides along with other pesticides.

C. Handling:

1. Never carry/ transport pesticides along with food materials.
2. Avoid carrying bulk - pesticides (dusts / granules) on head, shoulders or on the back.

D. Precautions for Preparing Spray Solution :

1. Use clean water.
2. Always protect your NOSE, EYES, MOUTH, EARS and HANDS.
3. Use hand gloves, face mask and cover your head with cap.

4. Use polyethylene bags as hand gloves, handkerchiefs or piece of clean cloth as mask and a cap or towel to cover the head (Do not use polyethylene bag contaminated with pesticides).
5. Read the label on the container before preparing spray solution.
6. Prepare spray solution as per requirement.
7. Do not mix granules with water.
8. Concentrated pesticides must not fall on hands etc. while opening sealed containers. Do not smell the sprayer tank.
9. Avoid spilling of pesticide solution while filling the sprayer tank.
10. Do not eat, drink, smoke or chew while preparing solution.
11. The operator should protect his bare feet and hands with polyethylene bags.

E. **Equipment:**

1. Select right kind of equipment.
2. Do not use leaky, defective equipment.
3. Select right kind of nozzle.
4. Don't blow/clean clogged- nozzle with mouth. Use old tooth- brush tied with the sprayer and clean with water.
5. Do not use same sprayer for weedicide and insecticide.

F. **Precautions for applying pesticides:**

1. Apply only at recommended dose and dilution.
2. Do not apply on hot sunny day or strong windy condition.
3. Do not apply just before the rains and also after the rains.
4. Do not apply against the wind direction.
5. Emulsifiable concentrate formulations should not be used for spraying with battery operated ULV sprayer.
6. Wash the sprayer and bucket etc with soap water after spraying.
7. Containers, buckets etc. used for mixing pesticides should not be used for domestic purposes.

8. Avoid entry of animals and workers in the fields immediately after the spraying.

G. Disposal:

1. Left over spray solution should not be drained in ponds or water lines etc. Throw it in barren isolated area, if possible.
2. The used/ empty containers should be crushed with a stone / stick and burried deep into soil away from water source.
3. Never re-use empty pesticide container for any purpose.
