Validated IPM Technologies for Selected Crops – Mango

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Validated IPM Technologies for Selected Crops

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Mango

India is the second largest producer of fruits in the world sharing about 10% of fruit market out of a total production of 370 million tonnes in the world. In spite of large scale production of fruits, it has not been possible to meet the requirement of ever growing population. Increase in India's fresh produce has also not made any major dent in the international trade so far except for few fruits.

Of the several fruit crops, 'mango' known as 'king of fruits' is one of the most delicious and important fruits and occupies a place of pride amongst all the fruits grown in the country. It covers about 35 per cent of area and accounts for 22 per cent of the total production of fruits in the country, which is highest in the world with India's global share of about 54 per cent. Among various states, Uttar Pradesh is the largest producer of mango (37.5%) (Table 1) followed by Andhra Pradesh (19.9%) and Bihar (14.7%) with a productivity of 9, 12.5 and 12 tonnes per hectare, respectively.

Mango has adapted very well to diverse agro-climatic conditions prevailing in India. The country can boast of having the largest available germplasm wealth of mangoes with about 1000 cultivars. However, despite the country having a comparative advantage over other mango producing countries in terms of total production, the productivity continues to be low. Thus, even among various states, there is a wide gap in productivity which is rather low in Uttar Pradesh. One of the major constraints for low productivity in mango is high incidence of insect pests and diseases. More than 200 insect species and 70 diseases have been reported to affect the mango crop, resulting in a total yield loss of about 20-60 per cent.

The management strategy for these insect pests and diseases remains largely confined to chemical pesticides. Only during bloom stage itself farmers give 3-5 sprays with powerful tractor mounted sprayers which destroy the tender inflorescence as well as pollinators leading to wide-spread problem of physiological disorders and ultimately affecting the yield. Prevailing pest control schedules are not conducive for effective pest management, ecosystem and quality production apart from the other problems of pest resistance and resurgence. Strategy of the reliance on chemicals has to be given up in the present era of WTO wherein the pesticide residues in fruits are totally discouraged.

Realizing the need to have an ecofriendly approach to tackle the insect pest and disease problems in mango dominated region of UP, a project on IPM was started under NATP Mission Mode, in five villages in Malihabad belt of UP in a participatory approach with the main aim of reducing dependence on chemical pesticides and at the same time improving the ecosystem as a whole, obtain high quality produce to attain export competitiveness in global market and for improving the socio- economic status of small and marginal farmers.

During IPM validation programme several insect pests, diseases and weeds were observed in the mango orchards, the box on the next page details the key pests of mango crop.

Table 1. Area, production and productivity of mango in India and Uttar Pradesh (2000-2001)

	Area (000 ha)	Production (000 tonnes)	Productivity (t/ha)
India	1522.6	10237.0	6.7
Uttar Pradesh	252.0	3162.4	9.0

Major Pests of Mango in Uttar Pradesh and Other Regions

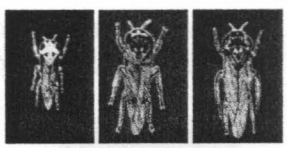
	Idioscopus clypealis, I. nitidulus and *Amritodus atkinsoni*
Mealy bug	*Drosicha mangiferae*
Inflorescence midge	*Erosomyia indica*
Fruit fly	*Bactrocera dorsalis* and *B. zonatus*
Leaf webber	*Orthaga euadrusalis*
Stone weevil	*Sternochetus mangiferae*
Stem borer	*Batocera rufomaculata*
Shoot gall psylla	*Apsylla cistellata*
Scale insects	*Chloropulvinaria polygonata*
Diseases	
Powdery mildew	*Oidium mangiferae*
Die back	*Botryodiplodia theobromae*
Anthracnose	*Colletotrichum gloeosporides*
Sooty mold	*Capnodium* sp.
Bacterial canker	*Xanthomonas campestris*
Weeds	
Congress grass	*Parthenium hysterophorus*
Bermuda grass	*Cynodon dactylon*
Jhonson grass	*Sorghum vulgare*
Nut grass	*Cyperus rotvndus*
Lamb grass	*Chenopodium album*

Key Pests and their Diagnostic Details

Insect pests

(i) Leaf hopper

Hoppers have a wedge shaped body with broad head and narrow abdomen towards the back. The hind pair of legs is well adapted for quick hops. They are grey in colour, have two to three spots on the abdomen and scutellum. Some species have a prominent white band across the light brown wings and measure 4-4.8 mm. They have tubular sucking mouth parts for puncturing the soft portion of the plant, thereby reducing the vigour of plants essentially the inflorescence, resulting in fruit drop. They also damage the crop by excreting a sweet sticky substance which facilitates the development of the sooty mold fungi, ultimately affecting the photosynthesis adversely.



Mango hoppers

(ii) Mealy bug

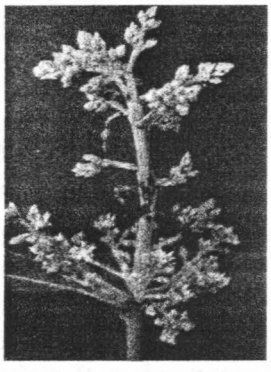
This pest is widely distributed all along the Indo-Gangetic plains and causes severe damage. Adult male is crimson coloured with brownish black forewings. Female bugs are mealy white in colour, elliptical in shape and

Mango mealy bug

covered with numerous minute hair, while nymphs are densely covered with waxy material. Eggs are usually laid in soil around tree trunk which are pink in colour that gradually changes to yellow. Nymphs and adults suck the plant sap and reduce the vigour of the plant and destroy inflorescence, causing the fruit drop. The adult female crawls down the tree in April-May and enters the soil for egg laying which hibernates till mid December.

(iii) Inflorescence midge

This pest lives in association with the mango crop from January to May. It is distributed all over India. The adult is minute yellowish midge with greyish back. The male being larger than the female. The wings are broad, claw is slender strongly arched and dentate. Midge attacks the inflorescence and small fruits. It attacks the crop at three different stages. The first attack is at floral bud burst stage. The larvae tunnel the axis of inflorescence and thus destroy it completely. Second attack starts at the fruit set as young maggots bore into these tender fruits which slowly turn yellow and finally drop. The third attack is on tender new leaves encircling the inflorescence. The most damaging one is the first attack in which the entire inflorescence is destroyed. The inflorescence finally dries up before flowering and fruit setting. The symptom of attack of this pest is appearance of tiny black spots on inflorescence.



Inflorescence midge infestation on panicle

(iv) Fruit fly

This is one of the most serious pests of mango in the country which has created problem in the export of fresh fruits. Its infestation is more in southern states than the northern states.

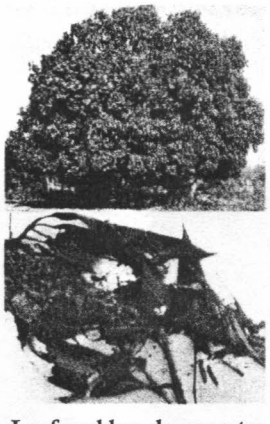
The well developed adult fly is stout and measures 14 mm across the wings and 7 mm in maximum length. The fly is brown or dark brown in colour with hyaline wings and yellow legs.

Fruitfly affected mango

The female punctures the outer wall of the mature fruits with the help of its pointed ovipositor and inserts eggs in small clusters inside the mesocarp of mature fruits. After hatching, the larva feeds on the pulp of fruits which appear normal from outside, but drop down finally. The mature maggots fall down into the soil for pupation. The emergence of fruit fly starts from April onwards and the maximum population is recorded during May-July which coincides with fruit maturity. The population declines slowly from August – September.

(v) Leaf webber

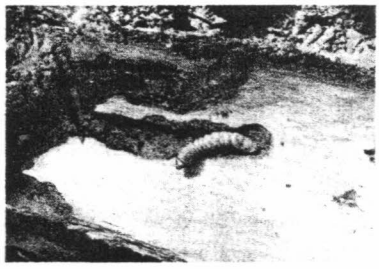
This pest is attaining serious proportions. Adult moths are medium size and somber coloured, eggs are greenish dull in colour. Full grown caterpillar is brownish blue with whitish striations dorsally. Its head is symmetrically variegated with white and brown spots and markings, there are four whitish longitudinal striations dorsally alternated in between by three pale olive green bands. Laterally, there are two brown to black striations and dorsally, two rows of symmetrical dots running longitudinally along the body. The caterpillar is smooth having sparse hair-like white setae. Pupae are dark blackish on maturity. Old orchards with less space between the tree canopies harbour more insects than open orchards. Its infestation starts from the month of April and



Leaf webber damage to the tree/leaves

goes up to December. Initially, caterpillars feed on leaf surface by scrapping. Later, they make web on tender shoots and leaves together and feed within. The infestation is severe in shady conditions.

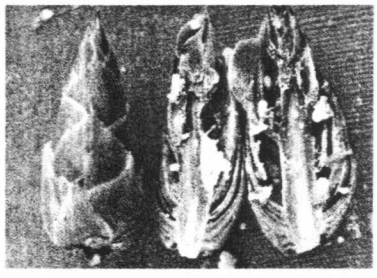
(vi) Stem borer



Stem borer infestation

Stem borer is widely distributed in India. It is a large, prominent, greyish brown beetle. There is also a white triangular patch at the junction of elytra. The general colour being dark brown, covered with grey or yellow grey pubescence. The colour in general resembles that of the mango bark. It has long segmented antennae. During flight they make noise. The freshly hatched larva is creamy white in colour. The grub is fat, fleshy and creamy white in colour. Average length of adult is about 5 cm. Damage is caused by the grub of this beetle as it feeds inside the stem, boring upward, resulting in drying of branches and in severe cases the attacked tree is killed. When the stem or any branch is attacked the sap and masses of frass exude from the bored hole. Often the damage may be visible by falling of the leaves of the attacked branches and sudden collapse of branches. The grub after hatching from the eggs first feed on the bark and makes irregular cavities. As the grub feeds, a harmonious sound is produced by its mandibles. On this account, the insect is popularly known as "Violin Beetle". It makes tunnels which may either be in the peripheral region or may go deep down into the base of the tree.

(vii) Shoot gall psylla



Shoot gall Psylla

It is a very serious pest of mango in many parts of India, particularly in the *tarai* region of the U.P. Adult psyllid measures 3-4 mm in length. The thorax and head are black and abdomen is light brown in colour. Wings cover the entire body and rather exceed the length of the body. Adults emerge from the conical galls from the first week of March. The abdomen in case of females is bulged up whereas in case of male it is tapering. Eggs are white and their tips partly projected outside. Nymphs are minute creatures having yellowish colouring with red markings all over. There are five such rows visible on the posterior end of the body. The activity of the pest starts from August.

Nymphs emerge during August -September and suck the cell sap from adjacent buds. As a result of feeding, the buds develop into hard conical green galls. The galls are usually seen during September - October. Consequently, there is no flowering and fruit set. Nymphs pass the winter inside the galls. There is only one generation of the pest in a year. Usually seedlings escape the damage while older plants of 5-10 years of age suffer every year. The affected trees acquire diminished growth and yield.

(viii) Scale insects

Scale insects

Scale insects are becoming serious pests of mango in certain regions lately. These copper oxy-chloridecids are immobile, fixed to the plant and survive only on living plants and die if the plant part is wilted. They are about 2.5 cm in size and have a covering of waxy, hairy, glassy, powdery white material. Adult females are wingless while males are winged. Eggs are found in a pouch. Tiny larvae crawl to the tender parts of plants and attack them at a spot. Larvae lose their original form and become a small, footless mass covered over the scale. The main period of activity is summer and produce

parthenogenetically. The nymphs and adult scales suck the sap of the leaves and other tender parts and reduce the vigour of the plants. They also excrete honeydew which helps in the development of sooty mold on leaves and other tender parts of the tree. Honey dew in due course also protects the insects from enemies. In case of severe scale infestation, growth and fruit bearing capacity of the tree is affected adversely. Among the various species, *C. polygonata* is posing serious threat to mango industry particularly in western U. P.

(ix) Stone weevil

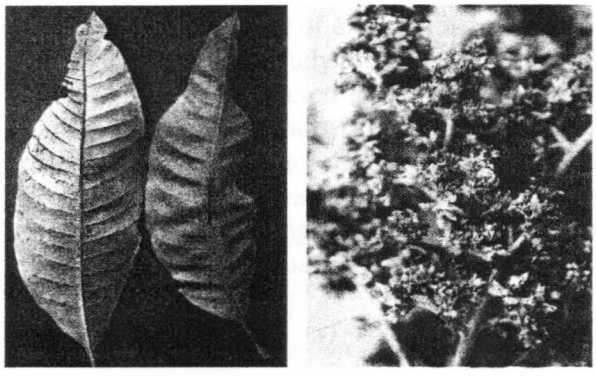
It is very sensitive to temperature and humidity. Therefore, it is confined in coastal and humid areas. This pest is serious only in South India. The late varieties suffer more. This pest is very important in view of the major constraint in the export of the fresh fruits to foreign countries. The weevil is about 8 mm in length and about 4 mm in breadth, greyish brown in colour which resembles the background of the bark of mango tree. Eggs are deposited in the fruits in the lower region of the tree. Adult has long snout for spotting out a suitable place for egg laying. After hatching the larva enters the fruit. However, the injury of the mango skin, flesh and seed coat, yet so nicely filled up that mango fruit appears to be very healthy with quite well developed insects inside the stone. If infested fruit falls and its fleshy portion decays, then the adult cuts out exit holes and emerges directly from the stone. If the fruit has not fallen then the adult weevil has to move through the pulp to come out and in the process makes the pulp dirty and unconsumable.

Apart from above insect pests, several other minor insect pests *viz.,* fruit sucking moth *Eudocima fullonia* and bark eating caterpillar *Inderbella quadrinotata* also occur occasionally in mango orchards which can become economically unprofitable under environmental conditions favourable to the pests.

Diseases

(i) Powdery mildew

It is most destructive disease of mango causing about 20 per cent of losses. Whitish superficial powdery appearance of fungal growth on inflorescence, leaves and young fruits is seen because of attack. Large scale shedding of flowers occurs as a result of attack on panicle. Young fruits covered by mildew become reshaped, yellow in colour, remain undersized and drop off at pea size stage. Young and tender leaves are invaded mostly on the under side with corresponding areas on upper side turning brown and causing necrosis. Such leaves curl downwards and become distorted (Prakash and Srivastava 1987).



Powdery mildew affected parts

(ii) Die back

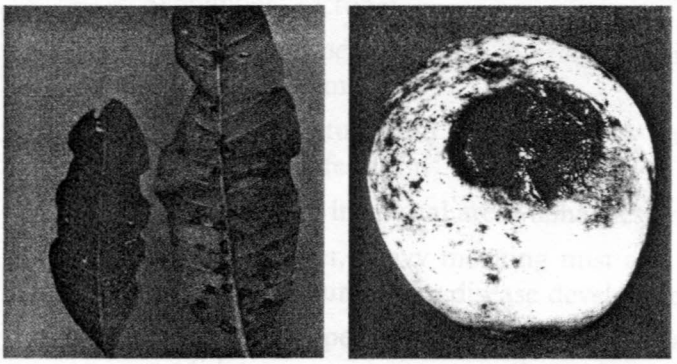
Death of plant from top downwards is of common occurrence in mango growing areas. The symptoms of this disease are characterized by dying back of twigs from top downward, particularly in the older

trees, followed by complete defoliation giving an appearance of scorching by fire. Discolouration and darkening of bark at a certain distance from the tip is the external evidence of the disease. These types of dark patches are generally seen on young green twigs. When the dark lesions increase in size, dying young twigs appear at the base. In severe cases leaves shrivel, fall off in a month, leaving the twigs bare altogether. Cracks appear on branches so that the general appearance of tree is conspicuous during October and November.

Die-back affected tree

(iii) Anthracnose

Anthracnose is severe in field and storage and is also known as blossom blight or fruit rot. The characteristic symptoms are numerous and/or irregular brown or deep brownish spots of variable size and shape scattered over the leaf. In humid conditions the spots enlarge and later rupture. The petiole when affected, turns grey. The disease is observed at several stages. The blossom blight associated with peduncle blight is the most destructive phase of this disease as this reduces fruit setting. The earliest appearance of the symptom of the disease is the blackish brown specks on the peduncle and flowers. Fruit is infected at any stage of development. Young fruits often become infected and fall in large numbers. On older fruits black spots are produced which later coalesce and form large irregular blotches.

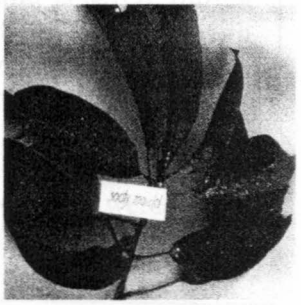


Anthracnose affected leaves and fruit

(iv) Sooty mold

This disease occurs wherever honey dew or secreting insects such as mango hopper, scales, copper oxy-chloridecids and mealy bugs are found.

The sooty mold is characterized by the presence of a black thin covering on the leaf lamina. In severe cases, the tree completely turns black with mould on entire surface of twigs and leaves. The affected leaves curl and shrivel under dry conditions. The fungi multiply and nourish on the 'honey dew' secreted by insects and spread on the plant surface making it black and ugly owing to masses of black spores on the leaf surface. The severity of disease depends upon the secretions by the insects. During flowering period its attack results into reduced fruit set and sometimes causes fruit drop.



Sooty mold affected leaves

(v) Bacterial canker

The disease attacks leaves, leaf stalk, twigs, branches and fruits. First small yellow coloured lesions appear on leaves which become enlarged to form cankerous patches. In severe cases leaves turn yellow and drop. On branches, twigs and stems fresh lesions form which are water soaked and swollen and later become raised and dark brown. When humid conditions prevail, the bacterial canker resembles anthracnose. On fruits the initial water soaked lesions gradually develop into canker.

Apart from above diseases, several other minor diseases *viz.*, red rust *Cephaleuros virescens* and phoma blight *Macrophoma mangiferae* also occur occasionally and might become economically important under environmental conditions favourable for these pests.

Environmental Factors Favourable for the Key Pests

Pest	Factors
Hoppers	• Shade and high humidity with moderately high temperature *i.e.* in February - April and July
Mealy bug	• Low temperature prevailing during November to March
Inflorescence midge	• Moderate to high temperature with low humidity prevailing during Jan - March
Fruit fly	• High temperature coupled with high humidity prevailing during May - July months
Leaf webber	• High temperature with high humidity prevailing during June - November
Stem borer	• Moderate temperature and moderate humidity prevailing during September - October
Shoot gall psylla	• Moderate temperature with intermittent high humidity during August - September
Scale insects	• High temperature and high humidity during July - August enhances its infestation
Stone weevil	• High humidity in coastal areas enhances its infestation
Powdery mildew	• Cloudy weather, heavy morning mist and increased humidity are highly favourable for disease development
Anthracnose	• Optimum temperature of 25 °C and favourable moisture conditions
Sooty mold (blotch)	• High humidity and presence of sugary substances
Bacterial canker	• The disease spreads rapidly during rains and is severe during July - August, the atmospheric temperature 28-30 °C coupled with above 80% humidity are congenial for its multiplication

Natural Enemies

While validating IPM technology in a wide area approach the following natural enemies were observed parasitising/preying upon various pests in the mango field. Some of the natural enemies recorded are listed below:

Pest	Natural enemies
Mealy bug	*Menochilus sexmaculatus, Chrysopa scelestes, Beauveria bassiana*
Leaf hoppers	*Chrysopa lacciperda, Epipyrops fuliginosa, Menochilus sexmaculatus, Verticillium lecanii*
Leaf webber	*Aspergillus flavus, Beauveria bassiana*
Shoot borer	*Bracon greeni*
Gall midge	*Tetrastichus sp., Platygaster* spp.

Pest Monitoring and Economic Threshold Levels (ETLs)

Crop insect pest and disease surveillance and monitoring are the cornerstones in integrated pest management programme. Monitoring of pest population through surveillance implies a complete vigilance on pest population, natural enemies, cropping system and weather factors. Monitoring of pest population at regular intervals round the year provides qualitative and quantitative data. The knowledge on biology and ecology of insect pests are also very essential elements for monitoring the pest population. Qualitative studies *viz.*, sample size, time, suitable sampling technique, spatial distribution and crop stages are also the pre-requisites for estimating the pest/natural enemy population which in case of mango were followed as per the recommended procedures for these parameters. Forecasting models developed using various abiotic and biotic factors alarm the farmers to prepare against insect pests and diseases and decide the timing of application etc. Control measures in mango were applied only when the insect pest and disease density reached economic threshold level and further losses were unsustainable. Farmers, observation boys (Scout) and researchers visited orchards regularly and monitored the field everyday to assess the field population and intensity of insect pests and diseases.

Pheromone traps using plastic bottles @ 10/ha were installed for monitoring and mass trapping of population of fruit fly (Fig 1). Leaf hoppers' population was monitored on 10 panicles especially in North-West direction of the plant by shaking them on one sq. ft. white ivory card board in a jar method and for stemborer adults using sweep net having thin linen bags/polythene bags, during off season. Mealy bug nymphal population was monitored around tree trunk at the base during the month of November - December when they start climbing on the tree. Inflorescence midge population was monitored by keeping a white paper sheet below the tree. Visual estimation of crop damage due to stem borer and diseases was taken. Control measures were adopted when the leaf hopper population reached 5 adults/panicle. As mango mealy bug, fruit fly and midge are the regular pests in the area, therefore, prevention /control measures like use of alkalthene for mealy bugs and use of methyl eugenol pheromone for mass trapping were used without waiting for the population to reach economic injury level.

Validation of IPM Technologies

The integrated pest management (IPM) package comprising of already known control technologies for major insect pests and diseases have been successfully validated in 16.8 ha of mango orchards in village Gulabkhera, Habibpur, Budhadia, Pathakganj, Rehmankhera and Kanar in Malihabad and Kakori belt of mango near Lucknow on Dashehari variety in a sustained manner for four years from 2000-2004. The major IPM components which were validated are detailed in the box.

Management options for hopper, mealy bug and fruit fly

Salient Features of Validated IPM Technology in Mango

- Spraying of copper oxychloride (3 g/L) for control of dieback, anthracnose and red rust diseases wherever it appeared during September - October
- Ploughing of orchard in November - December to expose pupae of fruit flies, midge, leaf hopper and eggs of mealy bug to natural enemies
- Polythene banding of tree trunk in December - January and application of NSKE (5%) and *Beauveria bassiana* in January
- Spraying of sulfex (2 g/L) for the control of powdery mildew disease
- Spraying of imidacloprid (0.5 ml/L) during April for control of hoppers and mealy bugs (adult female)
- Spraying of *Verticillium lecanii* in few orchards for control of hoppers
- Fixing of wooden block methyl eugenol traps to control fruit flies from April to August
- Mechanical removal of mango leaf webber larvae and webs by leaf web removing device developed by the Institute from April to Sept. - Oct.

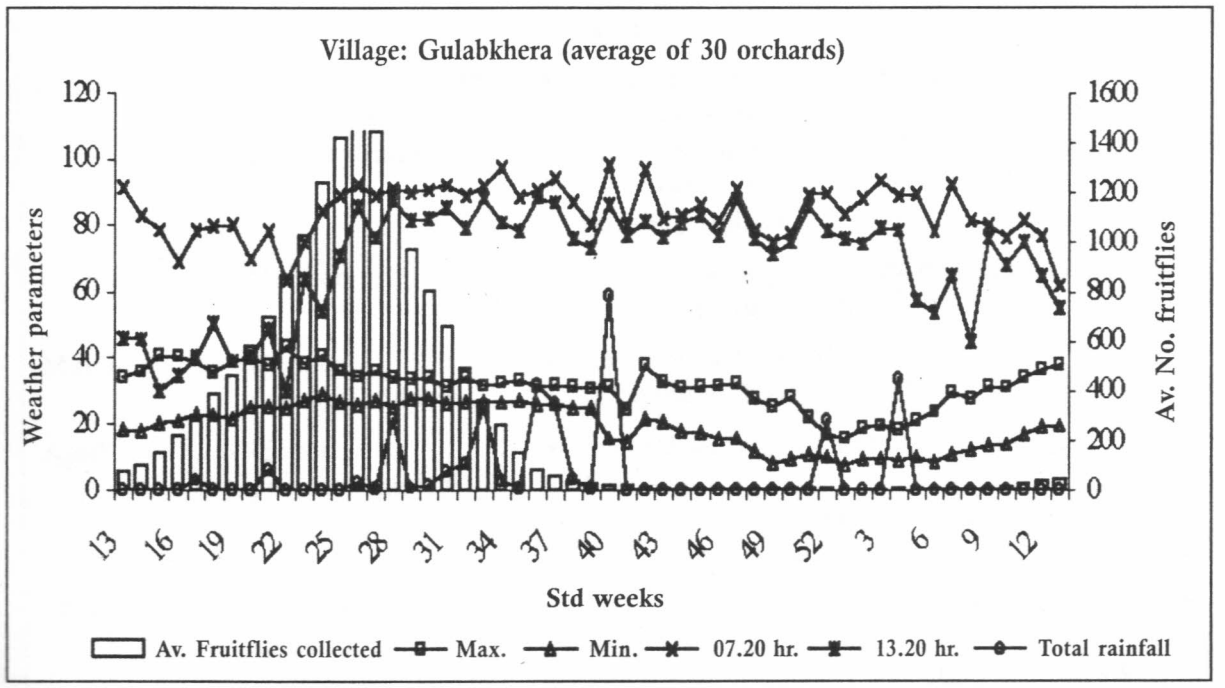


Fig. 1. Average population of fruit flies/wooden trap/week (average of 5 traps) in Malihabad, Lucknow along with weather parameters in 2003-04

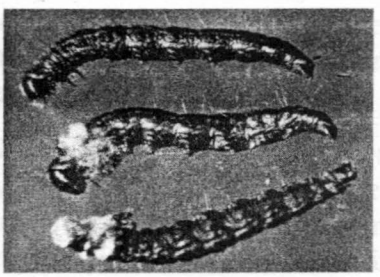
However mango being an annual crop, farmers are advised to adopt month-wise IPM operations in their orchards to keep, even the occasional pests which under favourable conditions assume a status of economically important, below economic threshold levels. The month-wise IPM activities to be followed are given in the following box:

Calendar of IPM Activities		
Months	**Target pest**	**IPM activities**
September	Leaf webber	• Removal of webs by leaf web removing device and burning them. • Pruning of over crowded and overlapping branches
October	Eggs of mealy bug, pupae of midge and fruit fly, die-back, anthracnose	• Flooding of orchards • Pruning of infected and dried branches, 10 cm below the dried portion and pasting of copper oxychloride • Spray of 0.3 % copper oxychloride (3 g/L) after pruning • Removal of diseased foliage/twigs infected with anthracnose (twig blight stage)
November	Mealy bugs, die-back and anthracnose	• Deep ploughing of orchards for exposing eggs and pupae of insects • Removal of weeds in orchards which harbour insects and diseases • Spraying of copper oxychloride (3 g/L) for die back
December	Mealy bug	• Fastening of alkathene sheets of 400 gauge thickness, 25 cm wide around the base of tree • Raking of soil around the tree trunk and mixing with neem
January	Inflorescence midge, mealy bug, powdery mildew	• Cleaning the alkathene bands at regular interval • Spray of quinalphos @ 0.05 % or some safer insecticide at bud burst stage • Removal of weeds and infected young leaves for powdery mildew
February	Hopper	• Spraying with neem seed kernel extract (5%) at bud burst stage for hoppers
March	Hopper, powdery mildew	• Spraying with quinalphos (0.05%) • Spraying with sulphur @ 2 g/L
April	Hopper, powdery mildew	• Second spraying of wettable sulphur @ 2 g/L after fruit setting • Removal of powdery mildew infected leaves and malformed panicles
May	Fruit fly, sooty mould	• Hanging of methyl eugenol traps (0.1%) + malathion (0.1%)
June	Fruit fly, anthracnose, bacterial canker	• Continuation of methyl eugenol traps (0.1%) + malathion (0.1%) • Early harvesting of mature fruits to avoid fruit fly infestation and anthracnose • Collection and destruction of fruit fly infested fruits • Second spray of streptocyclin @ 200 mg/L for bacterial canker

Contd...

July	Scale insect, stem borer, red rust	• Timely picking of fruits • Spraying of quinalphos @ 0.04 % or dimethoate 30 EC @ 0.06 % for scale insects • Cutting of stem borer affected branches • Spraying of copper oxychloride (COC) @ 0.3% for red rust and anthracnose
August	Shoot gall psylla, leaf webber, red rust, anthracnose, damping off (nursery)	• Spraying of quinalphos @ 0.05% • Removal of leaf webber affected branches • Spraying of copper oxychloride (COC) for red rust and anthracnose • Proper drainage in nursery • Sanitation and removal of weeds from orchard

Econonic Viability and Farmers' Acceptabiltiy of IPM Technologies



Leaf webber larvae killed by *Beauveria bassiana*

Highly accepted technology of alkathene band against mealy bug

During the period 2001 - 2004, the integrated pest management for mango crop was validated and promoted in about 58 ha area spread in 11 villages of five districts of Uttar Pradesh covering 112 farming families. The farmers of these villages have been raising mango crop since several decades and it is the main source of their income and livelihood. Because of uninterrupted raising of this crop for several decades, many diseases and other insect pests have become major problems in mango orchards. Despite 7- 9 sprays of pesticides given for their control, farmers are unable to raise the productivity of mango from 35 – 70 q/ha. IPM module successfully validated and adopted by mango farmers comprised sprays of neem seed kernel extract (NSKE) 5%, neem soap and *Verticillium lecanii* for mango hopper; *Beauveria bassiana* for mealy bug; use of alkthene bands for mealy bugs, installation of methyl eugenol pheromone traps and collection and destruction of fruit fly affected fruits from time to time, collection of die-back affected twigs; mechanical collection of leaf webber; deep ploughing of orchards during October-November and need based application of insecticides based on monitoring of insect pests and diseases. The mango fruit fly has been very effectively managed in mango orchards using methyl eugenol plastic bottle traps having small wooden blocks. This is highly economical and environmentally safe. Wooden blocks were very cheap and efficient in capturing fruit flies @ 2500 flies/trap. Mango mealy bug was kept under check utilizing non-chemical method *i.e.* alkathene band (25 cm wide, 400 gauge) around tree trunk during 3rd week of December and drenching with 5% neem seed kernel extract and *Beauveria bassiana* around the trunk in December-January. This method prevented migration of early instars of mealy bugs on tree. Deep ploughing of orchards during November which is also a common practice in mango, exposed the eggs of mealy bugs, pupae of fruit fly, leaf webber and midge to birds and removal of weeds helped in reducing the population of these insects harbouring them. Mango hoppers, inflorescence midges and mealy bugs which ascended on tree by chance were effectively controlled by spraying neem seed kernel extract (5%), monocrotophos and chlorpyriphos (0.05%) spray. These two insecticides did not persist for long in mango orchards

Economics of IPM in mango

Variables	IPM	Non-IPM
No. of chemicals sprays	3	7
Cost of plant protection (Rs/ha)	10444	21000
Total cost of production (Rs/ha)	34778	39889
Yield (q/ha)	51	40
Gross income (Rs/ha)	158622	107666
Cost: Benefit ratio	1:4.48	1:3.03

and were found to be below maximum residual limits (MRL) fixed by WHO. These can be used safely in mango under proper supervision. In fields where this package was not followed (non - IPM) higher residue of these insecticides i.e. 0.01 and 0.005 ppm were found. Looking into the slightly higher residues of monocrotophos insecticide, farmers were advised to use chlorpyriphos. Mango leaf webber was effectively controlled by leaf webber removal device which is locally available and is very cheap. To reduce the use of synthetic insecticides vigorous campaigning was done which was readily accepted by the farmers. Sooty mold was easily controlled by using non-chemical starch @ 2%. Powdery mildew disease was easily controlled by giving a single spray of sulfex fungicide.

As a result of adoption of IPM and due to vigorous campaigning, *Gosthis*, meetings etc. the farmers were convinced to minimize the number of sprays from 6-8 to 2-3 only. Yield of mango also increased from 60 to 90 q/ha as it was 35 - 70 q/ha earlier in non - IPM orchards. The total cost of plant protection varied from Rs 13,000 to 15,000/ha in IPM orchards whereas it was Rs 15,000-17,000 in non-IPM orchards. By adopting IPM, the mango growers in that area earned profit of Rs.30,000 to 55,000/ha while the farmers who did not adopt IPM, earned a profit of Rs 17,000 to Rs 35,000/ha only.

Farmers of the area were highly convinced of the efficacy of using cheaper and efficient methods of using methyl eugenol wooden blocks pheromone traps, efficacy of neem based kernel extract (NSKE) spray, alkathene banding of stem at base etc. This is because of the higher profits/ha they earned and the convincing of farmers about the IPM technology that the area increased from 9.5 ha in Ist year (2001) to 16.8 ha in 3rd year (2003). Moreover from a meagre beginning with 18 farmers, about 39 farmers adopted IPM in the third year. More and more farmers were willing to adopt this technology, now. Farmers had on their own formed the 'self help' groups comprising 35 members to begin with, for sustainability and continuity of IPM programme. Farmers of this group themselves collected neem seed, cultured vermicompost and bio-dynamic fertilizers, so that the dependence on chemical pesticides and fertilizers was reduced in future. It is only the acceptability of the technology that the alkathene banding of tree stem for the control of mango mealy bug has increased from 15.31 per cent in 2001 to 26.67 per cent in 2003. The village Gulabkhera has been declared as "IPM village" by the Central Institute for Subtropical Horticulture, Lucknow. It is the awareness and success of validation of IPM programme and acceptability of the technology by the farmers that they were not more using more harmful pesticides like methyl parathion (folidol dust) and synthetic pyrethroids any more. Farmers are now aware and are appreciative of IPM technology. They can differentiate between pest and natural enemies and nutritional deficiencies in plants and take appropriate measures and were quite innovative. Alkathene banding technology for the control of mealy bug has been adopted by the farmers of nearby villages like Kakori, Mall, Rasulpur, Ludhausi and Drganti, Malihabad etc. This technology has been used by some of the non-IPM farmers also.

The farmers who have adopted IPM technology in mango themselves narrated their experience of its benefits. Adopted farmers used to give on an average 7-8 sprays of pesticides in their orchards of

mango until they adopted the technology. They have been immensely benefited as the production of mango has increased and pesticide consumption reduced tremendously. Other non-IPM farmers of the village are eager and keen to come forward and adopt the technology. From their own experiences of growing mango for several years they themselves inferred that in mango orchards jackfruit should not be grown as it acts as an alternate host for mealy bugs. They further wished that more and more farmers come forward to adopt the IPM technology and reap the benefits.

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