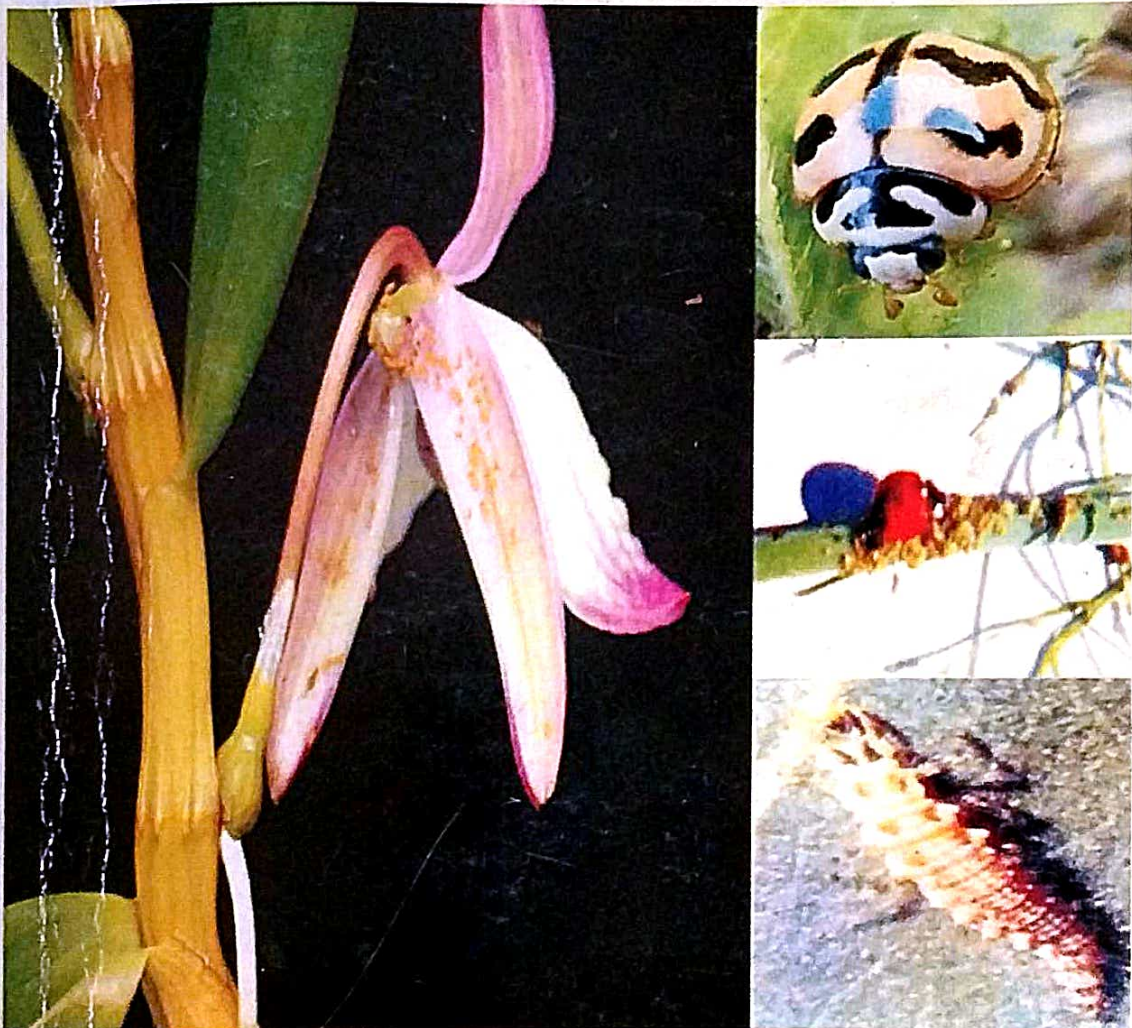


Pest Management in Orchids



**N K Meena, R P Medhi
R P Pant, Rampal & D Barman**

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National Research Centre for Orchids
(Indian Council of Agricultural Research)
Pakyong – 737 106, Sikkim, India



Mini Mission-1, Technical Bulletin 6

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**N K Meena
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Technical Bulletin

Pest Management in Orchids

National Research Centre for Orchids
Pakyong- 737 106, Sikkim

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Cover page photographs

Clockwise - Yellow aphid, *Macrosiphum luteum* on flower of *Dendrobium nobile*, bio-control agents viz., *Menochilus sexmaculatus*, *Coccinella septempunctata* and larva of *Chrysoperla carnea*

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Foreword

Orchids are one of the most important flowers in world floricultural trade. This floricultural crop needs attention because of various problems it faces lead to poor quality flower production. Pests such as red spider mite, scale insects, aphid, mealybug, thrips, black weevil, yellow beetle, shoot borer, grass hopper, snails and slugs and lepidopteran caterpillars contribute to demolish the quality and lower the production substantially. Hence the seriousness of the problems caused by these insect-pests can not be ignored or undermined. In this context pest identification and management strategy assumes the utmost importance. The present technical bulletin has been conceived to facilitate the formulation and implementation of this strategy based on identification of the pest problem.

This technical bulletin covers the genera wise pest infestation and their identification, nature of damage, host range, management strategy and basic knowledge about pesticides. The authors have put up their best efforts to make the technical bulletin self explanatory and handy. It has been scripted and laid out in such a way that it can be understood by everyone. Photographs of individual pests have been given for correct identification.

I am sure that this bulletin will generate greater awareness among the farmers or orchid growers about the qualitative as well as quantitative losses in orchid flower production caused by insect-pests and their suitable management practices. This bulletin will also serve equally to the needs of the researchers, students and extension workers to identify the pest's problem and manage them more efficiently and effectively by following the suitable measures at right time in order to harvest the quality flowers and better returns.



NRC for Orchids, Pakyong, Sikkim
December, 2010

R. P. Medhi
Director

Contents

Sl. No.	Title	Page No.
1.	Introduction	1
2.	Generawise pests infestation	2
3.	Seasonal occurrence of pests	2
4.	Identification, nature of damage and management practices	9
5.	Pesticides and their application	23
6.	First aid precautions	26
7.	Handling of pesticides	28

I. Introduction

Orchids are scientifically significant and commercially important group of flowering plants. It has a trouble free source of beautiful flowers when they are grown indoors under the correct environmental conditions. These flowers are grown and displayed in polyhouse, greenhouses, conservatories, interiors capes and residential homes. Flowers are uniqueness in their shape, size and colour, exquisitely attractive, remains fresh for a long period in comparison to other flowers. These qualities have made orchid growing a highly profitable industry in all over the world and today more than 1.2 lac hybrids of different orchids species are known and cultivated for flowers. The orchids are cosmopolitan in distribution but in India it is growing in high altitude areas of all northeastern states including Sikkim, Darjeeling district of West Bengal and Jammu & Kashmir for temperate and subtropical orchids, whereas, Tamil Nadu, Kerala, Karnataka, Andaman and Nicobar group of islands and Maharashtra for tropical as well as sub tropical orchids. They can also grow in soil (terrestrial orchids); on other plants usually on trees (epiphytic orchids); on rocks (lithophytic orchids) or even semi aquatic conditions. The greatest diversity occurring in Sikkim (an organic state), whereas, all positive factors for orchid growth (high humidity, thick vegetation and high altitude) prevail. Orchids are susceptible to a number of insect pests, which significantly affect the quality and quantity of orchid flower production. To minimize the pests problem in orchid, implementation of proper management strategies and prevention is the best strategy for managing orchid's pests. Proper cultural practices such as correct amount of water, fertilizer doses, temperature,

light and humidity, minimize the potential pests problems. The authors want to extend the accumulated knowledge to the farmers for correct identification and appropriate management practices of the pests of orchids through this bulletin.

II. Generawise pests infestation

Orchids are subject to attack by various kinds of insect-pests. Amongst them, some insects are host specific and few are polyphagous in nature feed on other hosts (orchids, other ornamentals and weeds) during a particular part of the year or round the year depends on biological and abiotic factors. A clean, airy environment with optimum humidity, suitable temperature is certainly conducive to the well being of plants but not an absolute guarantee to be free from pests. Even under best conditions pest may attack the plants but constant and attentive vigilance can keep the pests at bay. The information on generawise pests, their destructive stages and plant portions damaged are given in Table 1.

III. Seasonal occurrence of pests

As per survey, the pests associated with orchids under polyhouse conditions at National Research Centre for orchids, as well as farmers fields, adjoining areas of Sikkim and Darjeeling hills of West Bengal. The important insects are two spotted red spider mite, *Tetranychus urticae*; thrips, *Dichromothrips nakahari*; scale insects (*Pinnaspis buxi*, *Diaspis boisduvali*, *Coccus hesperidum*, *Lecanium* sp. and *Chrysomphalus aonidum*); shoot borer, *Peridaedala* sp.; aphids (*Toxoptera auranti* and *Macrosiphum luteum*); mealybug, *Pseudococcus* sp.; slugs and snails; black weevil, *Siphalinus*

Table 1. Generawise pests their destructive stages and plant parts damaged

Sl. No.	Orchids genera	Name of the pests		Destructive stage	Plant parts damaged
		Common name	Scientific name		
1.	<i>Aerides</i>	Ti scale	<i>Pinnaspis buxi</i>	Nymph & Adult -do- Larva Grub & Adult	Leaf/petiole/pseudobulb Leaf/flower spike Shoot Leaf at midrib/pseudobulb
		Soft brown scale	<i>Coccus hesperidum</i>		
		Shoot borer	<i>Peridaedala</i> sp.		
		Black weevil	<i>Siphalinus</i> sp.		
2.	<i>Acampe</i>	Yellow aphid	<i>Macrosiphum luteum</i>	Nymph & Adult Larva Nymph & Adult	Leaf/flower bud/flower Shoot Pseudobulb/leaf/flower
		Shoot borer	<i>Peridaedala</i> sp.		
		Mealybug	<i>Pseudococcus</i> sp.		
3.	<i>Ascocentrum</i>	Soft brown scale	<i>Coccus hesperidum</i>	Nymph & Adult Larva Grub & Adult	Leaf/pseudobulb Shoot Leaf/shoot/ pseudobulb
		Shoot borer	<i>Peridaedala</i> sp.		
		Black weevil	<i>Siphalinus</i> sp.		
4.	<i>Bulbophyllum</i>	Shoot borer	<i>Peridaedala</i> sp.	Larva Nymph & Adult -do-	Shoot Pseudobulb/leaf/flower bud Leaf/petiole/pseudobulb
		Mealybug	<i>Pseudococcus</i> sp.		
		Ti scale	<i>Pinnaspis buxi</i>		
5.	<i>Calanthe</i>	Thrips	<i>Dichromothrips nakahari</i>	Nymph & Adult -do-	Flower Leaf/flower spike
		Soft brown scale	<i>Coccus hesperidum</i>		
6.	<i>Coelogyne</i>	Thrips	<i>Dichromothrips nakahari</i>	Nymph & Adult Grub & Adult	Leaf/shoot/flower Pseudobulb/leaf
		Black weevil	<i>Siphalinus</i> sp.		

		Yellow aphid Mealybug Red spider mite	<i>Macrosiphum luteum</i> <i>Pseudococcus</i> sp. <i>Tetranychus urticae</i>	Nymph & Adult -do- -do-	Flower bud/flower Pseudobulb/leaf/flower bud Leaf/flower
7.	<i>Cymbidium</i>	Red spider mite Ti scale Florida red scale Soft brown scale Boisduval scale Yellow aphid Black aphid Mealybug Black weevil Thrips Grasshopper Snails Lepidopteran caterpillars Leaf folder	<i>Tetranychus urticae</i> <i>Pinnaspis buxi</i> <i>Chrysomphalus aonidum</i> <i>Coccus hesperidum</i> <i>Diaspis boisduvali</i> <i>Macrosiphum luteum</i> <i>Toxoptera aurantii</i> <i>Pseudococcus</i> sp. <i>Siphalinus</i> sp. <i>Dichromothrips nakahari</i> <i>Hieroglyphus banian</i> <i>Cryptaustenia verrucosa</i> <i>C. heteroconcha</i>	Nymph & Adult -do- -do- -do- -do- -do- -do- -do- -do- Grub & Adult Nymph & Adult -do- Young once and Adult Caterpillar -do-	Leaf/flower Leaf/petiole/pseudobulb Leaf Leaf/petiole Leaf/petiole/pseudobulb Spike/flower bud/flower Spike/flower bud/flower Pseudobulb/leaf/flower Pseudobulb/leaf Leaf/flower Leaf/flower bud/flower Root/leaf/bud/flower
8.	<i>Cattleya</i>	Mealybug Boisduval scale Yellow aphid	<i>Pseudococcus</i> sp. <i>Diaspis boisduvali</i> <i>Macrosiphum luteum</i>	Nymph & Adult -do- -do-	Leaf/pseudobulb Root/leaf/petiole Flower

	Lepidopteran caterpillars	Caterpillar	Buds/flower	
9.	<i>Dendrobium</i> Red spider mite Yellow aphid Black aphid Thrips Ti scale Lecanium scale Shoot borer Black weevil Mealybug Snails Lepidopteran caterpillars Yellow beetle Grasshopper	<i>Tetranychus urticae</i> <i>Macrosiphum luteum</i> <i>Toxoptera aurantii</i> <i>Dichromothrips nakahari</i> <i>Pinnaspis buxi</i> <i>Lecanium</i> sp. <i>Peridaedala</i> sp. <i>Siphalinus</i> sp. <i>Pseudococcus</i> sp. <i>Cryptaustenia verrucosa</i> <i>C. heteroconcha</i> <i>Anomala</i> sp. <i>Chrotogonus trachypterus</i>	Nymph & Adult -do- -do- -do- -do- -do- Larva Grub & Adult Nymph & Adult Young once and adult Caterpillar Adult Nymph & Adult	Buds/flower Leaf/flower Spike/flower bud/flower Spike/flower bud/flower Flower bud/flower Leaf/petiole/pseudobulb Stem/leaf/spike Shoot Pseudobulb/leaf Pseudobulb/leaf/flower Root/leaf/bud/flower Buds/flower Leaf/flower Leaf/flower
10.	<i>Eria</i> Shoot borer Soft brown scale Snails	<i>Peridaedala</i> sp. <i>Coccus hesperidum</i> <i>Cryptaustenia verrucosa</i>	Larva Nymph & Adult Young once and Adult Shoot Leaf/spike Root/bud/flower	

11.	<i>Epidendrum</i>	Mealybug Lecanium scale Yellow aphid Shoot borer Grasshopper Mite	<i>Pseudococcus</i> sp. <i>Lecanium</i> sp. <i>Macrosiphum luteum</i> <i>Peridaedala</i> sp. <i>Hieroglyphus banian</i> <i>Brevipalpus essigi</i>	Nymph & Adult -do- -do- Larva Nymph & Adult -do-	Petiole/leaf/flower Stem/leaf Flower bud/flower Shoot Leaf/flower bud/flower Leaf/flower
12.	<i>Liparis</i>	Shoot borer Soft brown scale	<i>Peridaedala</i> sp. <i>Coccus hesperidum</i>	Larva Nymph & Adult	Shoot Leaf/spike
13.	<i>Luisia</i>	Mealybug Thrips	<i>Pseudococcus</i> sp. <i>Dichromothrips nakahari</i>	Nymph & Adult -do-	Petiole/leaf Flower
14.	<i>Oncidium</i>	Yellow aphid Black aphid Florida red scale Red spider mite	<i>Macrosiphum luteum</i> <i>Toxoptera aurantii</i> <i>Chrysomphalus aonidium</i> <i>Tetranychus urticae</i>	Nymph & Adult -do- -do- -do-	Flower bud/flower/spike -do- Leaf Leaf
15.	<i>Phalaenopsis</i>	Soft brown scale Lepidopteran caterpillars Snails	<i>Coccus hesperidum</i> <i>Cryptaustenia verrucosa</i>	Nymph & Adult Caterpillar Young once and Adult	Leaf/spike Leaf/bud/flower Bud/flower
16.	<i>Phaius</i>	Red spider mite Mealybug	<i>Tetranychus urticae</i> <i>Pseudococcus</i> sp.	Nymph & Adult -do-	Leaf/flower Petiole/leaf/pseudobulb

		Black weevil Ti scale Lecanium scale	<i>Siphalinus</i> sp. <i>Pinnaspis buxi</i> <i>Lecanium</i> sp.	Grub & Adult Nymph & Adult -do-	Leaf/shoot/pseudobulb Leaf/petiole/pseudobulb Stem/leaf/spike
17.	<i>Paphiopedilum</i>	Soft brown scale Lepidopteran caterpillars	<i>Coccus hesperidum</i>	Nymph & Adult Caterpillar	Leaf/stem/spike Leaf/bud/flower
18.	<i>Pholidota</i>	Ti scale Soft brown scale Mealybug	<i>Pinnaspis buxi</i> <i>Coccus hesperidum</i> <i>Pseudococcus</i> sp.	Nymph & Adult -do- -do-	Leaf/petiole/pseudobulb Leaf/stem/spike Leaf/pseudobulb
19.	<i>Rhynchosstylis</i>	Mealybug Grasshopper	<i>Pseudococcus</i> sp. <i>Hieroglyphus banian</i>	Nymph & Adult -do-	Petiole/leaf/pseudobulb Flower bud/flower
20.	<i>Thunia</i>	Thrips Red spider mite Lepidopteran caterpillars	<i>Dichromothrips nakahari</i> <i>Tetranychus urticae</i>	Nymph & Adult -do- Caterpillar	Shoot/flower Leaf/flower Leaf/bud/flower
21.	<i>Vanda</i>	Boisduval scale Shoot borer	<i>Diaspis boisduvali</i> <i>Peridaedala</i> sp.	Nymph & Adult Larva	Root/leaf/petiole Shoot
22.	<i>Zygopetalum</i>	Red spider mite Snails Grasshopper	<i>Tetranychus urticae</i> <i>Cryptaustenia verrucosa</i> <i>Hieroglyphus banian</i>	Nymph & Adult Young once and Adult Nymph & Adult	Leaf/flower Flower bud/flower Leaf/flower bud/flower

sp.; lepidopteran caterpillars; yellow beetle, *Anomala* sp. and grasshopper are important pest of orchids. Leafhopper, white fly, tobacco caterpillar, bud borer, *Helicoverpa armigera*, mite, thrips, aphids and leaf minor are also infest to the other ornamentals like gerbera, carnation, rose, gladiolus, liliium, marigold etc. The time of pests occurrence on host plant as well as nature of damage may vary in species to species and weather conditions. Red spider mite, *T. urticae* and scale insects are being active throughout the year but its heavy infestation occurs during May to September along with high rainfall, relative humidity and maximum temperature. Thrips, *Dichromothrips nakahari* also active round the year but more incidence seen during March to August. Shoot borer, *Peridaedala* sp., mealybug, *Pseudococcus* sp., slugs and snails and black weevil, *Sipalinus* sp. feed on orchids especially during rainy season, however, its peak incidence is noticed from June to October. Shoot borer is more prominent during onset of monsoon to till September. The infestation of aphids (*Macrosiphum luteum* and *Toxoptera aurantii*) start from January and being active up to May when cloudy weather and low rainfall is received in the region. Grasshopper attacks on orchids from April to September, while, lepidopteran caterpillars are more severe from August to end of December.

IV. Identification, nature of damage and management practices

1. Red spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae)

Mite is a serious pest of many species of orchids found on ventral surface of leaves, flower buds and flowers. The incidence of pest on orchids is being active through out the year under protected (open polyhouse) conditions. In India it is found in all orchids growing states but very common in Sikkim, West Bengal, Assam, Arunachal Pradesh, Meghalaya, Mizoram, Andaman and Nicobar group of islands and Kerala.



Fig. 1 Mite infested plant of *Cymbidium*

Identification

Adult is oval shape, about 0.4 - 0.6 mm length with well marked four pairs of legs. Pale greenish to yellow in colour with pairs of distinct dark lateral patches from orange to brick red. Nymphs are pale green with darker margins. The larvae look like small adults but only have three pairs of legs (Fig. 1).

Nature of damage

All active stages viz., nymph and adult feed on undersurface of leaves and flowers by sucking the cell sap from epidermal layer, especially along with midrib and the base. The loss of cell sap causes yellowing of leaves. The injuries due to feeding can be seen as silvery marks left on both the surface of

leaves which usually turn brown or black after a period of time. In case of severe infestation, plants covered with webbing as a result, pests can spread from one plant to another plants. Whole plants get weakened, growth stunted and loss of foliage occurs in the infested plants. Flower buds not open properly and flowers are usually abortive, turn brown and fall down before maturation.

Management

Weekly monitoring of farm or nursery to find out build-up of pests incidence hence action (control) may be taken. Remove the infested plant parts (leaves/flowers) and destroy them to reduce the further multiplication of mite. Make clean cultivation, proper ventilation and should apply balanced fertilizers dose and irrigation to curtail the mite population. If mite population (infestation) is severe than immediately spray the plants with plain water twice a day to check the infestation until the arrangement of suitable insecticide is done. Initially spray the plants with neem oil 0.03 EC (Azadirachtin) 5 ml/lit. of water to reduce the mite population. If required, spray the plants with any one of the following insecticides i.e. dicofol 18 EC or ethion 50 EC or propargite 57 EC or bifenthrin 10 EC (talstar) or avermectin 1.8 EC (avid) @ 0.05% or imidacloprid 17.8 SL (confidor) at 0.003% alternatively and repeat the spray at 10-15 days interval to provide effective control against mite.

2. Scale insects

There are five predominant species of scale insects viz., ti scale, *Pinnaspis buxi*; florida red scale, *Chrysomphalus aonidum*; lecanium scale, *Lecanium* sp.; soft brown scale,

Coccus hesperidum and boisduval scale, *Diaspis boisduvali* which damage orchids round the year. The name of these species of scales kept as per their physical appearance and their description are given as under.

2.1 Ti scale, *Pinnaspis buxi*

Identification

Ti scales are sticky to elongated pear shaped, small sized (about 1-2 mm long), brown to dark brown coloured, flat bodied and without any permanent body organs like wings, legs or eyes. It looks dried rather than plump like dead ones (Fig. 2).



Fig. 2 Ti scale infested leaves of *Dendrobium densiflorum*

2.2 Florida red scale, *Chrysomphalus aonidum*

Identification

This type of scales are round or moderately convex shaped, dark reddish brown to almost black or ash grey coloured. Size is almost 2 - 2.5 mm in diameter. The exuviae are approximately central, reddish brown or brick red sometimes covered with grayish secretion, surrounded by a reddish brown ring (Fig. 3).



Fig. 3 Florida red scale infested leaves of *Cymbidium*

2.3 Lecanium scale, *Lecanium* sp.

Identification

The Lecanium scales are usually bowl or dome or turtle shaped, slightly longer than wide, about 4 to 6 mm in diameter, smooth and shiny brown coloured. Insect bearing protective covering of wax, secreted from their body (Fig. 4).



Fig. 4 Lecanium scales infested twig of *Epidendrum*

2.4 Soft brown scale, *Coccus hesperidum*

Identification

Soft brown scales are oval and more flattened than either the black or hemispherical, small sized (2 - 3 mm long). They are pale brown, dirty white or grayish mottled with dark brown spots on the back (Fig. 5).



Fig. 5 Soft brown scale infestation

2.5 Boisduval scale, *Diaspis boisduvali*

Identification

Boisduval scales are circular to oval shaped, thin flat, about 1.2 - 2.25 mm in diameter. White to light yellow and



Fig. 6 Boisduval scale infestation

semitransparent. Exuviae (cast skin) ventral to sub central, white to light yellow. The body is fully covered with white cottony growth (Fig. 6).

Nature of damage

All the five species of scale insects suck the juice from leaves, petioles, pseudobulbs, flowers and cause loss of vigor and deformation of infested plants. Heavy scale infestations, however, can reduce overall plant health and cause yellow leaves, leaf drop and stunted new growth. The most visible damage caused by scales is the sticky honeydew they excrete which attracts sooty mould and dust particles that are difficult to remove. The honeydew is not secreted by all the species of scales. The quality of flowers produced from infested plants deteriorated which affect the market value.

Management

Cleanliness and regular care is necessary. Select scales free planting material to prevent early built up of pest. Prompt pruning and burning of infested parts reduces further spread, isolate infested plants from others to prevent the scales from moving one plant to another. Scales can be removed by rubbing the scurf encrustation with toothbrush or cotton swab dipped in 70% Isopropyl alcohol or methylated spirit. Keep up the manual removal of all scales, if possible. If scales infestation found on root, repotting should be done to eradicate harboring eggs and crawlers and after gentle cleaning, roots should be sprayed with insecticides. Spraying of malathion 0.05% or endosulfan 0.05% or monocrotophos 0.05% or acephate 0.05% or carbaryl 0.2% would help to reduce scales infestation.

3. Aphids

Aphids are the major problem in orchids, mainly two species yellow aphid, *Macrosiphum luteum* and black aphid, *Toxoptera aurantii* cause damage to orchids.

3.1 Yellow aphid, *Macrosiphum luteum* (Hemiptera: Aphididae)

Identification

This species of aphid is pale green colour during nymphal stage and greenish yellow to yellow colour in adult stage, oval shaped and minute size about 2-3 mm in length. Blackish two cornicles are present on the tip of abdomen.

Adults are winged or wingless and wingless form has a brownish patch on the top of the abdomen (Fig. 7).



Fig. 7 Yellow aphid infested flower of *Dendrobium*

3.2 Black aphid, *Toxoptera aurantii* (Hemiptera: Aphididae)

Identification

Black aphids are also oval shaped, small sized about 2 - 3 mm in length, wingless in nymphal stage and wingless as well as winged in adult stage (Fig. 8). One pair of cornicles is situated on the tip of abdomen



Fig. 8 Black aphid infested flower of *Cymbidium*

which secretes honeydew. Aphids formed colonies on the flower buds and flowers.

Nature of damage

Both the nymphs and adults suck the cell sap usually from flower spikes, flower buds and flowers. Small, irregular shaped spots appear on the petals and sepals due to loss of cell sap. They also excrete honeydew on which sooty mould developed that affect the photosynthesis. High humidity and cloudy weather fasten the population buildup. The affected plants retard growth and ultimately deteriorate the quality of flowers. They are also believed to transmit some viral diseases from infested to healthy plants.

Management

As soon as the pest appears on the new spikes or flower buds before opening the flowers. Initially spray the plants with tobacco leaf extract (10 ml/lit) or neem oil 0.03 EC (Azadirachtin) 5 ml/lit. of water to reduce the aphid population. If aphid population appear again then the plants should be treated with insecticides like endosulfan 35 EC or malathion 50 EC or acephate 75 SP at 0.05% or imidacloprid 17.8 SL (confidor) at 0.003% in 10-15 days interval.

4. Shoot borer, *Peridaedala* sp. (Lepidoptera: Tortricidae)

Shoot borer is also a serious insect of many species of orchids, especially in *Dendrobium* spp.

Identification

Adults are small moth, black in colour with white spots

on the wings, size about 8-10 mm in length across the wings. Caterpillars are small in size with tiny black head and yellow to creamy in colour (Fig. 9).

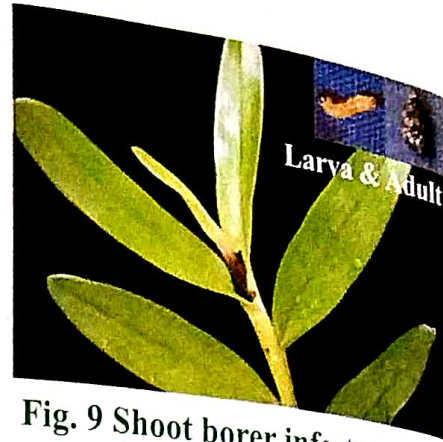


Fig. 9 Shoot borer infested plant of *Dendrobium nobile*

Nature of damage

Young larvae bore downward into the shoots, make tunnel and feed therein by leaving excreta at opening hole. Shoot growth is checked and dead shoots or yellow shoot flag produced as a result plant growth is checked and flower production gets affected.

Management

The pests can be suppressed by cutting and destroying the infested branches on which dead shoots produced. Spray the plants with ahook 1500 ppm 5 ml/lit. of water or econeem plus 3000 ppm 3 ml/lit or malathion 50 EC or endosulfan 35 EC @ 0.05% and if required, repeat the spray at 10 days interval to control the insect.

5. Thrips, *Dichromothrips nakahari* (Thysanoptera: Thripidae)

Thrips feed on leaves, flower buds and flowers of *Cymbidium*, *Dendrobium* and other species and hybrids of orchid.

Identification

The adults are slender, dark brown to black in colour having apically pointed wings and measures about 1 - 2 mm length. Nymphs are resemble to the adults in their shape but pale yellow in colour, wingless and smaller size with black eyes (Fig.



Fig. 10 Thrips infested plant of *Cymbidium*

10). The insects are just visible to the unaided eye and are seem moving briskly on the leaves and flowers of orchids.

Nature of damage

Damage is caused by the nymphs as well as by the adults. They suck the cell sap from tender portion of plants. Leaves of attacked plants become curled, wrinkled and discoloured. In case of severe infestation, there are malformation of leaves, flower buds and flowers. The attacked plants become stunted and may finally dry up. The insect may also be responsible for transmitting some viral diseases of orchids from infested to healthy plants.

Management

Immediately remove the infested plant parts or whole plant (if required) and destroy them to reduce the incidence. Spray the plants with neem oil 0.03 EC 5 ml/lit. of water or malathion 50 EC or endosulfan 35 EC or carbaryl 50 WP at 0.05% or imidacloprid 17.8 SL (confidor) @ 0.003 percent. If required, repeat the spray at 10 days interval to control the insect.

6. Mealybug, *Pseudococcus* sp.

Identification

Mealybug cause damage to many orchids in open nursery or under controlled conditions. Adults are soft, filamentous pink or yellow coloured and body is covered with white powdery wax like cottony growth in irregular shape (Fig. 11). It has piercing and sucking type of mouthparts with long antennae.



Fig. 11 Mealybug infested plant of *Cymbidium*

Nature of damage

Both young ones and adult suck the cell sap from the leaves and petioles or any jointed portion of plants as a result plants become weakened. They also secrete honeydew that attracts ants. In case of severe infestation sooty mould develop on infested plant parts. The attacked plant looks like wilted plant resulting poor quality of flowers production.

Management

Removal and destruction of infested plant parts. Proper distance should be maintained within the plants to reduce the pests infestation. Spraying of insecticides like malathion 50 EC or endosulfan 35 EC at 0.05% or imidacloprid 17.8 SL (Confidor) @ 0.003% to curtail the mealybug population. Generally two sprays are required with any one of the above mentioned insecticides at 10 to 15 days interval.

7. Black weevil, *Sipalinus* sp. (Coleoptera: Curculionidae)

Identification

The adults are black in colour measuring about 12-14 mm in length and 5-6 mm width and larvae are creamy white in colour (Fig. 12).

Nature of damage

Just after hatching, the newly born larvae feed on young leaves, exudates come out from the puncture on which *Fusarium* fungus grow. Fungus helps in deceasing adjacent portion. The larvae enter into the shoot and thereafter, feed on pseudobulbs resulting rotting of pseudobulbs and thereby further growth is arrested. Feeding of adult weevils cause serious damage to the plant parts in many orchids.



Fig. 12 Infestation of black weevil on *Cymbidium*

Management

The pest can be suppressed by using following steps: procured planting materials should be free from weevil infestation. Manually collection and destruction of adult weevil when it is noticed on the plants. Spray the plants with any one of the following insecticides like carbaryl 50 WP or malathion 50 EC or chlorpyrifos 20 EC at the rate of 0.05% to check the pest incidence and repeat the spray at 10 days interval if required.

8. Snail, *Cryptaustenia verrucosa* and *C. heteroconcha*

Identification

Snails are soft bodied animals belonging to Class Gastropoda of the phylum Mollusca. Their body is asymmetrical, spirally coiled which enclosed in a shell. They have small flat foot which used for creeping. It is slime trails leading toward the damaged plant (Fig. 13).

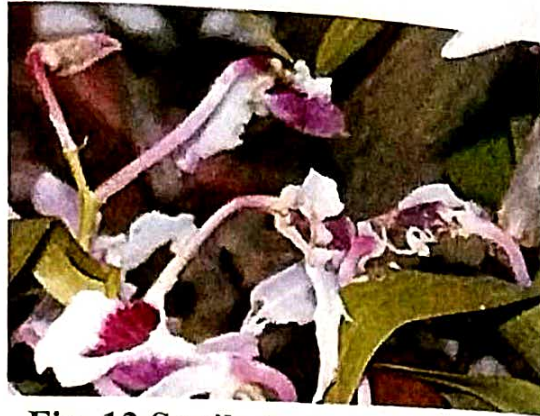


Fig. 13 Snails damaged flowers of orchid

Nature of damage

Both young and adult stage of snails feed on orchid roots, leaves, flower buds and even fully opened flowers. The damage is done on the plant parts through cutting by their mouthparts in irregular shape. Slime trail leading to the plant injury is indicative of their presence. Generally snails prefer shady and dark conditions and its attack prevalent only during night in monsoon period or highly humid conditions. If snails attack in opened flowers, it changes the physical appearance and decreased the beauty of flowers.

Management

Make clean cultivation on the farm by proper and timely weeding. Plants should be maintained at proper distance to curtail the over crowding. Manually collect and killed them by dropping in 5% salt solution is the most effective method to lower the snails population. Always avoid the plants putting

over ground. Spreading metaldehyde 1% on the floor at 20 days interval gives effective control. Metal barriers may be engaged to prevent the snails to climb on the racks. Spraying of neem oil 3 ml/lit. water on foliage will also provide good protection against the pest. Use cabbage leaves as bait at the surrounding area of orchids to minimize the snails population.

9. Grasshopper, *Hieroglyphus banian* Fabricius (Orthoptera: Acrididae)

Identification

Various species of grasshoppers are widely distributed in India. They are polyphagous in nature and feed on many crops and weeds other than orchids. The adults are 35-40 mm long and are shining greenish yellow having some marking across the pronotum. Nymphs are yellowish in colour with reddish brown spots on the back in early stage (Fig. 14).



Fig. 14 Grasshopper infestation on *Cymbidium* flower

Nature of damage

Grasshoppers are polyphagous in nature. The greatest amount of damage is caused during rainy season (August-September) when nymphs and adults feed on foliage of side grasses before attacking the main crop (orchids). On *Cymbidium*, they feed on young leaves, un-opened flower buds and flowers by cutting them in irregular shape with their biting and chewing type of mouth parts and ultimately flowers quality gets affected.

Management

Field sanitation should be done to maintain the grasshoppers population below economic threshold level. Remove the unwanted plants (weeds) from the nearby vicinity. Hand picking of nymphs and adults with the help of insect collecting net and kill them by putting in kerosenized water to reduce the insect population. Dusting with methyl parathion dust 5% or carbaryl 5% or malathion dust 5% to control the pest. Spray with neem oil 0.03 EC 5 ml/lit. water to repell the grasshoppers from the main crop (orchids).

10. Lepidopteran caterpillars

There are several species of lepidopteran caterpillars damage the orchids. Beside orchids, it has also been reported on various other ornamental plants like rose, gerbera, gladiolus, *chrysanthemum* and some weeds.

Identification

Larva of these insects have dense hairs on their body (Fig. 15), orange to pinkish white coloured with black head. Moths are medium sized.



Fig. 15 Lepidopteran caterpillar on flower of *Cymbidium*

Nature of damage

The larvae feed on tender leaves, flower buds and flowers. Newly hatched larva makes hole in flower buds before opening flowers leaving excreta from the feeding side which

show the infestation of caterpillars and at last, flower quality gets affected.

Management

The pest can be reduced by hand picking and killing manually. Use light trap at surrounded area to catch adult moths and kill them by putting in kerosenized water. Spray the crop with any one of the following insecticide like endosulfan 35 EC or malathion 50 EC @ 0.05% or econeem plus 3000 ppm 3 ml/lit. or spinosad (tracer) 1 ml/lit. of water. If required, repeat the spray at 10 to 15 days interval to control the caterpillars.

V. Pesticides and their application

The following pesticides are restricted as well as banned for manufacture, use and import by government of India due to their adverse effects on plants, domestic animals and human beings. Though, the farmers should be aware about those pesticides which are not safe for our health directly or indirectly.

Table 2 (A). Pesticides restricted for use in India

1	Aluminium phosphide	4	Methyl bromide
2	DDT	5	Sodium cyanide
3	Lindane	6	Methoxy ethyl mercuric chloride (MEMC)

Table 2 (B). Pesticides/pesticide formulations banned for manufacture, import and use

1	Aldrin	13	Ethylene dibromide
2	Aldicarb	14	Heptachlor
3	BHC (Benzene hexachloride)	15	Maleic hydrazide
4	Calcium cyanide	16	Menazone
5	Chlordane	17	Nitrofen
6	Chlorobenzilate	18	Paraquat dimethyl sulphate
7	Copper acetoarsenite	19	Pentachloro nitrobenzene
8	Dibromochlopropane	20	Sodium methane arsonate
9	Dieldrin	21	Pentachlorophenol
10	Endrin	22	TCA (Trichloro acetic acid)
11	Ethyl mercuric chloride	23	Tetradifon
12	Ethyl parathion	24	Toxafen

Source: Directorate of Plant Protection, Quarantine and Storage, Government of India, Faridabad, Haryana

Preparation of insecticides dilution for spray

There are some formulae, which can be used to calculate the required quantities and strength of insecticides from their known quantities and strength.

- (1) To find out the quantity of insecticide required for treating an area at a required strength, the following formula may be used.

$$\frac{\text{Total spray solution required} \times \text{Percent strength desired}}{\text{Strength of the chemical available}}$$

= Quantity of pesticide required

Example: To find out the quantity of endosulfan 35% EC required for treating an area which required 250 litres of spray solution at 0.05% strength

$$\frac{250 \text{ liters} \times 0.05}{35 \text{ percent}} = 0.357 \text{ litre or } 357 \text{ ml}$$

- (2) To obtain the strength of a finished spray solution when a known quantity of chemical is added to a known quantity of water, the following formula may be used

$$\frac{\text{Quantity of insecticide used} \times \text{Strength of insecticide}}{\text{Total quantity of finished spray solution needed}}$$

= Percent concentration of end product

Example: What will be the strength of endosulfan 35%EC if one litre insecticide diluted in 1000 litres of water

$$\frac{1 \text{ liter} \times 35 \text{ percent}}{1000 \text{ liters}} = 0.035\%$$

- (3) To obtain the quantity of formulated insecticide if only the quantity of actual insecticide to be applied per acre is known.

Example: 50 gm of malathion is to be applied per acre, what will be the amount of 50 per cent malathion emulsion required

$$\frac{100\% \text{ purity of insecticide used} \times \text{Quantity of actual insecticide used}}{\text{Strength of the given formulated insecticide}} = \text{Quantity of insecticide required}$$

$$\frac{100 \times 50}{50} = 100 \text{ g}$$

VI. First aid precautions

In case of pesticide poisoning, call a physician immediately. Awaiting the physician's arrival, apply the First -Aid.

1. Swallowed poisons

- (a) Remove the poison from the patient's stomach immediately by inducing vomiting. Give common salt, one teaspoonful (15 gm) in a glass of warm water (emetic) and repeat until the vomit fluid is clear. Gentle stroking or touching the throat with the finger or placing the blunt end of a spoon will help to induce vomiting when the stomach is full of fluid.
- (b) If the patient is already vomiting, do not give common salt in warm water but give large amount of warm water and follow the specific directions as suggested. Do not induce vomiting if the patient is in a coma.

2. Inhaled poisons

- (a) Carry the patient (do not let him walk) to fresh air immediately.
- (b) Open all doors and windows, if patient is inside.
- (c) Loosen all tight cloths.
- (d) Apply artificial respiration, if breathing has stopped or is irregular. Avoid vigorous application of pressure to the chest.
- (e) Prevent chilling.
- (f) Cover the patient with blanket.
- (g) Keep the patient as quiet as possible.
- (h) If the patient is convulsing, keep him in bed in some dark room.
- (i) Do not give alcohol in any form.

3. Skin contamination

- (a) Initially drench the skin with water.
- (b) Apply a stream of water to the skin while removing the clothing.
- (c) Cleanse the skin thoroughly with water.
- (d) Rapid washing is most important for reducing the extent of injury.

4. Prevention of collapse

- (a) Cover the patient with a light blanket.
- (b) Do not use a hot water bottle.

- (c) Raise the feet of the patient on the bed.
- (d) Apply the elastic bands to arms and legs.
- (e) Give strong tea and coffee.
- (f) Give a hypodermic injection of stimulants such as caffeine and epinephrine.
- (g) Give fluid administration of dextrose 5 per cent intravenously.
- (h) Do not exhaust the patients by too much or too vigorous treatment.

5. Eye contamination

- (a) Hold eyelids open.
- (b) Wash the eyes gently with stream of running water immediately. A delay of even a few seconds greatly increases the extent of injury.
- (c) Continue washing until the physician arrives.
- (d) Do not use chemicals, they may increase the extent of injury.

VII. Handling of pesticides

Pesticides being toxic to human beings and domestic animals should be handled with carefully. The following precautions should always be observed.

1. The pesticides should always be stored in their original containers and kept in a locked cupboard where they are out of reach to the children and domestic animals.
2. They should be kept away from food or feed stuffs and

- medicines.
3. The instruction found on the labels should be carefully read and strictly followed.
 4. Bags and containers of pesticides should be cut open with a separate knife intended for such purpose.
 5. The empty containers after the use of the chemical, should be destroyed and should not be put into some other use.
 6. While preparing the spray solutions, bare hands should not be used for mixing the chemicals with water.
 7. Before starting the spraying or dusting, mask on mouth and gloves on hands should be wear.
 8. Do not use smoke, chewing of tobacco or other eating material during mixing or application of insecticides. If it is needed, always wash the hands with soap before drinking water, eating or even smoking.
 9. Ensure that food, animal feed and water sources are not getting contaminated by drift while spraying or dusting.
 10. Particles or drops of pesticides which may accidentally get into eyes should be flushed out immediately with large volumes of clean water.
 11. It is preferable that protective clothing and devices are used while handling poisonous chemicals to avoid exposure to sprays or drifts.
 12. Dusting and spraying should never be done against the wind and it is preferable to have them in cool and calm weather.
 13. Sprayer nozzles should not be blown by mouth if gets

blocked while spraying. Washers and contaminated parts should be buried.

14. After handling pesticides, hands, face and body should be washed and clothing changed.
15. Washing the equipments after use and containers in or near wells or stream should be avoided.
16. Persons engaged in handling pesticides should undergo regular medial check-up.
17. In case of any suspected poisoning due to insecticides the nearest physician should be called immediately.

TABLE 2. Ready to use formulations of pesticides in commercial products

Desired strength of solution in %	Percent of active ingredient of insecticide in commercial products												
	10	20	25	30	35	40	50	60	70	75	80	85	100
	Quantity of pesticides to be added per litre of water in g or ml												
0.005	0.50	0.25	0.20	0.17	0.14	0.13	0.10	0.08	0.07	0.07	0.06	0.06	0.05
0.010	1.00	0.50	0.40	0.33	0.29	0.25	0.20	0.17	0.14	0.13	0.13	0.12	0.10
0.020	2.00	1.00	0.80	0.67	0.54	0.50	0.40	0.33	0.29	0.27	0.25	0.24	0.20
0.025	2.50	1.25	1.00	0.83	0.71	0.63	0.50	0.42	0.36	0.33	0.31	0.29	0.25
0.030	3.00	1.50	1.20	1.00	0.86	0.75	0.60	0.50	0.43	0.40	0.38	0.35	0.30
0.035	3.50	1.75	1.40	1.17	1.00	0.88	0.70	0.58	0.50	0.47	0.44	0.41	0.35
0.040	4.00	2.00	1.60	1.33	1.14	1.00	0.80	0.67	0.57	0.53	0.50	0.47	0.40
0.050	5.00	2.50	2.00	1.67	1.43	1.25	1.00	0.83	0.71	0.67	0.63	0.59	0.50
0.060	6.00	3.00	2.40	2.00	1.71	1.50	1.20	1.00	0.86	0.80	0.75	0.71	0.60
0.080	8.00	4.00	3.20	2.67	2.29	2.00	1.60	1.33	1.14	1.07	1.00	0.94	0.80
0.1	10.00	5.00	4.00	3.33	2.86	2.50	2.00	1.67	1.43	1.33	1.25	1.18	1.00
0.15	15.00	7.50	6.00	5.00	4.29	3.75	3.00	2.50	2.14	2.00	1.88	1.76	1.05
0.2	20.00	10.00	8.00	6.67	5.71	5.00	4.00	3.33	2.86	2.67	2.50	2.35	2.00
0.25	25.00	12.50	10.00	8.33	7.14	6.25	5.00	4.17	3.57	3.33	3.13	2.94	2.50
0.3	30.00	15.00	12.00	10.00	8.57	7.50	6.00	5.00	4.29	4.00	3.75	3.53	3.00
0.4	40.00	20.00	16.00	13.33	11.43	10.00	8.00	6.67	5.71	5.33	5.00	4.71	4.00
0.5	50.00	25.00	20.00	16.67	14.29	12.50	10.00	8.33	7.14	6.67	6.25	5.88	5.00
0.75	75.00	37.50	30.00	25.00	21.43	18.75	15.00	12.50	10.71	10.00	9.38	8.82	7.50
0.8	80.00	40.00	32.00	26.67	22.86	20.00	16.00	13.33	11.43	10.67	10.00	9.41	8.00
1.0	100.00	50.00	40.00	33.33	28.57	25.00	20.00	16.67	14.29	13.33	12.50	11.76	10.00

Table 4. Commonly available formulations of pesticides for agricultural use.

Class	Type	Abbrev.	Description
Dry	Dust	D	<ul style="list-style-type: none"> ▪ Ready to use, off shelf available. ▪ Low percentage of active ingredients. ▪ Very fine dry inert carrier made from tale, chalk, clay or ash. ▪ Prone to high level of pesticide drift.
	Granule	G	<ul style="list-style-type: none"> ▪ Granule pesticide are larger and heavier. ▪ Used for soil treatment and broadcasting to manage nematodes, insect-pests and weeds.
	Wettable Powder	WP	<ul style="list-style-type: none"> ▪ Finely grounded powder. ▪ Mixed with water for spray application.
	Micro-encapsulated	M	<ul style="list-style-type: none"> ▪ Particles of active ingredients (liquid or dry) surrounded by a plastic coating.
Liquid	Emulsifiable Concentrate	EC	<ul style="list-style-type: none"> ▪ Liquid active ingredients, concentrate dissolved in petroleum based solvents. ▪ Easily absorbed through skin
	Liquid Concentrate	LC	Diluted with a liquid solvent before solution being applied.
	Ultra Low Volume	ULV	<ul style="list-style-type: none"> ▪ Very high percentage of active ingredients. ▪ Used before dilution or diluted with small quantities of solvent.
	Flowable	F L	<ul style="list-style-type: none"> ▪ Finely grounded solid active ingredients suspended in use the liquid with inert materials.
Fumi-gants	Pellets liquids		<ul style="list-style-type: none"> ▪ Solid or liquid that release/vaporized into toxic gasses.

Table 5. List of insecticides commonly used for pest control

Sl. No.	Common Name	Trade Name	Mode of action	Formulations
(A) Organochlorines				
1.	Dicofol	Kelthane, Banmite, Delcofol, Micothane, Decofol and Acarin	C	18 EC
2.	Endosulfan	Thiodan, Agrosulfan, Endocel, Endocid, Endomil, Entacid, Hexasulfan, Hildan, Thiokill, Sujadane, Thiotox	C, S	35 EC, 4D
(B) Organophosphates				
1.	Acephate	Asataf, Acefex, Acemil, Agrophate, Dhanraj, Lucid, Tremor, Lancer, Orthane	Sy, S, C	25 EC, 75 SP
2.	Chlorpyrifos	Agrofos, Chlorofos, Classic, Dursban, Dhanusban, Dhanvan Lethal, Radar, Strike, Hexaban, Sulban-20, Tricel	C, S, F	20 EC
3.	Dichlorvos	Agrovan-76, Bangvos, Bargros, Divipam, Divisol, Luvon, Nukem776, Nuvan, Nuvasul, Paradeep, Vapona	C, F	76 WSC
4.	Dimethoate	Agromet, Agromet-30, Rogor, Dimex, Cygon, Hygro, Devigon, Dimor, Dimer, Entogor, Hexagor Kiltex, Micor, Paragor, Tagor, Tara-909	Sy, C, F	30 EC
5.	Ethion	Demite, Dhanumit, Ethiosul, Fosmite, Force, Lazor, MIT 505, Novathion, Gilmor, Raythion, Rhodocide, Volthion EC, Tafathion	C	50 EC
6.	Fenitrothion	Agrothion, Acothion, fenitox, Fenitrogil-50, Fethiol, Folithion, Hexafen, Sumithion	C, S, F	50 EC, 5D
7.	Formothion	Anthio	Sy, C, S	25 EC

8.	Malathion	Agrolmal, Cythion, Corothion, Murphy malathion dust, Agromala, Bangmal, Entomol, Hilthion, Malamar, Malahi-90, Malatox, Malzone, Taimal	C, S	50 EC, 5D
9.	Monocrotophos	Azodrin, Nuvacron, Agrocron, Balwan, Crotocele, Corophos, Croton, Entofos, Luphos, Gyphos, Hexaphos, Indophos, Monitar, Monocid, Monocil, Monocos, Monostar, Micophos, Kagrophos, Monodhan, Phoskill, Ramphos, Triphos, Vimonfos	Sy, C	36 WSC, 36 SL
10.	Quinalphos	Agriphos, Ekalux, Desalux, Agroquin, Agroquinal, Award, Dhanulux, Entolux, Keterphos, Kilex, Krush, Milux, Quinal, Kinalux, Ramlux, Quinaltaf, Smash, Starbrand,	C, S	25 EC, 5G
11.	Phosalone	Agrosalone, Micozon, Phosalone, Sugalone, Zolone	S, C	4 D, 35 EC
12.	Profenophos	Carina, Curacron, Celcron, Aurifos, Profex	S, C	50 EC
13.	Trizophos	Hostathion, Trifos, Trizocel	C, S	40 EC
(C) Carbamates				
1.	Aldicarb	Temik	Sy, C	10 G
2.	Carbaryl	Sevin, Agrovin, Carbamate, Corovin, Bangwin, Carvint, Devicarb, Hexavin, Kervin, Sevidol, Sevimo	C	10 D, 50, 85 WDP, 75 WP
3.	Carbofuran	Furadan, Hexafuran, Legend, Fury, Vegfrodiafuran	Sy, C, S	3 G
4.	Methomyl	Dunet, Lannate	C, Sy, S	40 SP
5.	Propoxer	Baygon	C	20 EC
(D) Synthetic Pyrethroids				
1.	Alphacypermethrin	Alphaguard Fastac, Numethrin	C, S	10 EC
2.	Beta-cyfluthrin	Bulldock	C	2.5 SC

3. Bifenthrin	Talstar, Capture	C, S	10 EC, SC, WP
4. Cypermethrin	Agrocyper, Bullet, Challenger, Cilcord, Cymbush, Cymet, Cyper 10, Cyperhit, Cyperkill, Cypermil, Cyporin, Hipower, Lacer, Mortal, Parathrin, Shakthi-10, Shakthi-25, Superkiller, Starcyprin	C, S	10 EC, 25 EC
5. Deltamethrin	Decis, Decamethrin, Decathrin	S, C	25 EC
6. Fenvalerate	Agrofen, Sumicidin, Capvalerate, Fencel, Fencid, Fenkil, Fenicidin, Fenoron, Hyfen, Lufen, Parafen, Pensil Ramfen, Starfen, Sujafen, Trifen, Valour	C, S	25 EC
7. Lambda-cyhalothrin	Karate, Kungfu, Icon	C	2.5 EC, 5 EC, 10WP
(E) Neonicotinoids			
1. Imidacloprid	Confidor, Gaucho, Tatamida, Admire, Provado, Premier, Premise	Sy	17.8 SL, 70 WS, 200 SL
2. Acetamiprid	Pride	C, S, Sy	20 SP
3. Thiamethoxam	Actara, Cruiser	Sy	25 WG
4. Fipronil	Regent, Prince	Sy, C	SC, EC, WP
(F) Botanical Products			
1. Neem oil (Azadirachtin)	Godrej, Achook, Biosol, Kemissal Margoside OK, Neem plus, Neemguard, Neemlin	Antifeedant, Repellent, Feeding deterrent, IGR	0.03 EC
2. Econeem	Achook, Aphidin, Bioneem, Biopest, Field marshal, Jawan, Fortuna Aza Jai Neem, Jeevan Crop Protector, Margocideck,	Antifeedant, Repellent, IGR	EC, ppm

		Neemark, Margosan-O, Neemazal-F, Neemgold, Neem Guard, Neem Rich, Neemolin, Neempouran, Nim-76, Neemactine, Replin-555, Phytowin, Rakshak, Nimbin, Nimbitor		
3.	Tobacco extract (<i>Nicotiana tobaccum</i>)	Black Leaf -40, Tobacco Leaf Extract	C, F	D, F
(G) Biocides				
1.	<i>Bacillus thuringiensis</i> (B.t)	Dipel, Delfin, Biolep, Bioasp, Spectrin, thuricide, Biobit, Halt, Lupin	S	LE
2.	Nuclear Polyhedrosis Virus (NPV)	Elcar, Virex-X, HaNPV, SINPV	S, C	WP, LE
3	<i>Verticillium lacanii</i>	Vertilec	C, S	WP
4.	<i>Beauveria bassiana</i>	Dispel, Boveria	C	EC, WP
5.	<i>Metarrhizium anisopliae</i>	Biomax	C	WP
6.	Spinosad	Tracer, Naturalyte	S	45 SC, 2.5 SC
(H) Miscellaneous Compound				
1.	Indoxacarb	Avaunt	C	14.5 SC
2.	Diflubenzuron	Dimilin	IGR	25 WP
3.	Sulphur	Sulfotox, Wetsulf, Sufex, Devisulfan, Wetsul	C	40, 80, 85 WP

Abbreviations

A- Acaricide, C- Contact Poison, D- Dust, F- Fumigant, IGR- Insect Growth Regulator, S- Stomach Poison, Sy- Systemic Poison, EC- Emulsifiable Concentrate, G- Granule, SC- Soluble Concentrate, SL- Soluble Liquid, SP- Soluble Powder, WP- Wettable Powder, WSC- Water Soluble Concentrate, LE - Larval Equivalent, L - Liquid.



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