1. Introduction

The diversity of living organisms is so vast that a specialized branch of biology is required to study it. This is science of taxonomy, which may be defined as the theory and practice of classifying organisms. Taxonomy is fundamental to biology as it involves the accurate naming and identification of species. Most of the insects are tropical; but certain of the genera belong to a temperate climate; while others, such as the cockroaches, have become universal, and, with flies, mosquitoes and bugs enjoy the range of the world. Insects may be divided into those useful to man, and those injurious or harmful to man and nature. Pest is the main focus of this newly conceived science. Pest, unfortunately has been overbearing the monotonous name for insect world since its inception in agriculture sciences. Thanks to Apple and Smith, who in 1976 elaborated the meaning of term Pest which defines the pest as any organism (other than man and animal world to man) causing injury to other organism that detrimental to man or his property in causing damage of significant (economic / other kind) importance (Wood, 1974). In India nearly 500 insect species have been reported to be pests of agricultural importance. Out of this, approximately 75 insect species have been classified as pests of economically important crops. Thus the man made conditions have led certain species to increase to their population densities. A few thousand species out of approximately 3 million species are pests.

The modern sericulture technology not only paid rich dividends by increasing silk production but also drastically disturbed natural seri-ecosystem. The pest population of silkworm and its host plants has increased and frequently there is outbreak of new pest. It causes extensive damage to silk host plants, which resulted in the deterioration of quality and quantity of leaves of silk host plants and ultimately fluctuation in cocoon production (Singh and Thangavlu, 1994). The increase in the productivity of silk per unit area can be achieved by following suitable production technology combined with management of pests and diseases of mulberry. About 300 insect and non- insect species of pests are known to occur on mulberry (Kotikal, 1982). The major insect orders known to be the pest of mulberry in order of largest number of species attacks the mulberry are Lepidoptera, Hemiptera, Coleoptera,
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Thysanoptera, Orthoptera and Isoptera besides the acarids and molluscan (Sengupta et al., 1990).

Mulberry, Morus alba L. has become a popular agricultural crop for silkworm rearing in India. It is affected by a number of sucking pests such as scale insects, leafhoppers, mealy bugs, thrip and whitefly. The perennial nature of mulberry combined with monocultural practices, harbours several pests throughout the year with seasonal variations (Rangaswamy et al., 1976). The production of appreciable quantity of quality mulberry leaf is often hampered by insect pests belonging to large number of insect orders. Apart from insect pests, predators, parasitoids, naturals and detrivores also survive on mulberry plant. Studies on diversity are the preliminary for any management work. Narendran (2001) explained that taxonomy is the foundation of biodiversity. Hence a survey was conducted in mulberry ecosystem to survey the diversity of the insects. The taxonomic diversity of the insect communities was worked out in the mulberry ecosystem.

Mulberry (Morus spp.) leaf is the only natural food for the silkworm, Bombyx mori L. It is a perennial, evergreen, luxuriant crop cultivated in all types of soils, both under rainfed and irrigated conditions. The crop is prone to depredation of diverse organisms, because of its fast growth and green foliage throughout the year, in varying proportions either for space, food or both. So far, over 300 insect and non-insect species of pests are known to infest mulberry in varying intensities during different stages of the crop and seasons (Naik, 1997). Though the frequent leaf picking and pruning of the attack of pests, many of them still final enough time and place on mulberry for feeding and breeding on it. From India, about 100 insect pests have been reported on various varieties of mulberry.

The occurrence of various pests recorded by various researchers are as in Karnataka the incidence of Spilosoma obliqua Walker (Lepidoptera: Arctidae) commonly known as Bihar hairy caterpillar was recorded during November to January (Rangaswamy et al., 1976) but the maximum infestation occurs during October in certain fields of Kanakapura taluk (Shree and Manjunatha, 1998). Sidhu et al., (1968) observed high damage by thrips (Pseudodendrothrips mori Nawa) (Thysanoptera:
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Thripidae) during February in Kanakapura taluk. Among the sap feeders, incidence of thrips was the highest (42.55%) and followed by mealy bug (20.80%) (Sathyaprasad and Manjunatha, 1993). The disorder caused by mealy bug (*Maconellicoccus hirtus* Green) (Hemiptera: *Pseudococcidae*) is commonly known as ‘Tukra’ disease in West Bengal (Mukherjee, 1919) and considered as widespread disease throughout the silk producing states of India (Shriharan *et al*., 1979). Sengupta *et al*., (1990) reported undesirable damage to mulberry by wingless grasshopper (*Neorthacris acuticeps niligiriensis* Uvarov) (Orthoptera: Acrididae) in southern parts of India and highest infestation was reported during April in of Kanakapura taluk (Manjunatha and Shree, 1997). The lepidopteran insect pests causing damages to the mulberry in different part of the world in a very concise form. It is evident from available literature that the more than 20 lepidopteran species belonging to *Pyralidae, Arctiidae, Lymantridae, Noctuidae, Geometridae, Amatidae, Syntotomidae* and *Tortricidae* cause damage to mulberry crop in different parts of world (Narayanswamy *et al*., 2001).

Among the sucking pests attacking mulberry in all stages, leafhoppers constitute one of the important groups. Both adult and nymphal stages of leafhopper desap the plants causing speckling symptoms and if severe, cause crinkling and distortion of leaves. Among the leafhoppers, *Empoasca flavescens* (Fabricius) is the important species attacking mulberry, causing “hopper burn” to the tune of 40 % (Kariappa and Narasimhanna, 1978). Rangaswami *et al*., (1976) and Ullal and Narasimhanna (1982) reported severe occurrence of *Empoasca flavescens* (Fabricius) from October till May. Kotikal (1982) reported the species to be active on mulberry during October- November. In addition, *Kolla* sp. and *Nisia nervosa* (Motschulsky) were prevalent during November. Recently the lepidopteran leaf roller *Diaphania puluverulentalis* (Hampson) has attained a serious pest status in the south of India during rainy and winter months with high percentage of infestation (Sengupta *et al*., 1990; Siddegowda *et al*., 1995; Geethabai *et al*., 1997; Rajadurai *et al*., 1999).

Defoliating insects are common in all agricultural ecosystems, feeding on different host plants. They are detrimental to the health and productivity of plants. Depending upon the duration and the severity of defoliation, plant growth may be
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negatively affected. Defoliator’s causes’ considerable damage to mulberry and early
detection and management are the key factors to control them. The two major groups
of defoliators that cause damage to plants through their chewing mouthparts include
the caterpillars and beetles. Other chewing insects occasionally damaging the plants
include grasshoppers, katydids and their relatives (Rajadurai, S, 2005).

Most molluscs are marine organisms, but a few groups of gastropod molluscs
(snails and slugs) have adapted very successfully to freshwater and terrestrial life. The
economic importance of slugs and snails, which together form a large group, ranks
next only to insects. They are both agricultural pests and carriers of diseases. Tens of
thousands of species of land snails exist today worldwide. Among other adaptations,
they have exchanged gills for lungs, and for this reason they are called pulmonates.
Slugs and snails are without doubt the worst pests in the garden. Many-times seeds are
sown and appear not to germinate when in fact they have been eaten by slugs
overnight. Their appetite is voracious and their taste in plants extraordinarily varied
but they all prefer succulent seedlings that are least able to resist the damage.

Both snails and slugs are members of the molluscs phylum and are similar in
structure and biology, except slugs lack the snail’s external, spiral shell. These
molluscs move by gliding along on a muscular “foot.” This muscle constantly secretes
mucus, which facilitates their movement and later dries to form the silvery “slime
trail” that signals the presence of either pest (Flint, 1998). Slugs reach maturity after
about 3 to 6 months, depending on the species, and lay clear, oval to round eggs in
batches of 3 to 40 beneath leaves, in soil cracks, and in other protected areas. Snails
and slugs are most active at night and on cloudy or foggy days (Dreistadt, S. H et al.,
1994). On sunny days they seek hiding places out of the heat and bright light. Often
the only clues to their presence are their silvery trails and plant damage. In areas with
mild winters, such as southern coastal locations, snails and slugs can be active
throughout the year (Sakovich et al., 1984).

Among the non-insect pests of agricultural as well as horticultural crops, the
Giant African snail, Achatina fulica Bowdich is reported as most important one in
many parts of the world. The characteristic symptom of the infestation was that the
snails were feeding on the bark of the stem. This brings down the nutritive value as the vascular is injured and senescence of mulberry leaves leading to defoliation. The incidence is one of the major factors that decide the productivity and profitability in sericulture is the maximization of quality mulberry leaf yield per unit area. However, the mulberry leaves from snail attacked plants are not suitable for silkworm feeding as they are found to be nutritionally inferior (Shree et al., 2006).

Population studies of insects are helpful in pin-pointing the factors that bring about numerical changes in the natural population and also in understanding the functioning of the life system of the pest species to take preventive and control measures. Developing a model on the basis of population can be of immense help in future strategy of pest control. Mulberry plants (Morus sp.) are commercially cultivated for their leaves which are used as food for the silkworm Bombyx mori L. mulberry plants are infected by several pests which cause considerable damage to them (Rangaswamy et al., 1976). The insect pests of mulberry have been amply documented in plains (Chatterjee., 1960; Pillai, 1968 a, b, c; Singh, 1972; Rajshekhar Gowda and Devaiah, 1988; Reddy and Kotikal, 1988; Saratchandra, 1988; Thangavelu, 1988; Saratchandra and Rajana, 1989; Miyazaki, 1990) and very little information is available under hill conditions (Pillai et al., 1980; Sharma and Tara, 1985; Parry and Pawen, 1988). In view of the above, a preliminary study was made to record the insect fauna available at Aurangabad district, Maharashtra state, India to know the seasonal occurrence of different species of insects and their possible relation with mulberry as pests as well as predators. In present work during study period some important pests of mulberry are described with respect to distribution, occurrence and type of damage and symptoms.
The insect and molluscan pests associated with mulberry gardens.

2. Materials and Methods

1. Study area description:
After detailed survey some of the mulberry fields were selected for the collection of insect and molluscan pests. The selected fields were from different tehsils of Aurangabad districts are viz. Aurangabad (University campus), Khultabad (Shulibhanjan), Gangapur (Ambewadi), Sillod (Kaigaon), Paithan (Nilajgaon) and Phulambri (Dongergaon) (Plate No. 5). Insects were collected by visiting each mulberry garden for 2 annual cycles i.e. from June 2009- May 2011 with more or less monthly periodicity.

Collecting Methods
Different insect pests were collected from mulberry gardens in and around the selected fields of Aurangabad districts, Maharashtra, India by standard insect collection techniques (Donald et al., 1981) and Manual for Entomology and Arachnology, (2000).

2.1. Collecting bag:
A lightweight bag with a shoulder or waist strap is required for carrying collecting equipment in the field. A basic kit of items for collecting insects consists of the following:

- Killing bottles of various sizes (Plate No. 23).
- Aspirators
- Forceps
- Tissue paper for lining Killing bottles and aspirators.
- Plastic and paper bags for plant specimens.
- Paper toweling to absorb moisture in bags of plant samples.
- Small paint brush for picking up small specimens.
- Pocket Knife for opening galls, fruit, seeds etc.
- Field notebook and pencil.
- Vials with alcohol or other preservative.
- Handlens.
- Containers for specimens, e.g. paper envelopes, small boxes, vials.
2.1.1. Aspirators:
An aspirator (also called a pooter) is used for catching small specimens by sucking them into a container. It is also useful for collecting small specimens that need to be kept alive.

2.1.2. Hand Collecting:
Sedentary or slow-moving arthropod and molluscan may be collected by hand. As many insects can bite or sting, forceps should be used to pick them up, unless one is certain that they are harmless.

a) Collecting Nets:

i) Arial nets: Arial nets (Plate No. 23) are used to collect flying insects like butter flies, flies, dragonflies, grasshoppers, wasps and bees. The net should be light weight, made of fine, soft, durable material. Once insect has been caught, the end of the net must be flipped over to prevent it escaping. Specimen can be removed from the net with the finger if harmless, or directed into a killing bottle or vial of preservative.

3. Killing and Temporary Storage: Once insects have been collected, they are mounted and/or preserved permanently. Killing and stored methods vary according to the type of arthropod and molluscan that has been collected these procedure explained bellow.

3.1. Killing Methods:

3.1.1. Use of liquid: All insects and larvae as well as molluscan pests must not be allowed to dry at once they are dead. They should be placed directly into a liquid preservative usually 70-95% ethyl alcohol. Formalin should not be used for storing insects and arachnids as it makes specimens hard and difficult to examine.

3.1.2. Freezing: Insects can be killed by placing them in a freezer. This method is particularly suitable for reared moths and butterflies.

3.1.3. Pinching: Larger butterflies can be stunned or killed by pinching the thorax between the thumb and fore finger.

3.1.4. Killing bottles: Most insects can be killed in killing bottles (Plate No.23). The bottle should be wide mouthed and made of glass; polypropylene or polyethylene
Absorbent paper should be placed inside the bottle to soak up condensation, regurgitated or defecated liquid and to prevent insects from damaging each other.

**Ethyl Acetate bottles:**

Preparation procedure:
1. Make a paste of plaster of Paris and water, and place a thick layer on the bottom of a bottle.
2. Allow the plaster of Paris to dry in well ventilated place.
3. Saturate the plaster of Paris with ethyl acetate any excess liquid should be poured off.
4. Place crumpled absorbent paper on the top of the plaster of Paris.
5. Let the bottle dry out before reaching it with ethyl acetate.

**3.2. Temporary storage:**

**3.2.1. Dry Specimen:** Butterflies and other large-winged can be stored in folded protective paper envelopes. Most arthropod specimens can be conveniently stored between layers of absorbent paper. If the containers are not sealed, on insects repellent such as naphthalene should be added to prevent attack by pests such as ant and battles.

**3.2.2. Specimens in liquid:** Specimens that are to be preserved in liquid are usually killed by placing them directly into a vial of preservative or fixative. Vials of samples can be stored in specially made rocks or boxes.

**3.3 Recording field data:**
All relevant data must be recorded at the time of collecting. It is essentials to note the locality, date, collector’s name, and other information such as host plant.

**4. Preservation:** Insects can be permanently preserved either dry, or on microscope slides; the method of preservation depends on the type of arthropods.

**4.1 Dry preservation:**
Insects that are to be preserved dry are best mounted in ways that facilitate study and permanent storage.

**4.1.1. Mounting large insects:** Insects longer than about 8mm are usually mounted on pins pushed through the thorax. Insect pins are longer than ordinary pins, and are
made of stainless steel that does not rust. A no 2 or no 3 entomological pin is suitable for most insects although those with delicate bodies may require assize no 0 or no 1.

4.1.2. Pinning (Plate No. 23):
1. Prepare a mounting board made thermocol covered with paper.
2. Push the pin vertically through a thorax, avoiding the legs as the point of the pin emerged on the underside of the body. The pin should be inserted slightly to the right of the centre of the mesothorax.
3. Secure a data label next to the insect.

4.1.3. Wing setting: The wings of certain insects must be spread, because the wing venation or wing pattern is important for identification.

4.1.4. Mounting small insects: Insects that are too small for mounting directly on standard pins are double mounted on cards points, card platform, minute pins or in gelatine capsules.
   a) Card points: Small bug’s wasps and files are mounted on card points about 12mm long and 3mm wide. These can be purchased or made by cutting up good quality drawing card.
   b) Card platforms (Plate No. 23): Small insects particularly certain beetles and parasitic wasps are suitable for mounting on card platforms measuring 5×10mm.
   c) Minuten pins: These are used for very small moths and other small insects, such as flies and bugs. Stainless steel minuten pins are small, 10-15mm long without heads.

4.2. Wet preservation: Most soft bodied insects become very distorted when they dry out. They have to be stored permanently in a suitable liquid. Ethanol (70-95%) is generally used, with the following few exceptions, Soft scale insects and mealy bugs mixture of 4 parts 90% ethanol and 1 part glacial acetic acid.

5. Labelling: Great care of should therefore be taken to ensure that all specimens are labelled correctly. The precise collecting locality; date of collection, name of the collector, host/habitat is recorded.

6.1. Types of collection:
6.1.1. Dry collection: A simpler way of storing pinned insects is to house them in hinged wooden boxes (Plate No. 23). The inside is lined with layer of pinning
substrate, and specimens are pinned onto both surfaces. The box must be deep enough to accommodate standard insect pins on both sides without them touching, and must close tightly to prevent insect’s pests from entering. Such boxes are stored in an upright position on shelves.

6.2.2. **Wet collection:** These are mostly collections of specimens stored on ethanol, or other preserving fluid, in vials with tight fitting stoppers, ideally, the vials should be of uniform size and are best stored upright in single rows in specially made racks of thermocol.

7. **Insect sampling and identification:**
The insect and molluscan pests collection was carried out in six sites from June 2009 to May 2011 for 12 months. All the sites ware sampled monthly with different collection methods. All the specimens were identified with the help of available literature and Zoological Survey of India, Entomology Section, Pune division. The website used for molluscan pest identification as follows: http://www.discoverlife.org.
3. Results

The present investigation shows taxonomical study on insect and molluscan pests of mulberry garden from various sites in Aurangabad district, Maharashtra during June, 2009- May 2011. The occurrence of insect and molluscan pests from various sites shows that the incidence of 10 Lepidopteran species are as Amasacta albistriga Walker, Amata passalis (Fb.), Diphania pulverulentalis (Hamson), Spodoptera litura (F), Spilosoma obliqua Walker, Eurema hecabe Linnaeus, Holochroa sp, Melanitis leda (Dr.), Catopsilia Pomona Fabricius, and Papilio demoleus Linnaeus. The order Hemiptera shows total 9 species are as Aonidiella qurantii, Dysdercus singulatus, Empoasca flavescens, Maconellicoccus hirsutus, Nezara viridula Linnaeus, Oxyrachis tarandus and Tessaratoma javanica, Erthesina acuminata Dallas, 1851 and Hotea curculionoides.

The order Orthoptera shows total 11 species are Acrida exaltata (Walker), Aulacobothrus sp., Gryllotalpa gryllotalpa Latreille, Brachytrupes portentosus echlenetein (Re), Melanoplus sanguinipes Fabricius, Neoconocephalus triops Linnaeus, Neorthacris acuticeps, Psoloessa delicatula Scudder, Schistocerca americana, Trigonidium sp. and Scudderia sp. Stal. The order Coleoptera shows total 7 species are as Apariona germani, Aspidimorpha miliaris, Chiloloba acuta Wiedemann, Chrysocoris stolli, Cryptogonus sp, Deloyala guttata and Psiloptera sp. The order Isoptera show 1 species is Odontotermes sp. of termite.

The order Hymenoptera shows total 2 species of predator Ammophila sp and Camponotus compressus. The order Mantodea also shows 2 species of predator Deiphobe indica and Mantis religiosa.

The molluscan pests order Mollusca shows total 3 species are as Achatina fulica, Rachis punctutus and Laevicaulis alte.

A) Insect pests associated with mulberry garden.

1. Order: Lepidoptera

1.1 Spilosoma obliqua Walker (Plate No. 24)

Common name: Bihar hairy caterpillar
Phylum: Arthropoda
The insect and molluscan pests associated with mulberry gardens.

Class: Insecta  
Order: Lepidoptera  
Family: Arctidae  
Genus: Spilosoma  
Species: oblique  

Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, Aurangabad district, Maharashtra, India.  
Occurrence: The pest is found to occur frequently from August to February.  
Type of damage and symptoms:  
Gregarious young caterpillars feed upon the chlorophyll layer of leaf exposing the veins. Late instar caterpillars are voracious eater of mulberry leaves. The affected leaves look dead, dried and easily fall off. Clear branches without leaves can also be noticed after a severe attack.

1.2. Amasacta albistriga Walker (Plate No. 24)  
Common name: Red hairy caterpillar  
Phylum: Arthropoda  
Class: Insecta  
Order: Lepidoptera  
Family: Arctidae  
Genus: Amasacta  
Species: albistriga  

Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields except Khultabad, Aurangabad district, Maharashtra, India.  
Occurrence: This is serious pest of ground nut, seasame, cow pea, mung bean, cotton, bajra, sorghum, castor and many other crops has found to be infesting mulberry as has been observed in farm of Research Extension Centre of CSB, Krishnagiri in Tamil Nadu during September (Vijaya Kumar et al.,2005).
Type of Damage and symptoms:
In the early instars, larvae feed gregariously on the same leaf by scraping the lower surface of tender leaves leaving the upper epidermal layer intact. In later stages, the damage will be severe and the entire plant is eaten and looks like as if grazed by cattle.

1.3. *Amata passalis* Fabricius (Plate No.24)

Common name: Wasp moth  
Phylum: Arthropoda  
Class: Insecta  
Order: Lepidoptera  
Family: Amatidae  
Genus: *Amata*  
Species: *passalis*  
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.  
Occurrence: Mostly found from February to August.  
Type of Damage and Symptoms:  
Reduction in leaf yield. Branches without leaves are noticed in the garden.

1.4. *Diphania pulverulentalis* Hamson (Plate No.24)

Common name: Leaf roller  
Phylum: Arthropoda  
Class: Insecta  
Order: Lepidoptera  
Family: Pyralidae  
Genus: *Diphania*  
Species: *pulverulentalis*  
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.  
Occurrence: Summer and autumn seasons.  
Type of Damage and symptoms: 
The insect and molluscan pests associated with mulberry gardens.

The caterpillars roll the leaves. They tie or fold one to several blades of leaves of mulberry with silken thread and feed internally in the leaf folds. As a result, quality and quantity of leaves is adversely affected. The pest is troublesome to rainfed and irrigated mulberry crops. By egg laying, apical shoots are destroyed. The pest cause a great problem to chawki rearing by contaminating the leaves since pathogens harbour and increase the incidence of pebrine disease silk worms.

1.5. *Spodoptera litura* Fabricius (Plate No. 24)

**Common name:** Cutworm

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Lepidoptera

**Family:** Noctuidae

**Genus:** *Spodoptera*

**Species:** *litura*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Mostly from August to February on mulberry.

**Type of Damage and symptoms:**

The caterpillars cause the damage to shoot of young plants by cutting them. The cut portion of the shoot dries up and finally falls down. The caterpillars also cause damage to leaves by feeding upon them. Newly sprouted mulberry garden or young plant gardens skeletonized totally in severe infestation.

1.6. *Eurema hecabe* Linnaeus (Plate No. 24)

**Common name:** Common grass yellow

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Lepidoptera

**Family:** Pieridae

**Genus:** *Eurema*

**Species:** *hecabe*
The insect and molluscan pests associated with mulberry gardens.

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Mostly from August to February.

**Type of Damage and symptoms:**
The caterpillars cause the damage to shoot of young plants by cutting them. The cut portion of the shoot dries up and finally falls down. The caterpillars also cause damage to leaves by feeding upon them.

1.7. *Holochroa* sp. (Plate No. 25)

*Phylum:* Arthropoda  
*Class:* Insecta  
*Order:* Lepidoptera  
*Family:* Geometridae  
*Genus:* Holochroa  
*Species:* -

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from Gangapur and Paithan mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Mostly from August to February.

**Type of Damage and symptoms:**
The caterpillars cause the damage to shoot of young plants by cutting them. The cut portion of the shoot dries up and finally falls down. The caterpillars also cause damage to leaves by feeding upon them.

1.8. *Melanitis leda* (Dr.) (Plate No. 25)

**Common name:** Common Evening Brown  

*Phylum:* Arthropoda  
*Class:* Insecta  
*Order:* Lepidoptera  
*Family:* Nymphalidae  
*Genus:* Melanitis  
*Species:* leda
**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Mostly from August to February.

**Type of Damage and symptoms:**
The caterpillars cause the damage to shoot of young plants by cutting them. The cut portion of the shoot dries up and finally falls down. The caterpillars also cause damage to leaves by feeding upon them.

1.9. *Catopsilia Pomona* Fabricius (Plate No. 25)

**Common name:** Lemon Emigrant

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Lepidoptera

**Family:** Pieridae

**Genus:** *Catopsilia*

**Species:** *Pomona*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Mostly from August to February.

**Type of Damage and symptoms:**
The caterpillar feeds on plants of the family Fabaceae. It is occasional pests on *Sesbania* sp and *Cassia* sp. The caterpillars also cause damage to leaves by feeding upon them.

1.10. *Papilio demoleus* Linnaeus. (Plate No. 25)

**Common name:** Lemon butterfly

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Lepidoptera

**Family:** Papilionidae
Genus: *Papilla*
Species: *demoleus*
**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
**Occurrence:** Mostly from August to February.
**Type of Damage and symptoms:**
The caterpillar feeds on plants of the family Fabaceae. It is occasional pests on *Sesbania* sp and *Cassia* sp. The caterpillars also cause damage to leaves by feeding upon them.

2. **Order: Hemiptera**

2.1. *Maconellicoccus hirsutus* (Plate No. 25)

**Common name:** Mealy bug
**Phylum:** Arthropoda
**Class:** Insecta
**Order:** Hemiptera
**Family:** Psudococcidae
**Genus:** Maconellicoccus
**Species:** *hirsutus*
**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
**Occurrence:** Mostly in summer months.
**Type of Damage and symptoms:**
The leaf yield is tremendously reduced and is depleted in nutritive values. The affected apical shoot show retarded growth and flattening of apical shoot. Thickening of the affected leaves is also observed. The leaves are wrinkled and dark green in colour.

2.2. *Aonidiella qurantii* Maskell (Plate No. 25)

**Common name:** Red scale insect
**Phylum:** Arthropoda
The insect and molluscan pests associated with mulberry gardens.

Class: Insecta
Order: Hemiptera
Family: Coccidae
Genus: Aonidiella
Species: qurantii
Locality and Habitat: From the mulberry plant, Morus alba L., from Aurangabad tehsil mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: Mostly in summer season.
Type of Damage and symptoms:
It attacks the twigs, branches and stems, causing loss of vitality. The maximum damage done by this insect is during the first 1.5 years of planning. It rarely attacks the older plants. It sucks plant sap. In case of severe attack on young plant, the leaves become yellow and finally the whole plant dries up and dies.

2. 3. Dysdercus singulatus Fabricius (Plate No. 26)
Common name: Red cotton bug
Phylum: Arthropoda
Class: Insecta
Order: Hemiptera
Family: Pyrrhocoridae
Genus: Dysdercus
Species: singulatus
Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: Mostly in summer season.
Type of Damage and symptoms:
The adults and nymphs suck cell sap from leaves. But generally there occurrence on cotton due which it is called as red cotton bug. It is one of the most injurious pests of cotton, but at period of research during study their occurrence is noted down on mulberry plant.
2. 4. *Empoasca flavescens* (Plate No. 26)

**Common name:** Jassid / Leaf hopper  
**Phylum:** Arthropoda  
**Class:** Insecta  
**Order:** Hemiptera  
**Family:** Cicadellidae  
**Genus:** *Empoasca*  
**Species:** *flavescens*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields except Khultabad, Aurangabad district, Maharashtra, India.

**Occurrence:** From July to October months.

**Types of Damage and Symptoms:**

Both nymphs and adults suck the cells sap from leaves at the time of sucking cell sap jassids inject toxins in the plant body as result that leaves becomes curly and edges of the leaves start burning this is called as “hopper burn”. The hopper burn is caused by the toxic virus and jassids is a vector very first a triangular brown spot at the tip of leaf is appear. Secondly, jassids secrets honeydew like substance on leaf surface further, it cause sooty mould and affect photosynthesis of plant. In general, the jassids affect the quality and quantity of leaves. The jassids also suck the cell sap from tender’s stems of twigs.

2. 5. *Nezara viridula* Linnaeus (Plate No. 26)

**Common name:** Southern green stink bug/ Pentatomid bug  
**Phylum:** Arthropoda  
**Class:** Insecta  
**Order:** Hemiptera  
**Family:** Pentatomidae  
**Genus:** *Nezara*  
**Species:** *viridula*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: in all season.

Types of Damage and Symptoms:
Nymphs and adults suck the cell sap from tender leaves and stems and devitalize the host plants.

2.6. *Oxyrachis tarandus* Fabricius (Plate No. 26)
Common name: Tree hoppers
Phylum: Arthropoda
Class: Insecta
Order: Hemiptera
Suborder: Homoptera
Family: Membracidae
Genus: *Oxyrachis*
Species: *tarandus*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: in all season.

Types of Damage and Symptoms:
Foliar distortion was noticed because of continuous sucking of cell sap by the *Oxyrachis tarandus* (Fabricius). Due to the sucking of cell sap and injection of toxins through saliva by these insects, the physiology plants get affected. In addition to this, sooty mould, *Capnodium* sp. develops on honey dew droplets on different plant parts, which results in the production of poor quality leaves. In future, it may become major pest, because mulberry crop is grown round the year and these hoppers may prefer it an alternate host whenever the main host plant are not available.

2.7. *Tessaratoma javanica* Thunberg (Plate No. 26)
Common name: Litchi bug
Phylum: Arthropoda
Class: Insecta
Order: Hemiptera
Family: Tessaratomidae
The insect and molluscan pests associated with mulberry gardens.

Genus: *Tessaratoma*
Species: *javanica*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** From June to January.

**Types of Damage and Symptoms:**
Nymphs and adults suck the cell sap from tender leaves and stems and devitalize the host plants.

2. 8. *Erthesina acuminata* Dallas (Plate No. 26)

Common name:

Phylum: Arthropoda
Class: Insecta
Order: Hemiptera
Family: Pentatomidae
Genus: *Erthesina*
Species: *acuminata*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from Gangapur and Paithan mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Mostly in rainy season

**Types of Damage and Symptoms:**
Their presence on mulberry is also reported as predator.

2. 9. *Hotea curculionoides* (Plate No. 27)

Common name: Reduviide bug

Phylum: Arthropoda
Class: Insecta
Order: Hemiptera
Family: Reduviidae
Genus: *Hotea*
Species: *curculionoides*
Localities and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: Throughout the year.

Types of Damage and Symptoms:
Their presence on mulberry is also reported as a predator.

3. Order: Orthoptera

3.1 *Acrida exaltata* Walker (Plate No. 27)

Common name: Indian Grasshopper

Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Acrididae
Genus: *Acrida*
Species: *exaltata*

Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: In month of winter season and also found throughout the rainy season except during the fourth week, when temperature was maximal and humidity was minimum.

Types of Damage and Symptoms:
Nymphs and adults of this pest voraciously feed upon the mulberry leaves and leaf yield is reduced considerably. Branches of plants without leaves are observed in the mulberry garden.

3.2. *Aulacobothrus* sp. (Plate No. 27)

Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Acrididae
Genus: *Aulacobothrus*
Species: -
Locality and Habitat:
From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: From July – August, more frequently.

Types of Damage and Symptoms:
Nymphs and adults of this pest voraciously feed upon the mulberry leaves and leaf yield is reduced considerably. Branches of plants without leaves are observed in the mulberry garden.

3.3. *Melanoplus sanguinipes* Fabricius (Plate No. 27)
Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Acrididae
Genus: *Melanoplus*
Species: *sanguinipes*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: From July – August, more frequently.
Types of Damage and Symptoms:
Nymphs and adults of this pest voraciously feed upon the mulberry leaves and leaf yield is reduced considerably. Branches of plants without leaves are observed in the mulberry garden.

3.4. *Neorthacris acuticeps nilgriensis* Uvarov (Plate No. 27)
Common name: Wingless Grasshopper
Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Acrididae
Genus: *Neorthacris*
Species: *acuticeps*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: From July – August, more frequently.

Types of Damage and Symptoms:
Nymphs and adults of this pest voraciously feed upon the mulberry leaves and leaf yield is reduced considerably. Branches of plants without leaves are observed in the mulberry garden.

3.5. *Psoloessa delicatula* Scudder (Plate No. 27)

Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Acrididae
Genus: *Psoloessa*
Species: *delicatula*

Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: From July – August, more frequently.

Types of Damage and Symptoms:
Nymphs and adults of this pest voraciously feed upon the mulberry leaves and leaf yield is reduced considerably. Branches of plants without leaves are observed in the mulberry garden.

3.6. *Schistocerca americana* (Plate No. 28)

Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Acrididae
Genus: *Schistocerca*
Species: *Americana*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: From July – August, more frequently.

Types of Damage and Symptoms:
The plants are damaged by the grasshopper gnawing on the leaves, and young vegetable plants can be eaten to the ground. Most of the feeding damage is caused by the third, fourth, and fifth instar. Those three stages have a much larger appetite than the adults.

3.7. *Neoconocephalus triops* Linnaeus (Plate No. 28)
Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Tettigoniidae
Genus: *Neoconocephalus*
Species: *triops*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: From July – August, more frequently.

Types of Damage and Symptoms:
Nymphs and adults of this pest voraciously feed upon the mulberry leaves and leaf yield is reduced considerably. Branches of plants without leaves are observed in the mulberry garden.

3.8. *Scudderia* sp. Stal (Plate No. 28)
Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Tettigoniidae
Genus: *Scudderia*
Species: -
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: From July – August, more frequently.

Types of Damage and Symptoms: 
Nymphs and adults of this pest voraciously feed upon the mulberry leaves and leaf yield is reduced considerably. Branches of plants without leaves are observed in the mulberry garden.

3.9. *Brachytrupes portentosus echlenetein* (Re) (Plate No. 28)
Common name: Cricket
Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Gryllidae
Genus: *Brachytrupes*
Species: *portentosus echlenetein*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: Throughout the year.

Types of Damage and Symptoms:
Damages young shoots and buds. It has also been observed that both the nymphs and adults collect seedlings, leaves and other soft part of the plant both dead and alive and drag them into their burrow where they are stored and finally eaten. Fresh sappy material is often left on the surface for a day or two, to wilt before being taken into the burrow. Generally attacks mulberry grown on such soils where burros easily to be excavated. Young mulberry plantations with damage on various soft parts are noticed in the garden.

3.10. *Trigonidium sp.* (Plate No. 28)
Common name: Tail cricket
Phylum: Arthropoda
The insect and molluscan pests associated with mulberry gardens.

Class: Insecta
Order: Orthoptera
Family: Gryllidae
Genus: Trigonidium
Species: -
Locality and Habitat: From the mulberry plant, Morus alba L., from Gangapur mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: During rainy season.
Types of Damage and Symptoms:
It attacks mulberry grown on such soils where burros easily to be excavated. Young mulberry plantations with damage on various soft parts are noticed in the garden.

3.11. Gryllotalpa gryllotalpa Linnaeus (Plate No. 28)
Common name: Mole cricket
Phylum: Arthropoda
Class: Insecta
Order: Orthoptera
Family: Gryllotalpidae
Genus: Gryllotalpa
Species: gryllotalpa
Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: Occurs mostly during rainy season
Types of Damage and Symptoms:
Generally there attacks mulberry grown on such soils where burros easily to be excavated. Young mulberry plantations with damage on various soft parts are noticed in the garden.

4. Order: Coleoptera
4.1. Aparino germarii (Plate No. 29)
Common name: Stem borer
Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family: Cerambycidae
Genus: Aparino
Species: germarii
Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, except Paithan, Aurangabad district, Maharashtra, India.
Occurrence: Throughout the year.
Types of Damage and Symptoms:
Twigs are easily broken by winds because the twig tissues are partially destroyed during the egg laying process. Severely attacked plants may die. Frass expulsion holes are made at intervals along the main gallery, so frass can be seen externally and these provide conspicuous symptoms of attack.

4.2. Chiloloba acuta Wiedemann (Plate No. 29)
Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family: Scarabaeidae
Genus: Chiloloba
Species: acuta
Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Distribution: It is widely distributed in the Indian subcontinent.
Types of Damage and Symptoms:
Adults will sometimes feed on cultivated cereal and millet crops such as sorghum and maize, damaging flowers and grain. It is rarely a serious pest. Their occurrence on mulberry is also reported.

4.3. Chrysocoris stolli (Plate No. 29)
Common name: Jewel Bug
Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family: Scutelleridae
Genus: Chrysocoris
Species: stolli
Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: Occurs mostly during rainy season.
Types of Damage and Symptoms:
Adults are feed on mulberry leaves. There is holes are seen during study period on mulberry leaf.

4.4. Cryptogonus sp (Plate No. 29)

Common name: Lady beetles
Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family: Coccinellidae
Genus: Cryptogonus
Species: -
Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: during month of June.
Types of Damage and Symptoms:
Seventy plant species were studied for their host’s importance. Among lot of species, these species were collected from mot grass; it is in a predator of scale insects. Their presence on mulberry is also reported as predator.

4.5. Deloyala guttata (Plate No. 29)

Common name: Tortoise beetle
Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family: Chrysomelidae
Genus: *Deloyala*
Species: *guttata*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from Aurangabad and Gangapur, mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: Occurs mostly during rainy season
Types of Damage and Symptoms:
The caterpillar attacks on young leaves of mulberry.

4.6. *Aspidimorpha miliaris* (Plate No. 29)
Common name: Spotted tortoise beetle
Phylum: Arthropoda
Class: Insect
Order: Coleoptera
Family: Chrysomelidae
Genus: *Aspidimorpha*
Species: *miliaris*
Locality and Habitat: From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.
Occurrence: Occurs mostly during rainy season
Types of Damage and Symptoms:
The caterpillar attacks on young leaves of mulberry.

4.7. *Psiloptera* sp. (Plate No. 30)
Common name: Wood borer
Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family: Buprestidae
Genus: *Psiloptera*
Species: -
The insect and molluscan pests associated with mulberry gardens.

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from Aurangabad mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Throughout the year.

**Types of Damage and Symptoms:**
Twigs are easily broken by winds because the twig tissues are partially destroyed the adult beetles during the egg laying process. Severely attacked plants may die.

5. **Order: Isoptera**
5.1. *Odontotermes* sp. (Plate No. 30)

**Common name:** White ant

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Isoptera

**Family:** Termitidae

**Genus:** *Odontotermes*

**Species:** -

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** The infestation starts from October onwards and continues up to the onset of monsoon.

**Types of Damage and Symptoms:** Workers of the colony cause the damage. Termites form an earthen sheath on the stem and feed on the bark and kill the plant. Drying of plants and reduction in leaf yield. Mulching with dry twigs favours the populations build up in endemic areas. More damage is seen in red loam and sandy soil.

6. **Order: Hymenoptera**
6. 1. *Ammophila* sp. (Plate No. 30)

**Common name:** Wasp

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Hymenoptera
Family: Sphecidae
Genus: *Ammophila*
Species: -

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Throughout year.

**Types of Damage and Symptoms:**
The wasps are feed on caterpillar of various insects. Their presence on mulberry is also reported as predator.

6. 2. *Camponotus compressus* (Plate No. 30)

**Common name:** Black ant

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Hymenoptera

**Family:** Formicidae

**Genus:** *Camponotus*

**Species:** *compressus*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Throughout the year.

**Types of Damage and Symptoms:**
The black ants feed on mealy bugs are reported during study period. Their presence on mulberry is also reported as predator.

7. **Order:** Mantodea

7.1. *Deiphobe indica* (Plate No. 30)

**Common name:**

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Mantodea

**Family:** Mantidae
Genus: *Deiphobe*
Species: *indica*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Throughout the year.

**Types of Damage and Symptoms:**
Their presence on mulberry is also reported as predator.

7.2. *Mantis religiosa* (Plate No. 30)

**Common name:** Praying mantids

**Phylum:** Arthropoda

**Class:** Insecta

**Order:** Mantodea

**Family:** Mantidae

**Genus:** *Mantis*

**Species:** *religiosa*

**Locality and Habitat:** From the mulberry plant, *Morus alba* L., from all mulberry fields, Aurangabad district, Maharashtra, India.

**Occurrence:** Throughout the year.

**Types of Damage and Symptoms:**
Their presence on mulberry is also reported as predator.
B) Molluscan pests associated with mulberry garden.

1. *Achatina fulica* (Plate No. 31)
   
   **Common name:** Giant African snail
   
   **Phylum:** Mollusca
   
   **Class:** Gastropoda
   
   **Superfamily:** Achatinoidea
   
   **Family:** Achatinidae
   
   **Subfamily:** Achatininae
   
   **Genus:** *Achatina*
   
   **Species:** *fulica*

   **Locality and Habitat:** From the mulberry plant, *Morus alba* L., from Gangapur mulberry fields, Aurangabad district, Maharashtra, India.

   **Occurrence:** Throughout year but active during rainy season.

   **Type of Damage and Symptoms:**

   Extensive chewing of blossoms, leaves, and shoots stunts the growth of young trees and trees that have been top worked. The land snail can especially be a problem following wet winters and springs. Land snail feeding is not a problem in mature groves. Thick, dry leaf mulch suppresses snail numbers and large trees tolerate any modest chewing.

2. *Rachis punctatus* Anton (Plate No. 31)
   
   **Common Name:** Land snail
   
   **Phylum:** Mollusca
   
   **Class:** Gastropoda
   
   **Subclass:** Pulmonata
   
   **Superorder:** Stylommatophora
   
   **Superfamily:** Pupilloidea
   
   **Family:** Pupillidae
   
   **Subfamily:** Pupillinae
   
   **Genus:** *Rachis*
   
   **Species:** *punctatus*
The insect and molluscan pests associated with mulberry gardens.

Locality and Habitat: From the mulberry plant, Morus alba L., from all mulberry fields, Aurangabad district, Maharashtra, India.

Occurrence: Throughout year

Type of Damage and Symptoms: Extensive chewing of blossoms, leaves, and shoots stunts the growth of young trees and trees that have been top worked. The land snail can especially be a problem following wet winters and springs. Land snail feeding is not a problem in mature groves. Thick, dry leaf mulch suppresses snail numbers and large trees tolerate any modest chewing.

3. Laevicaulis alte Férussac (Plate No. 31)

Common Name: Flat African slug

Phylum: Mollusca
Class: Gastropoda
Subclass: Pulmonata
Superorder: Stylommatophora
Superfamily: Veronicelloidea
Family: Chalcidoidea
Genus: Laevicaulis
Species: alte

Locality and Habitat: From the mulberry plant, Morus alba L., from Paithan, Sillod, Gangapur and Aurangabad mulberry fields, except Khultabad, Aurangabad district, Maharashtra, India.

Occurrence: Throughout year.

Type of Damage and Symptoms:
Slugs feed on a variety of living plants and on decaying plant matter. They chew irregular holes with smooth edges in leaves and can clip succulent plant parts.

This information infers that all these insect pests of single host; mulberry has systematic adaptability to avoid competition among them. When the infestation of mealy bugs was highest in August, the incidence of hairy caterpillars was almost negligible. Similarly, when the incidences of grasshoppers were highest during October, the infestation of Mealy bugs, Bihar hairy caterpillar, hemipteran bugs and
other order insects on mulberry was also negligible. Though incidence of wingless 
grasshoppers was common from August to January, the infestation was noticed in 
October compared to the other pests.

The present study also reveals that August is favourable for Mealy bugs; 
October is favourable for Bihar hairy caterpillars and wingless grasshoppers. 
Therefore, an appropriate insecticide at specific dose based on pest population / 
density should be administrated to safeguard the loss of mulberry foliage during these 
months. According to sericulturists of the area, severe cocoon loss was not only due to 
infestation also due to the stinking smell of mucus layer (both wet and dry conditions) 
released by the Giant African snail, *Achatina fulica* on mulberry plant. The silkworm 
showed an aversion towards feeding on such leaves and as result, considerable 
quantities of harvested leaves were wasted.
4. Discussion

The present investigation shows taxonomical study on insect and molluscan pests of mulberry garden from various sites in Aurangabad district, Maharashtra during June, 2009- May 2011. The occurrence of insect and molluscan pests from various sites shows that the incidence of 10 lepidopteran, 7 coleopteran, 9 hemipteran, 2 hymenopteran, 11 orthopteran, 1 isopteran and 2 mantodea were reported during study period. There are 3 molluscan pests recorded from study area. There is dominance shows by the lepidopteran as well as orthopterans orders then followed by hemipterans, coleopterans, hymenopterans and mantodea. In present work pests of mulberry are described with respect to distribution, occurrence and type of damage and symptoms caused by them.

The present findings are in conformity with the findings of Sathe (1998) and Sengupta (1990) has been reported that a survey on insect pests of mulberry of the different orders viz. Lepidoptera, Hemiptera, Coleoptera, Trysanoptera, Orthoptera and Isoptera. In which he provide detail about each insect species with respect to their distribution, occurrence and type of damage and symptoms.

This is in agreement with the work done by Hemalatha and Shree (2008) show the study among the various species of hemipterans pests which infests mulberry, attack of mealy bugs (*Maconellicoccus hirsutus*) appeared to be severe during the summer months of March and April with maximum pest population of 15.64 bugs /plant and 15.66 bugs /plant respectively. Pest population reached minimum in winter months of December (2.47 bug /plant) and January (2.14 bugs / plant). In rainy season months of July to October, population gradually decreased from 8.30 bug /plant to 4.93 bug/ plant.

Similar results were observed by Vijaya Kumar *et al.*, (2005) has reported that the incidence of Red hairy caterpillar, *Amasacta albistriga* Walker which is serious pest of ground nut, seas am, Cow pea, mung bean, cotton, Bajara, sorghum (Jawar), finger millet, castor and many other crops has found to be infesting mulberry. The pest is gregarious in early instars and highly migratory in late instars. Though not a regular pest, it causes extensive damage and economic loss to mulberry crop.
The insect and molluscan pests associated with mulberry gardens.

The lepidopteran insect pests causing damages to the mulberry in different part of the world in a very concise form. It is evident from available literature that the more than 20 lepidopteran species belonging to *Pyralidae, Arctiidae, Lymantridae, Noctuidae, Geometridae, Amatidae, Syntomidae* and *Tortricidae* cause damage to mulberry crop in different parts of world (Narayanswamy *et al.*, 2001). Recently the lepidopteran leaf roller *Diaphania pulverulentalis* (Hampson) has attained a serious pest status in the south of India during rainy and winter months with high percentage of infestation (Sengupta *et al.*, 1990; Siddegowda *et al.*, 1995; Geethabai *et al.*, 1997; Rajadurai *et al.*, 1999). Similar observations were recorded by us during study period.

Similar results were reported by the mulberry scale insect fauna was review by Narayanaswamy and Reddy (1997) shows that the number of scale insects belonging to families of Diaspididae (hard scales), Margarodidae, Coccidae and Diaspididae (soft scales). So far, 26 species have been reported to occur on mulberry in the world. The results of our findings are show that the occurrence of *Aonidiella qurantii* during study period (Sengupta *et al.*, 1990).

Sunil Misra *et al.*, (2003) report on the *Oxyrachis tarandus* (FB) on mulberry in Andra Pradesh, India. They also observed that the presence on mulberry twigs, branches and pedicles of leaves. Further, the nymphs and adults of these treehoppers were attended by a large number of black ants, *Camponotus compressus* for honey dew excreted by them. This is first report on mulberry as a new host for the treehopper, *Oxyrachis tarandus*. In the present study the record of this treehoppers *Oxyrachis tarandus* on mulberry field is noted during study period.

Rao *et al.*, (1993) and Ali (1995) noticed that, the population of mealy bug started building up from March and reached maximum during April to June. Kotikal (1982) observed the prevalence of mulberry scale insect from March to still May. Narayanswamy and Reddy (1997) noticed decline in scale population in winter. The similar seasonal occurrence also noted during study period.

The occurrence of various pests recorded by various researchers are conformity with our work and similar incidence of *Spilosoma obliqua* Walker (Lepidoptera: Arctidae) commonly known as Bihar hairy caterpillar was recorded.
The insect and molluscan pests associated with mulberry gardens.

during November to January (Rangaswamy et al., 1976) but the maximum infestation occurs during October in certain fields of Kanakapura taluk, Karnataka (Shree and Manjunatha, 1998). Sidhu et al., (1968) observed high damage by thrips (Pseudodendrothrips mori Nawa) (Thysanoptera: Thripidae) during February in Kanakapura taluk. Among the sap feeders, incidence of thrips was the highest (42.55%) and followed by mealy bug (20.80%) (Sathyaprasad and Manjunatha, 1993). The disorder caused by mealy bug (Maconellicoccus hirsutus Green) (Hemiptera: Pseudococcidae) is commonly known as ‘Tukra’ disease in West Bengal (Mukherjee, 1919) and considered as widespread disease throughout the silk producing states of India (Shriharan et al., 1979). Sengupta et al., (1990) reported undesirable damage to mulberry by wingless grasshopper (Neorthacris acuticeps niligiriensis Uvarov) (Orthoptera: Acrididae) in southern parts of India and highest infestation was reported during April in of Kanakapura taluk (Manjunatha and Shree, 1997).

This is in agreement with the work done by Rajalakshmi et al., (1995) has also reported the Hemipteran pests in the collection included Nezara viridula (Pentatomidae) and Dysdercus singulatus (Pyrrhocoreidae). One of the important lepidopteran pests in the collection was Spodoptera litura (Noctuidae), a polyphagous pest, which has many alternative hosts (Ramkrishna Ayyar, 1938) like cotton, tea, brinjal; chilly, etc. other lepidopteran pests collected were Pericallia ricini (Arctidae), Earias fabia (Arctidae), Exelastis atomosa (Pterophoridae) and Agrotis spp. (Noctuidae). Among important coleopteran pests were curculionid beetles such as Myllocerus subfasciatus and M. viridanus. In addition to these pests, three predators were also noticed in the following order: Menochilus sexmaculatus, Brumus saturalis and Chilocorus circumdatus.

Chavadi and Manjunatha (2008) has been also reported the incidence of mealy bugs was comparatively more in august to January and the rate of infestation was gradually reduced as temperature increased from 27.8 to 31.2 °C with decreased relative humidity and zero rainfall. In Hubli and Dharwad taluk mealy bugs were dominant during August as was reported by Shree and Boraiah (1998) and Ali (1995) in other parts of Karnataka. Manjunatha and Shree (1997) recorded more damage
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caused by mealy bugs during January and March than other periods. Both this findings
are conformity with our findings.

Both this findings are conformity with our findings is as Ramkishore et al.,
(1994) reported the prevalence of Bihar hairy caterpillars throughout the year with
most damage occurring between August and February. This results are contrary with
our findings in Aurangabad districts all surveyed mulberry gardens, whereas Shree
and Manjunatha (1998) reported highest infestation in October from Kanakapura.
Although S. obliqua is distributed in traditional and non- traditional belts of
sericulture, the rate of infestation varies in accordance with ecological factors.

Similar results were observed by Reddy and Kotikal (1988) reported that
sporadic attack by grasshoppers starts from May or June and continues until December
and January. The present study indicates that wingless grasshoppers were found
throughout in varying intensities with major peak during October in all the collection
sites. However, Manjunatha and Shree (1997) recorded the highest incidence of
grasshoppers during June and July in Kanakapura taluk.

Basir et al., (2011) and (Singh et al., 2008) has recorded the study on different
insect pests of mulberry and other agricultural crops were collected from mulberry
gardens and agricultural crop fields in and around Mysore, Karnataka, India. The
collected insects were screened for microsporidian infection and microsporidian
spores were isolated from infected specimens. The species name of the insect pests,
namely, P. rapae, Catopsilia crocale, Catopsilia pyranthe, Spilosoma obliqua and D.
pulverulentalis respectively from which these microsporidia were isolated.
Microsporidia have been isolated from different agricultural and mulberry pests,
namely, Spodoptera litura, Spodoptera exigua, Helicoverpa armigera, Plutella
xylostella, P. rapae Crucivora and Pieris conidia sordida and Spilosoma obliqua.

Nath and Misra, (1980) also shows that similar incidence snail, Rachis
punctatus Anton on Thuja coccidentalis var compacta and Juniperus chinensis L.
Snails as pests of agriculture and horticulture have already been known. In citrus,
defoliation due to the attack of the snail, Pila sp. has been reported (Puttarudraiah,
1964; Srivastava, 1977). In mulberry damage of leaves due to a snail, Cryptozona
semirugata (Devaiah et al., 1982). Das et al., (1989) has also reported an occurrence of two new snail pests, Cyclophorus fulguratus (Pfeiffer) and Cryptaustenia ovate (Blanford) observed in the mulberry fields of the regional Sericulture Research Station, Kalimpong during rainy season. These findings are conformity with our findings.

Similar results were observed by on the studies in India, the slug Laevicaulis alte fed on a number of food plants, but the duration of feeding varied with food plant species and Laevicaulis alte showed 2 distinct feeding peaks, one in the early hours of the night and one in the late hours. The feeding rhythm appeared to be controlled mainly by endogenous factors by Raut and Panigrahi (1990).

In the present study the occurrence of the Giant African snail, Achatina fulica is reported from Gangapur mulberry field during rainy season but there occurrence is throughout the year, due to hibernation time these are not much active as compare to rainy season. Shree et al., (2006) also report on the occurrence of the Giant African snail, Achatina fulica in some parts of Karnataka is infest mulberry. The incidence of snails was recorded in all the villages, in the every months starting from August to December. According to sericulturists of the area, severe cocoon loss was not only due to infestation also due to the stinking smell of mucus layer (both wet and dry conditions) released by the Giant African snail, Achatina fulica on mulberry plant. The silkworm showed an aversion towards feeding on such leaves and as result, considerable quantities of harvested leaves were wasted.