



IPM PACKAGE NO. 61



INTEGRATED PEST MANAGEMENT PACKAGE

FOR
SPINACH



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 SPINACH

CONTENTS

Subjects	Page No.
Foreward	i
Preface	ii
Acknowledgements	iii
I. Major Pests	1
A. Insect pests	
B. Diseases	
C. Weeds	
II. Pest Monitoring	2
A. Agro Eco-System Analysis	
B. Field Scouting	
C. Yellow pan/sticky traps	
III. Integrated Pest Management Strategies	2-4
A. Cultural Practices	
B. Mechanical Practices	
C. Biological Practices	
D. Chemical Practices	
IV. Do's and Don't's in IPM	4
V. Safety Parameters in Pesticides Usage	5-6



Government of India
Ministry of Agriculture

Department of Agriculture & Cooperation

DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE
N. H. IV, FARIDABAD - 121 001 (HARYANA)

DR. P. S. CHANDURKAR
Plant Protection Adviser
to the Government of India

FOREWARD

Integrated Pest Management (IPM) approach has been globally accepted for achieving sustainability in agriculture. It has become more relevant due to a number of advantages like safety to environment, pesticide-free food commodities, low input cost 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, 2002 and 2003 to update and develop IPM Package of Practices for agricultural and horticultural crops. Presently, IPM Package of Practices for 77 crops have been finalized to help the extension workers and farmers to manage the pests and diseases and to minimize 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/Horticulture. 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.

P. S. Chandurkar
14/8/03
(P. S. CHANDURKAR)

August, 2003

P R E F A C E

In order to minimize 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.

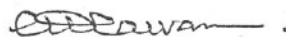
With a view to provide technical knowledge to the extension functionaries and farmers in the States, first National Workshop on IPM for harmonization of Package of Practices was organized at National Plant Protection Training Institute (NPPTI), Hyderabad during June 29-30, 1992. Subsequently workshops were organized on April 15-17, 1998 and Nov. 5-6, 1998 at the Directorate of Plant Protection, Quarantine & Storage, Faridabad and IPM Package of Practices for 20 crops were finalized 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 14-17, 2001 and Feb. 20-22, 2002 respectively to update 20 available IPM Packages and develop 31 new IPM Packages especially for horticultural crops. Sixth and Seventh National Workshop held at Central Insecticides Laboratory, Faridabad on 4th-5th July, 2002 and 9th-10th January, 2003 respectively for 18 IPM Packages and Eighth National Workshop was held at NPPTI, Hyderabad on 28th-29th May, 2003 for 8 IPM Packages. In these Workshops, 77 IPM Package of Practices for cereal crops (Rice, Wheat, Maize, Sorghum, Millets), commercial crops (Cotton, Sugarcane, Tobacco, Tea, Betelvine, Saffron), pulse crops (Pigeonpea, Gram, Black gram/Green gram, Pea, Rajma), oilseeds (Groundnut, Soybean, Rapeseed/Mustard, Sesame, Olive, Safflower, Castor, Sunflower, Oilpalm), vegetables (Potato, Onion, Tomato, Brinjal, Okra, Chillies, Cruciferous vegetables, Leguminous vegetables, Cucurbitaceous vegetables, Broccoli, Spinach, Lablab bean, Garlic), fruits (Citrus, Banana, Apple, Mango, Guava, Grapes, Jackfruit, Pineapple, Sapota, Pomegranate, Litchi, Papaya, Apricot, Peach, Pear, Cherry, Walnut, Ber, Amla, Loquat, Strawberry, Watermelon, Fig, Phalsa, Persimmon, Custard apple, Raspberry, Kiwi, Passion fruit), spice and plantation crops (Small Cardamom, Large Cardamom, Black Pepper, Ginger, Coriander, Cumin, Fennel, Coconut, Cashew and Arecanut) have been finalized.

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 encompass various management strategies for containing the pest and disease problems. Pest monitoring is one of the important components of IPM to take proper decision to manage any pest problem. It can be done through Agro-Ecosystem Analysis (AESAs), 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 Agricultural 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 agriculture and horticulture. These will also be useful in reducing the pesticide residues in 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 IPM packages will be useful for the researchers, extension workers and farmers alike who are engaged in the agricultural practices.

7th October, 2003



(A. D. Pawar)
Addl. PPA-cum-Director(IPM)

ACKNOWLEDGEMENTS

The IPM Package of Practices for Spinach crop was discussed and finalized in the National Workshop on IPM held at CIL, Faridabad during 9-10 January, 2003. The input received from the following experts is thankfully acknowledged :

- (i) Chairman Dr. A.D. Pawar, Director (IPM)
Dte. of P.P.Q. & S., Faridabad
- (ii) Co-Chairman Dr. Raj Singh, JD(Bio)
Tech. Session Dte. of P.P.Q. & S., Faridabad
- (iii) Coordinator- Sh. K.K. Singh, Asstt. Director (Ent)
Tech. Session Dte. of P.P.Q. & S., Faridabad
- (iv) Expert Inputs
1. Dr. U.S. Singh, Nematologist, IICRP on Betelvine, RAU, Pusa, Bihar
 2. Dr. N.L.M. Tripathy, Sr. S.M.S., UPDASP, Deptt. of Horticulture, Lucknow
 3. Sh. Ashok Shukla, PPO(PP), CIPMC, Baroda
 4. Dr. R.P. Misra, PPO(E), CIPMC, Lucknow
 5. Sh. P. Manickam, PPO(PP), CIPMC, Bangaore,
 6. Sh. A..P. Sinha, APPO, CIPMC, Kolkota
 7. Sh. Dinesh Sachan, PPO, Deptt. of Hort., Lucknow
 8. Sh. C. Elangowan, PPO(E), CIPMC, Trichy
 9. Dr. S.K. Verma, PPO, CIPMC, Patna
- (v) Technical Input
1. Sh.S.P.Singh, APPO, IPM Div., Dte. of PPQ&S, Fbd.
 2. Sh. K.S. Sharma, SSA-III, IPM Div., Dte. of PPQ&S, Fbd
 3. Sh. Yogesh Kunwar, SSA-III, IPM Div., Dte. of PPQ&S, Fbd
 4. Sh. R.S. Tomer, SSA-III, IPM Div., Dte. of PPQ&S, Fbd
 5. Sh. M.C. Sharma, SSA-III, IPM Div., Dte. of PPQ&S, Fbd
 6. Sh. Laxmi Chand, TO-II, IPM Div., Dte. of PPQ&S, Fbd
 7. Mohd. Abrar Alam, Steno, IPM Div., Dte. of PPQ&S, Fbd
 8. Sh. N.K. Mishra, LDC, IPM Div., Dte. of PPQ&S, Fbd

IPM PACKAGE FOR SPINACH

I. MAJOR PESTS:-

(A) Insect pests:

- i) Leaf miner (*Liriomyza trifoli*)
- ii) Spinachcrown mite (*Rhizoglyphus sp.*)
- iii) Caterpillars-
 - (a) *Spodoptera exigua*
 - (b) *Spodoptera sp.*
 - (c) *Helicoverpa armigera*
 - (d) *Agrotis ipsilon*
 - (e) *Hymenia recurvalis*
- iv) Aphids

(B) Diseases:

- i) Downy mildew
- ii) Anthracnose
- iii) Cladosporium leaf spot
- iv) Stemphylium leaf spot
- v) Damping-off
- vi) Root rot

(C) Weeds:

(A) Monocot weeds

- (i) Burmuda grass (*Cynodon dactylon*)
- (ii) Nut grass (*Cyperus rotundus*)
- (iii) Darnel (*Loium temulentum*)
- (iv) Polypogon (*Polypogon monspiliensis*)

(B) Dicot weeds

- (i) Dock's (*Rumex sp.*)
- (ii) Sweet clover (*Melilotus sp.*)
- (iii) Wild pea (*Lathyrus aphaca*)

II. PEST MONITORING:

1. Agro Eco System Analysis (AESA)

AESA is an approach, which can be gainfully employed by extension functionaries and farmers to analyse field situations for pests, defenders, soil conditions, plant health, the influence of climatic factors and their relationship for growing healthy crop. A critical analysis of the field situations will help or enhance in decision making skill for implementation of 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.

2. Field scouting:

AESA requires skill and the trained farmers can able to undertake exercises. However, remaining farmers can do field scouting in their own fields at regular intervals to monitor the major pest situation. It helps to reduce pesticide usage to a large extent.

3. Yellow pan/sticky traps:

Set up yellow pan/sticky traps for monitoring thrips @ 10 traps per ha. Locally available empty yellow tins coated with grease/castor oil on outer surface may also be used as yellow pan trap.

III. IPM STRATEGIES:

A) Cultural practices:

- i) Line spacing is maintained at 20 cm. and thinning is done to maintain plant spacing within lines at about 10-12 cm.
- ii) To improve germination, seeds are soaked in water over night before sowing.
- iii) For winter crop use 10-15 kg. seed/ha and for summer crop 25-30 kg/ha.
- iv) Application of FYM @ 25 tonnes/ha along with land preparation.
- v) Thinning of over crowded seedling is essential.

- vi) Usually irrigation is done at 4-5 days intervals in summer and 8-10 days intervals in winter.
- vii) Crop rotation is needed against white rust.

B) Mechanical Practices :

- i) Collection of egg masses of *Spodoptera sp.* etc.
- ii) Harvesting/cutting of leaves at regular intervals helps to reduce the spread of pests/disease.
- iii) Use of light trap against insect pests during early hours of night.
- iv) Installation of pheromone traps against *Spodoptera sp.*
- v) Use of yellow sticky traps against aphids, serpentine leaf miner, etc.
- vi) Weeding is essential because spinach can not compete well with the weeds.
- vii) Provide bird perches for the control of leaf caterpillars.

C) Biological Practices:

- i) Conserve all natural enemies existing in the crop ecosystem like coccinellids, rove beetles, ground beetles, crickets, meadows grass hoppers, dragon/damsel flies, spiders and different parasitoids. Keep pesticide free zone area for growing healthy and pollution free crop.
- ii) Use *Trichoderma* powder along with the soil and also as seed treatment @4-8 gm. per kg seed against soil/seed borne pathogens.
- iii) Spraying NPV @ 250 LE per ha in 400-500 litre of water.
- iv) NSKE (5%) may be sprayed, use neem cake to soil, if grub occurs regularly.

D) Chemical Practices:

The use of pesticide should be discouraged as spinach is a leafy vegetable. Being a short duration crop, insect pests can be managed using botanicals, *Bacillus thuringiensis*, Nuclear Polyhedrosis Virus (NPV) and following regular cultural practices. This will help in conservation of coccinellids, syrphids and other natural enemies to keep most of the pests' population below economic damage.

IV. DO'S AND DONT'S IN IPM:

Do's	Don'ts
1. Weeding and hoeing in the plant periphery should be regularly carried out keeping in mind to expose the soil borne pathogens to unfavourable environment conditions.	Do not damage the root system, main or sub main roots.
2. Use fertilizers and manures as per recommendations.	Avoid imbalanced use of fertilizers.
3. Application of pesticides should be on the basis of ETL and pest defender ratio only.	Do not apply chemical pesticides on blind recommendation or calendar basis.
4. Use only recommended and comparatively safer chemical pesticides where necessary.	Do not mix two pesticides.
5. Be specific in dose and quantity of water.	Avoid indiscriminate use of pesticides and wrong sprayers.
6. Spray in morning or evening hours so that pollinators are not hit.	Do not spray crop during flowering and in noon hours as honey bees visit the crop.
7. Encourage the use bio-fertilizers along with compost.	Do not use FYM which has not been properly decomposed.

BASIC PRECAUTIONS IN PESTICIDE USAGE

A. Purchase:

1. Purchase only JUST required quantity e.g 100,250,500 or 1000g/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 levels/leaflets.

B. Storage

1. Avoid storage of pesticides in the house premises.
2. Keep pesticides only in original containers with intact seal.
3. Do not transfer pesticides to other containers.
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 sunlight 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, shoulder or on the back.

D. Precaution for preparing spray solution

1. Use clean water.
2. Always protect your NOSE, EYES, MOUTH, EARS, and HANDS.
3. Use hand gloves, face masks and cover your head with cap.
4. Use polythene bags as hand gloves, handkerchiefs or pieces of clean clothes as masks and a cap or towel to cover the head(Do not use polythene bags contaminated with pesticides).
5. Read the label/leaflets on the container before preparing spray solutions.
6. Prepare spray solution as per requirement.
7. Do not mix granules with water.
8. Concentrated pesticides must not fall on hands or other body parts while opening sealed container. Do not smell the sprayer tank.
9. Avoid spilling of pesticides solution while filling the sprayer tank.
10. Do not eat, drink, smoke or chew while preparing and applying spray solution.
11. The operator should protect his bare feet and hands with polythene bags.

E. Equipments

1. Select right kind of equipments.
2. Do not use leaky, defective equipments.
3. Select right kind of nozzles.
4. Do not blow/clean clogged-nozzles 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. Precaution for spraying pesticides:

1. Apply only 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 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 but should be dumped in barren isolated area.
2. The used/empty containers should be crushed with a stone/stick and buried deep into soil away from water sources.
3. Never re-use empty pesticide container for any other purpose.