4.1 Mango Varieties in Devgad:

In India there are more than 1000 mango varieties with distinct colour, shape, size, taste, aroma and other qualities (Chattopadhyay 2010). Among these varieties there are about 25-30 mango varieties that are economically important. Flowering and fruiting stages on mango plants depend on the locality. The taste and fruit quality is also governed by the location of plantation. Fruit setting in mango plantations along coastal area is earlier as compared to those near hill foots or interior areas. Climatic conditions and hard rock land supports mainly Alphonso mango variety. Monoculture of a single mango variety that is Alphonso is identity of Devgad Tehsil. This mango variety is commercially important for people living here. However monoculture of Alphonso mango variety has marginalized several native mango varieties. Native mango varieties are unpopular mango varieties that are not grown on commercial basis. Presently Alphonso mango is the most important economical crop in Devgad tehsil. Along with Alphonso other mango varieties are also cultivated in Devgad, but on small scale and not for economic perspective. Very few trees of other mango varieties are present in Devgad tehsil. Following are some of the popular mango varieties of cultivated in Devgad tehsil. Among these mango varieties cultivations of Alphonso variety are done through the tehsil, while other varieties are rarely plated.

1. **Alphonso:**

Alphonso is a famous mango variety throughout the world. Especially the Alphonso mangoes grown in Konkan region are known for their distinct aroma, colour and flavor. Agro climatic conditions of Konkan region are suitable for this variety, thus this variety is planted on large scale in coastal region of Konkan. Fruits are yellowish orange in colour, ovate oblique and medium sized. Alphonso mango trees generally start flowering from November – December. But the percentage of hermaphrodite flowers is less up to 13%. Therefore fruit setting and productivity is low. Ripe fruits are consumed directly and also processed into jam, squash, jellies, toffies, etc. While unripe fruits are utilized for preparing pickles, chutney, toffies, juice, etc. Alternate bearing and presence of spongy tissue are two major drawbacks of this variety. Shelf life of these fruit is quite good that is up to three weeks from the date of harvesting.

2. **Payari:**
Payari mango variety is especially known for its juicy content. It is one of the leading mango varieties in Devgad. The fruit quality of Payari is inferior as compared to Alphonso. Fruits are medium sized ovate and green in colour. Fruits pulp is yellow in colour with distinct flavor and aroma. Alternate fruit bearing is a major drawback of this variety. Shelf life of fruit is fair. But farmers do not prefer to cultivate Payari.

3. Totapuri:

Totapuri mango variety is also known as banglora. It is commercially important mango variety in South India. Fruit setting is more but late in May-June. Fruits are elongated, pointed at base, thick skinned, yellowish coloured and taste is slightly sweet. Pulp of this variety is thick as compared to other varieties. Seed is elongated and flat. Shelf life of fruit is more. Fruits are used for direct consumption as well as processed into different products. As the skin of fruits is thick it facilitates easy transportation and rough handling. Transportation of this variety is cheap and doesn’t require much packing material.

4. Kesar:

Kesar mango variety is named so as its aroma resembles saffron. It is mainly cultivated in Gujarat. Flowering phase usually starts from December to January and bears about 27% hermaphrodite flowers. Fruit setting is alternate in this variety. Fruits are generally used for consumption and for preparing juice. Shelf life of fruits is 7-8 days. Fruit setting in kesar is alternate but more than Alphonso variety. Kesar mangoes have good market value.

5. Ratna:

Ratna mango variety is a cross between Alphonso X Neelum varieties that was developed by Konkan Krushi Vidyapeeth in 1982. Ratna has regular fruit bearing with 27% hermaphrodite flowers. Thus fruit production of this variety is more. Fruits are large, slightly elongated, round and deep orange red. Generally fruits are harvested in May. Mango pulp is firm, fibreless and orange red in color. Shelf life of fruit is 8-10 days. Ratna mangoes are free from incidence of spongy tissue.

6. Sindhu:

Sindhu mango variety is a result of cross between Ratna X Alphonso varieties which was developed by Konkan Krushi Vidyapeeth in 1982. It is regular fruit bearing tree with slow development and dwarf in growth. Thus this variety is suitable for dense plantation. Fruits are medium in size and reddish yellow in colour. The pulp is dense soft and orange in colour. This variety is free from occurrence of spongy tissue. Seed is flat and small. In this variety pulp to seed ratio is 26:1. Flowering period starts from January with 35%
hermaphrodite flowers. Shelf life of fruit is 8 to 10 days. Sindhu is only mango variety the produce quality fruits with more pulpy content.

7. **Amrapali:**

   Amrapali is a result of cross between Neelum X Dashehari. Fruit setting is generally in May – June. Fruits are oblong and oblique in shape. The pulp content in fruit is less. Pulp is deep red in colour. Plant is dwarf in size with slow growth rate thus recommended for high density plantation. Ripe fruits are consumed directly and used for preparing mango juice, squash, etc.

8. **Dashehari:**

   Dashehari is one of the famous and economically important mango varieties in northern India. Fruit setting is considerable but alternate in this variety. Fruits are oval, medium size, juicy and turn yellow on ripening. Fruits have pleasant taste and odour. Shelf life of fruits is good.

9. **Goamankur:**

   This variety basically belongs to Goa but grows well in Devgad, Malvan and Vengurla. Fruit bearing is irregular in this variety. Fruiting period is from March to May. Fruits are medium sized and slightly flattened at base. Peel is soft, yellow and slightly thick. Fruits are tasty, consumed directly and exploited for making juice. Medium ripe fruits have distinct flavour and preferred for same. Shelf life of fruit is 7-8 days.

10. **Konkanruchi:**

   Konkanruchi is cross between Neelum X Alphonso. This mango variety is developed by Dr. Balasaheb Sawant Konkan Krushi Vidhyapeeth in 1991. This was mango variety was especially developed for preparation of pickles. This variety has regular fruit bearing; fruits are big in size, more pulp and thick skinned fruits. Fruits of Konkanruchi are suitable for making pickle. Therefore mangoes are mostly exploited for pickling.

11. **Suvarna:**

   Suvarna mango variety produces mangoes about 250 fruits per tree. This is regular fruit bearing mango variety. Fruit bearing is in bunch and early. Generally fruits are of same size and are utilized for direct consumption. This mango variety is free from incidence of spongy tissue.

12. **Konkoncha raja:**

   Konkoncha raja, is regular fruit bearing mango variety. About 110 to 120 fruits per tree is the productivity of the tree. Fruits of this variety are big in size and pulp content is more. Fruits are consumed in unripe as well as ripe stage.
Above mentioned mango varieties are cultivated in Devgad tehsil. Among these varieties Alphonso mango variety is cultivated on large scale on commercial basis. Some other popular mango varieties of India are discussed below:

1. **Langra:**
   
   Langra is mainly grown in north Indian states like Punjab, Uttar Pradesh and Bihar. It is popular as mid-season mango variety. Fruits are oblong shape, soft and colour light green. Fruit setting is alternate but heavy. Pulp content is more in these fruits. Pulp is thick, soft, sweet and slightly sour on taste. Tree crown is dome shaped and medium size. Shelf life of fruits is short. Fruiting period of variety is June-July. If langra variety is planted in Konkan region, application of paclobutrazol is necessary to promote fruit setting.

2. **Fazil:**
   
   It is famous mango variety of West Bengal. Trees are medium in size and grow vigorously. Fruit setting is in alternate year. Fruits are oblong, fibrous, sweet, thick skinned and dark green in colour. It is a late variety; fruits are harvested in July-August.

3. **Gulabkhas:**
   
   This mango variety is known for its rose flavor. It is popular in northern and eastern parts of India. Fruits are medium size, sweet and mature by end of May month. This is early mango variety. After ripening fruits turn yellow. Fruit bearing is heavy but irregular.

4. **Bombay green:**
   
   It is famous mango variety in West Bengal and Bihar. It is also popular as Malda. Tree is medium size and growth is slow. Fruits are medium size and turn yellow on ripening. Fruit bearing is heavy but not regular. Pulp content is less but sweet in taste. Fruits are generally harvested in May-June.

5. **Zardalu:**
   
   The origin of this variety is reported from West Bengal. Fruit bearing is medium to heavy. Fruit quality of this variety is excellent. Fruits are medium size, soft and yellow in colour. Pulp content is medium but very sweet and soft.

6. **Bathua:**
   
   It is a famous mango variety in Bihar and Uttar Pradesh. It is a late mango variety with oblong, thick skin, soft and green fruits. Pulp is soft and cadmium yellow in colour. Fruit bearing is regular and shelf life of fruits is medium.

7. **Swarnrekha:**
It is a popular commercial mango variety in Andhra Pradesh. It is also known as Sundari in Orissa. Fruit are red, attractive, medium size, tapering towards end and yellowish in colour. Fruit setting is heavy and regular. Fruits are generally harvested in May to June. Shelf life of fruit is only four days.

8. Neelum:

It is popular mango variety in south India in South India. Tree size is dwarf with medium size. Cropping season is from June to August. Fruits are medium size, oval, sweet and pleasant in taste. Pulp is yellow in colour. Fruit bearing is heavy and regular. Fruit quality is not up to mark. It is not popular as fruit setting is late in rainy season.

9. Arka Neelkiran:

This mango variety is developed by Indian Horticulture Research Institute, Bangalore. This variety is cross between Alphonso X Neelum. Fruit bearing is regular and is mainly in June – July. Average weight of fruit is 260g. Fruits turn reddish golden on ripening. Fruits are free from incidence of spongy tissue. Pulp is non-fibrous and content is medium.

10. Neelshan:

Regional fruit research station, Andhra Pradesh has developed this variety. This variety is cross between Neelum X Baneshan. Fruit bearing is heavy and regular. Fruit size is medium and average weight of is 300 gm. Pulp content is more in fruits. Fruits are sweet with pleasant flavour. This variety is popular for canning. Shelf life of fruits is good.

11. Neelagoa:

Regional fruit research station, Andhra Pradesh has developed this variety. This variety is cross between Neelum X Yeramalgoa. Fruit setting is regular. Average size of fruits is 270 to 300gm. Fruits are sweet with pleasant flavor and generally preferred for making juice.

12. Benganpalli:

It is a commercially important mango variety of Andhra Pradesh. It is also planted in Orissa, Bihar and Maharashtra. Dry climatic conditions are most suitable for this variety. This variety can grow well in Maharashtra except in Konkan region. It is early mango variety with regular fruit setting. Tree size is medium with dome shape. Fruit skin is soft, thin and yellow in colour. Fruits have good marketability due to long shelf life.

13. Mallika:

It was developed by Indian Research Institute, New Delhi in 1971. It is cross between Neelum X Dashehari. Fruits are big in size, yellow in colour and average size of fruits is 300 gm. Pulp is thick and orange yellow with few fibers. Fruit bearing is regular. Pulp content is
more. Shelf life of fruit is long and remains firm for considerable period after ripening. Fruiting is late in June- July.

14. Rajapuri:

It is popular in Gujarat and manly exploited for juice. Fruit bearing is regular. Tree is medium size and fast growing. Fruits are medium to big in size with pleasant aroma. Pulp is soft, yellow in colour, moderately sweet with few fibers. Fruiting period is from May- June. Fruits are also exploited for making pickle.

15. Chausa:

It is a popular but late mango variety. It get good price as hits market after mango season. Tree size is medium and fast growing. Fruit setting is alternate. Fruits are medium size, soft and pulp is yellow in colour. Fruiting period is from July – September. Shelf life of fruits is good.

16. Niranjan:

It is developed by Fruit Research Centre, Aurangabad. Fruit setting is irregular but heavy. Fruits are of medium size and average weight is 200gm.

17. Prabhashankar:

It was developed by Agriculture Research Institute, Sbour. It is cross between Bombay X Kalapady. Fruit setting is regular while tree size is dwarf. Fruit bearing capacity of this variety is strong and irrespective to adverse climatic conditions. Average size of fruit is about 140g. Pulp content is more. Pulp is orange and sweet. Shelf life of fruits is good. Fruits turn light green after ripening.

18. Mahmudbahar:

It was developed by Agriculture Research Institute, Sbour. It is cross between Bombay X Kalapady. Parents are similar to that of Prabhashankar variety. Fruit bearing is regular. Plants are dwarf in size. Average weight of fruit is about 200gm. Fruits ripen from June-July. Fruits appear light green in colour after ripening. Pulp content is more. Pulp is sweet and yellow.

19. Arka Anmol:

This mango variety is developed by Indian Horticulture Research Institute, Bangalore. It is a cross between Alphonso X Janardha Prasad. Tree is medium size and has regular fruit bearing. Fruits are of medium size. Pulp is dark orange and thick. This mango variety is free from incidence of spongy tissue. Shelf life of fruits is good.

20. Jawahar:
This mango variety is developed by Agriculture Research Institute, Sbour. It is a cross between Gulabkhas X Mahmundbahar. Fruit setting is regular. Trees are dwarf size. Average weight of fruit is about 210gm. Pulp content if more. Pulp is yellow and sweet with fewer fibers. Fruits turn greenish yellow in colour after ripening. Fruits are harvested from June-July.

21. Manjeera:

It is developed by Fruit research Station, Sangareddy in 1985. It is a cross between Rumani X Neelum. Fruit setting is heavy and regular. Fruit size is medium and colour is yellow. Pulp is thick, yellow and without fibers.

22. ArkaPuneet:

This mango variety is developed by Indian Horticulture Research Institute, Bangalore. It is a cross between Alphonso X Banganpalli. Tree had medium vigor and fruit setting is regular. Fruit size is medium with average weight 300gm. Pulp is dark orange with pleasing taste and no fibers present in it. It is free from incidence of spongy tissue. Shelf life of fruit is satisfactory.

23. Arka Aruna:

This mango variety is developed by Indian Horticulture Research Institute, Bangalore. It is a cross between Alphonso X Banganpalli. Tree size is dwarf and fruit setting is regular. Fruits are large in size with average weight 450- 650gm. Fruits are attractive with red colour. Pulp is creamy and good in flavor. Pulp content is more up to 78%. It is free from incidence of spongy tissue. Fruits are without fibers and stone size is small.

Other than these popular mango varieties are Dudhapedha, Kelya, Gopalbhog, Rumani, Sabri, Sunder Langra, Rajendra 1 and 2, Neeleshwari, Alfaizi, Neelidin, Nelphonso, Swarn Jahangir, etc. Agriculture Research Institutes are continuously working for developing new mango varieties with desirable characters. Many hybrid mango species are developed in institutes.

In Devgad tehsil Alphonso mango variety is cultivated on commercial basis. While other mango verities are rarely planted for economical perspective. Fruits are used for home consumption and sometimes sold. Rarely Payari variety is cultivated on commercial basis. There are few cultivations of Payarivariy in Devgad and Wada. Native mango varieties like rayval, pavshya, ghagari, skharya, kalya, godya, kesari, khobarya, etc. are also present in Devgad Tehsil. These are naturally growing trees without any grafting. Native mango varieties have different vernacular names at each location. There are variations in native mango varieties that are not yet studied. Generally native varieties are named as rayval by
local people but there variation in fruit size, shape, colour, taste, texture, seed size, etc. Fruits of these varieties are not much economically important. Sometimes this fruits are sold in local market and exploited for making pickles, chutney, etc. But these fruit have distinct flavor and aroma. Trees native mango verities are rarely found in mango orchards, they are mainly observed in village settlement, road side, backwards, etc. Mostly single tree is present at a location. Characteristics of these mango varieties are different than that of hybrid varieties. These trees are late fruiting; very tall and low bearing is less. Few decades before trees of these mango varieties were prominently reported in Devgad Tehsil. But now a day number of these mango trees are declining rapidly. These trees are cut for wood and construction of roads, bridges, houses, etc. Commercialization of Alphonso mango has marginalized other less invaluable mango varieties.

4.2 Insect pests on mango crop in Devgad Tehsil:

Present investigations on different insect pests on Alphonso mango cultivations in Devgad tehsil were carried out in field as well as under laboratory conditions during the years 2014-15 to 2016-17. The different insect pests were recorded by actual spot visits to the mango cultivations weekly in villages selected for the present studies namely Devgad, Wada, Kunkeshwar, Talebazar and Waghotan. Careful and keen observations were made at each site. Prescribed studies on the topic have revealed the presence fourteen species of pest insects belonging to eight orders. Detail study of insect pests like mango hopper, fruit fly, thrips, fruit borer, mango mealy bug, stone weevil, shoot borer, stem borer, leaf webber, mango scales, leaf miner, aphids, ants and termites was carried out. Various stages of the pests were observed on the mango cultivations in the tehsil. Life cycle of each insect pest infesting mango crop was studied in detail. Each life stage of insect pest was reviewed and observations were noted. Images of each stage of pest were taken for study.

In present chapter all data collected during study period is presented in systematic manner. Insect pests evaluated during study period are discussed in detail, that include their life cycle, life stages, nature of damage, period of emergence and control. Common names of insect pests along with scientific names are mentioned below. Also different species of same genus that were observed during study period are given below. Furthermore, order and family of each insect pest is cited. Images of each life stage namely, larvae, pupa and adult are given below. Each pest is described in a systematic manner. Data of all insect pests is presented in a unique format, comprising of images, tables and text. The said information is particularly based of the observation noted during study period, secondary data and personal interaction with farmers and personals related with mango industry. Various methods were applied to
gather the data essential for study. Young, old, men and women involved in mango industry and having sound of mango crop and related aspects were interviewed during study period.

Insect pest infestation on Alphonso crop was studied for proposed research. Leaves, fruits, mango seed, twigs, stem and flowers were acutely observed to note the readings. Similarly nature of damage of each pest was studies and infestation pattern was recorded. Insect pests attacking mango crop were evaluated for presented study. Maximum information that was collected about each pest is cited below in form of their general details, life cycle, nature of damage and images of their each stage. Also images featuring specimen and damaged caused by the pest are presented in detail. Along with these information control measures of each pest, which includes chemical, biological and mechanical methods are discussed. Similarly some special observations that were cited during the study period regarding each pest are mentioned. Insect pest incidence on mango crop at each location year wise is discussed in detail. Moreover the active period and damaging stage of each pest is discussed. Finally zoo-geographical distributions of individual insect pest are revealed. The results obtained are presented and discussed under.

1. Mango hopper [Idioscopus niveosparsus (Lethierry), Idioscopus clypealis (Lethierry), Amritodus atkinsoni (Lethierry)]

Order: Hemiptera
Family: Cicadellidae

Mango hoppers are the serious pest of mango crop responsible for causing heavy loss to inflorescence, young fruits and tender foliage. Three different species of Mango hopper were observed in the study area throughout the study period. They were as follow:
1) Idioscopus niveosparsus (Lethierry)
2) Idioscopus clypealis (Lethierry)
3) Amritodus atkinsoni (Lethierry)

These species of hopper pose serious threat to mango industry as their feeding activity causes loss of flowers and hamper fruit setting. Hopper is a small creature. It is about eighth of an inch in length and having a wedge shaped body. The head is broad and body shape is gradually getting narrow backwards. The mango hopper is able to jump and fly.

Life history:

The adults of Idioscopus niveosparsus (Lethierry) are relatively smaller in size. They are greenish grey in colour, wedge shaped along with prominent triangular whitish band around the neck. The adult of Amritodus atkinsoni (Lethierry) is comparatively bigger in size.
It is dark brown in colour without white band on neck. The adult of *Idioscopus clypealis* (Lethierry) is smallest in size as compared to other two species.

Obviously the mating and breeding period of the insect has been perfectly synchronized with the first flowering flush of the mango trees during October. Female insects deposit minute, mustard seed sized eggs with whitish creamy colour. They are deposited on the flower buds and flower pinnacles. The eggs are well deposited deep in the tissues through slits made by the ovipositor. The eggs have two ends, one is pointed and other is blunt. The blunt ends of eggs can be marked externally while their pointed ends are embedded deep in the flowering tissues. The site of oviposition in the flower becomes blackish brown in colour. The eggs hatch in 3 to 5 days depending on the environmental temperature. The nymphs are very active and move rapidly along the inflorescence and shoots. They are small in size and wingless, thus unable to fly. The nymphs cast their skin periodically to gain the adult stage in 15 to 19 days. Hoppers adults have been observed to remain alive but dormant without any feeding and breeding activity during the unfavorable season from March to September in fissures of mango tree. The crevices possibly prevent the wash off of their population due to extreme heat during the end months of the summer or the water runoff during the rains. Thus they can be observed throughout the year on an infected tree.

The pest population is highest during November to February.

**Nature of damage:**

Nymphs and adult both suck the sap from tender leaves, inflorescence and tender fruits which ultimately affects the fruit setting. Hopper population coincided with emergence of panicle and they migrated from trunk to upper canopy. The site of oviposition for eggs cause drying and withering of such plant parts. The infested plant parts like tender leaves and flowers get twisted and sometimes dry up. Hoppers secrete honey dew like substance which facilitates the development of fungi like *Meliola mangiferae* (Joshi *et al.* 2012) on leaves, twigs and inflorescence. This gives mango tree blackish look. Sooty mould affects photosynthetic activity and arrest fruit setting. In case of sever infestation entire orchard presents a sticky sight. Similarly the honey dew secretion drops down on ground and gives gummy appearance. Locally it is termed as ‘Chikta (चिकटा) or Khar(खार)’.

The infested plants are deprived of flowering flush and leaves appear shiny and are covered with sooty mould and thousands of cast skins of the hopper nymphs are found on the plant parts. Due to continuous incidence of pest every year, trees gradually lose their vigor and affecting the yielding capacity in long run. Hopper causes greatest damage to mango crop.
and is sometimes responsible for complete failure of crop. This damage is termed as Honey Dew Diseases. When hoppers multiply in large number they prove detrimental to mango crop. During studies it was observed old and neglected tree were prone to hoppers and incidence of pest was greater inside orchard as compared to trees along the border. The spacing between the mango trees plays important role in facilitating the development of hoppers. The mango cultivations with close plantation having taller trees with vigorous growth having shade attract hopper and cause massive damage. Hopper incidence increases with decrease in spacing between plants. During peak infestation characteristic clicking sounds of leaf hoppers can be heard in orchard. Warm, humid and cloudy climate are most congenial period for infestation. Higher temperature seemed to promote hopper population while rising relative humidity suppresses the pest population.

**Control:**

1. Dampness and less exposure to sunlight favours the infestation of mango hopper on mango crop. In case of dense plantation attack of hopper is severe.
2. To reduce the humidity in old mango cultivations, mango plants should be pruned regularly to maintain the canopy. This facilitates the sunlight to reach inside the tree and promotes ventilation in the vigor.
3. Pruning should be done every year or alternately as per the need or growth of the plants.
4. In case of high density plantations, every year pruning is necessary.
5. To control the hopper population out break on vegetative flush spray Quinalphos 25% (20ml / 10 lit.) or Carbaryl 50% (20 gm/ 10lit.)Spray of Diamethoate 30% or Cypermethrin 25% can be effective in controlling pest.
6. Pesticides should be applied should not be applied only on leaves and shoot but also branches and stem should be covered. This will kill the resting hopper population in cracks of branches.
7. Neem pesticides are especially used to control hopper attack. But in case of severe infestation neem pesticides are unable to suppress the pest attack immediately. Hence, for immediate action chemical pesticides should be applied. Then after to prevent further population growth neem pesticides can be applied.
8. Control measures should be adopted when hoppers are at nymphal stage. Pesticides should be applied at initial stages this will help to prevent further population explosion. Thus it is essential to observe each mango tree and inflorescence thoroughly to note the infestation at early stage. At initial stage of infestation honey dew secretion is not observed on the plants. Thus infestation cannot be noted by general view. To record the
infestation, hold inflorescence in one hand and slide other hand on it. Hopper nymphs, those are small in size can be seen moving in inflorescence. Thus hopper population and infestation level can be determined and pest management practices can be adopted accordingly.

9. Monitor the hopper population in mango cultivations prior to application of pesticides is essential.

Infestation of mango hopper

Fig. 4.2.1 Black Sooty mould on leaves

Fig. 4.2.2 Infestation of mango hopper on mango inflorescence
Fig. 4.3.3 Honey dew secretion by mango hopper on leaf surface

Fig. 4.2.4 *Amritodus atkinsoni* (Lethierry)

Fig. 4.2.5 *Idioscopus niveosparsus* (Lethierry)
2. **Fruit fly [Bactrocera dorsalis (Hendal)]**

**Order: Diptera**

**Family: Tephritidae**

Mango cultivations are visited by various insects like flies, butterflies, moths, beetles, ants and bugs to seek nectar from flowers and some help in pollination. However fruit flies are the most serious pest on mango crop and causes economic losses. Only single species of fruit fly, *Bactrocera dorsalis* (Hendal) was found to be infesting mango crop. This species is commonly called as mango fruit fly and considered as a main pest on mango cultivations. Even the trace amount of rainfall during fruiting and growth period of mango accelerates the population of flies to a considerable extent.

**Life history:**

Female flies prick the semi ripe fruits slightly inside the epidermal layer with help of strong ovipositor and lay eggs under the skin of fruit. After completing the oviposition female fly withdraws the ovipositor and puncture spot is left on fruit. Immediately after pricking, latex leaks out from the punctured wounds of the fruit skin.

Eggs hatch within 4 to 5 into maggots. The maggots become full grown within 12 to 14 days. Maggots are whitish legless and 6 to 7mm in length. Then after maggots move inside the fruit and start feeding on the pulp. Several maggots are found to be feeding inside a single fruit. Blackish brown necrosis is formed around the puncture marks followed by internal decomposition of fruit. Rotten patches appear on the infested fruit surface. Fruit fly infestation causes softening of fruit, internal discoloration of pulp, off flavor and finally fruit fall down. The full grown maggots pupate in soil. Pupa is brownish in colour and 4 to 5mm in
length. Pupal period is of 6 to 9 days. Adult fly is medium in size and measures from 6 to 8 mm in length. It has yellowish brown body with transparent wings. Fruit fly infestation is observed from April to July.

**Nature of damage:**

Fruit flies infest maturing and mature fruits which are almost ready to harvest. The presence of fruit fly alters some internal quality parameters of fruit making it unsuitable for export and consumption. This pest infests the harvestable fruits unlike other pests that attack mango crop at the nursery stage. The emergence of fruit fly indicates its selective performance of to the appropriate mango crop stage.

**Control:**

1. Pheromone traps should be hanged in in mango cultivation to attract male fruit fly. These traps attract male fruits flies and they die due the detrimental effect of pesticide present in the trap. These traps kill the male population of fruit fly thus preventing further population growth of the pest. Female population cannot be fertilized in absence of male, thus oviposition activity of females that is actually damaging mangoes does not take place. Pheromone traps containing methyl eugenol should be hanged in mango orchards at the rate of 4 traps per hectare from April to June. Traps should be hanged at 4-6 feet height. Also if possible traps should be hanged at the edges of mango orchards. This technique can be effective in controlling fruit fly population.

2. Mangoes infested with fruit fly should be collect and destroy immediately to control pest attack. Also fruits dropped due to incidence of fruit fly should be discarded.

3. Fruit flies infest mangoes at maturity stage or after maturity. Thus fruits should be harvested before attaining maturity to reduce the attack of fruit fly. If fruits are harvested after maturity, there are more chances of fruit fly attack. Therefore fruits should be harvested when they attain 85% maturity that is before it gets completely mature.

4. If possible plough the soil after harvesting fruit to expose and kill the hibernating fruit fly pupates in soil.

5. To reduce the attack of fruit fly, spay of Carbaryl 50% and Diamethoate 30% can be effective. Spray should be taken when fruits are attaining maturity at interval of 15 days.

6. Harvested fruits should be subjected to vapor heat treatment (VHT). This technique kills the larvae and eggs of fruit fly present on mangoes. Vapor base treatment is beneficial in international trade of mangoes. Many foreign counties have banned the trade of mangoes due to presence of fruit fly eggs and larvae on mangoes.
Infestation of fruit fly *Bactrocera dorsalis* (Hendal)

Fig. 4.2.7 Infestation of *Bactrocera dorsalis* (Hendal) on mango

Fig. 4.2.8 Pupa of *Bactrocera dorsali* (Hendal)
Fig. 4.2.9 Adult of *Bactrocera dorsalis* (Hendal)

Fig. 4.2.10 Pheromone trap for *Bactrocera dorsalis* (Hendal)
3. Thrips *[Scirtothrips dorsalis* (Hood)]

**Order:** Thysanoptera  
**Family:** Thripidae

*Scirtothrips dorsalis* (Hood) is popularly known as thrips. Thrips is a minute insect which pose great threat to mango production. Thrips have high reproductive potential and keen ability of adaptation to new environment. Pest remains undetectable until huge population exists on crop. When pest population attains peak, control measures will have no significant impact on them. Thrips attack mango crop during its vegetative and reproductive phases. Previously, that is decade before thrips was referred as a major pest and injury caused by pest was blow economical level. Attack of thrips was not major constraint, but in recent year thrips have emerged as serious pest on mango crop. Presently thrips occurrence is reported from all mango cultivation irrespective to its geographical location and pest management practices adopted by farmers. Mango hopper and thrips are two insect pests that infest almost all Alphonso mango trees in Devgad. Thrips is the most economical important insect pest on mango crop limiting the mango productivity.

**Life history:**

Adult is yellowish in colour and very small in size measuring about 1mm in length. At immature stage it is very small and yellowish in colour. Females oviposit within the tissues of the tender leaves. Eggs hatched out within 3 to 5 days. Nymphal period is about 10 to 14 days. Pupation takes place in soil. The life cycle of thrips complete within 15-20 days. Adults are tiny and yellow in colour. Adults are nymphs are can be noted by close observation of the inflorescence. For acute observation inflorescence should be held in one hand slide other hand over it. Adults and nymphs embedded with inflorescences can be spotted. Adults and nymphs move vigorously on inflorescence, fruits and leaves. Along with the progress of reproductive phases of mango such as flowering flush, panicle emergence, fruit setting and development thrips population gains momentum. Peak infestation is observed during December to February. In a single year there are about 25 generations of thrips on mango crop (Srivastava 1997).

**Nature of damage:**

Adults as well as nymphs of thrips simultaneously damage the leaves of mango plants. They initially cut the outer epidermis of the leaves and then damage the tissues below the epidermis. This activity of pest leaves minute spots on leaves and fruits which gradually brown. Both nymph and adult of thrips feed on plant sap by puncturing, lacerating and rasping the fruits, leaves, buds and flowers. As per leaves are concerned sever infestation is
observed on the edges and veins. Due to which edges turn upward causing leaf drop. Curling of infested leaves and wilting of the infested inflorescence are common symptoms of thrips attack. The site of infestation paves the way for attack of fungus and bacteria. Fruits appear rusty, shabby and unattractive with light brown colour. In case of severe infestation the fruits fail to attain the unique shape of mango and turn into round shape. These fruits are not suitable for consumption neither they are marketable. Fruit setting is severely hampered by thrips infestation. Presently thrips is the most noxious pest on mango crop that is responsible for maximum crop damage and low productivity. Farmers in Devgad tehsil are continuously trying application of different pesticides to suppress thrips attack, but they haven’t found one.

**Control:**

1. Spray of dimethoate 30 EC (12ml/10 lit) or phosalone (15 ml/10 lit) should be taken to control the pest.
2. Spray of Spinosad 45 SL (2.5 ml/10 lit.) followed by spray of Thiamethoxam 25 WDG (2 g/10 lit.) can be effective for controlling of pest.
3. Spraying should be done carefully that pesticides reach behind the tender leaves and cover immature fruits. Pesticide application should start immediately after emergence of panicle and should be repeated at interval of 15 days.
4. In case of severe infestation the interval of days between successive spraying may reduce.
5. Spreader solution should be used in spray solution for better result.
6. Weeds present in the orchards are the alternate host for thrips activities like breeding and feeding. Thus such weeds should be completely destroyed. Controlling the pest population becomes crucial to reduce the pest attack.
7. Pupal stage of thrips is in soil. Thus soil should be ploughed or treated so as to expose and kill the pupating pest.
8. There are no other biological or mechanical methods available to control the thrips attack on mango crop.

**Infestation of Mango Thrips Scirtothrips dorsalis (Hood)**
Fig. 4.2.11 Infestation of *Scirtothrips dorsalis* (Hood) on mangoes

Fig. 4.2.12 *Scirtothrips dorsalis* (Hood) on mango

Fig. 4.2.13 Infestation of *Scirtothrips dorsalis* (Hood) on inflorescence

4. **Fruit borer** [*Noorda albizonalis* (Hampson)]
Order: Lepidoptera
Family: Pyralidae

Mango fruit borer *Noorda albizonalis* (Hampson) is also known as Red banded caterpillar. Mango fruit borer was never a serious pest on Alphonso mango cultivation before a decade but now these borers are increasing at alarming rate. Red banded caterpillar is so called due to presence distinct alternate white and red bands on the body of caterpillar and black collar on the first segment. April to May is the congenial period for the borers to oviposit due to availability of medium size fruits. Peak infestation is recorded during mid of April but then after population drastically reduced as the mature larvae pupated. The most important factor for the emergence of fruit borer is availability medium size fruits. In the absence of fruits the borers failed to reproduce.

**Life history:**

Females lay eggs on the immature fruits that are generally of pea to marble size. Eggs are laid in cluster that hatches within 3 - 4 days. Soon after hatching larvae start boring the infested fruits. The full grown larvae is pinkish in colour with red bands on body and measures about 20-25mm. Due to presence of these distinct band pest is called as red banded caterpillar. The infestation of fruit borer is observed on pea to marble stage fruits were kernel is yet to harden from mid of March to first week of April. Generally the marble size fruits protected from complete sunlight are preferred sites for oviposition by females. The larval stage last for 18 to 22 days. The larva pupate either inside the infested fruit or occasionally outside in cracks and crevices of trees. The pupal period is about 10 to 12 days. Adults are small brownish black coloured moth with wing span of about 20mm-24mm.

**Nature of damage:**

Young larvae attack the tender fruits at early stage and start boring the fruit at from distal end. The pest infestation is mostly observed where more than two fruits are present on same panicle. Primarily the larvae bore into the tissue and make tunnel towards the seed. Larvae initially feed beneath the skin surface; later on it feed on the inner content of fruit that is seed. Small holes are observed at the site of infestation at initial stages. Gradually the hole gets enlarged and fecal matter gets accumulated inside fruit. Secondary pest infestation by bacteria and fungi was observed through the hole, causing fruit rotting. Such fruits generally fell from tree prematurely. Sometimes due to heavy infestation cracks develop on fruits. In some cases 2-4 larvae are found in a single fruit. In case of sever infestation of fruit borer massive fruit drop is observed under the mango tree. Infestation of fruit borer is mainly responsible for premature fruit drop which ultimately affects mango production. Fruit borer
Infestation on mango crop was initially below economical loss, but presently the infestation is gradually increasing.

**Control:**
1. Fruits infested by fruit borer should be removed and destroy along with larvae at early stage.
2. Also the collected fruit can be burned to prevent further spread of the pest on mango crop.
3. Dropped fruits in mango cultivations should be collected and discarded to control the infestation.
4. Insert a leaf or some barrier between fruits on same panicle to separate them from each other. The sites of attachment of fruits are preferred by the fruit borer female for oviposition.
5. Female generally oviposit on fruits that are present in damp places which are not exposed to sunlight. Thus regular pruning of mango tree is essential to facilitate the exposure of fruits to sunlight. This is one of the simple methods to control attack of fruit borer.
6. Canopy management of tree is necessary so that all fruits are evenly exposed to complete sunlight.
7. Spray of Dichlorovos can be effective in controlling pest attack in case of severe infestation.
8. There are no other methods like biological or pheromone traps or chemical to control the attack of fruit borer.
9. Regular monitoring and acute observation of the fruits when then attain pea size is essential. Special attention should be paid on the fruits that are in cluster and in damp places.
10. It is essential to work on other methods to control the attack of fruit borer on mango crop.

**Infestation of fruit borer Noorda albizonalis** (Hampson)
Fig. 4.2.14 Favourable conditions for breeding of *Noorda albizonalis* (Hampson)

Fig. 4.2.15 Infestation of *Noorda albizonalis* (Hampson) on marble size mango

Fig. 4.2.16 Insertion of leaf to prevent infestation of *Noorda albizonalis* (Hampson)
Fig. 4.2.17 Larva of *Noorda albizonalis* (Hampson)

Fig. 4.2.18 Pupa of *Noorda albizonalis* (Hampson)
Fig. 4.2.19 Adult of *Noorda albizonalis* (Hampson)

Fig. 4.2.20 Infestation of *Noorda albizonalis* (Hampson) on mango
5. Mango mealy bug [*Drosicha mangiferae* (Green)]

Order: Hemiptera
Family: Margarodidae

Among all insect pests on mango crop mealy bug, *Drosicha mangiferae* (Green) is most important pest and serious threat to mango industry after mango hopper. *D. mangiferae* (Green) is commonly known as ‘Giant mealy bug’ (Kumar *et al.* 2009). *D. mangiferae* is one the notorious and destructive pests accounting fruit loss on large scale. They are covered by white mealy powder, giving a powdery wooly like appearance to infested plant parts. Mealy bugs penetrate deep into plant tissue for sucking sap and therefore become safe from the deleterious effect of pesticides and other control measures.

**Life history:**

Females lay eggs in soil restricted to an area of a few diameters round the base of the mango tree. Oviposition in soil generally takes place from April to June. Eggs are yellow in colour and measures about 0.9 to 1.1 mm in length. The eggs laid in the soil take few months for hatching. Incubation of eggs is influenced by the temperature and moisture conditions of the soil. Late monsoon and winter rains delay the hatching of mealy bug. The hatching occurs from November onwards and continues up to January. The newly emerged nymphs are 1 – 2mm long. The young nymphs are very active and negatively geotropic. The young nymphs after hatching crawl up along the tree trunk and set on plant parts. The nymphal period is about 20-25 days. Thereafter, in case of male forming nymphs there is a pupal stage between nymphs and adult. Pupation takes within the crevices of tree. Pupa measure about 3-5mm in length whereas female producing nymphs do not undergo any pupation.

Adult females are wingless and possess large body. On other hand male are winged with a single pair of wings. Males live for 22 to 27 days where as females live for 75–135 days. Life span of male adults is much shorter than females. After fertilization the females crawl down the tree trunk to ground where they lay eggs. Pest incidence begins from December and gradually gains momentum and attains peak population during middle of April. Population of mealy bug was found to decrease during rainy season but increased in dry season.

**Nature of damage:**

Mealy bug damages the plant by constant sucking of cell sap by nymphs and adults from inflorescence, tender leaves, fruit stalk, fruit surface and shoots. Excessive desaping of infested plant parts leads to drying, wilting and finally arrest fruit setting. As a result yellowish patches develop on the infested plant parts. The infested fruit stalk become week
and leads to fruit drop. Pest infested plant parts are affected by sooty mould. Photosynthesis process of plant is interrupted by the growth of sooty mould. Further the sooty mould decolorizing fruits and make them unacceptable for consumption. Pest incidence is hardly suppressed by the pesticides due to waxy body coating Kumar(2016).

**Control:**
1. Remove the weeds and grass in orchard to control the attack of mealy bug.
2. If possible plough or dig the soil during summer to the expose the eggs of mealy bugs.
3. At initial stage of infestation pest appears in certain patches only. Thus it is essential to monitor the mango cultivation thoroughly and spray Dichlorvas 76% @ 10 ml/ 10lit.
4. Dust Methyl parathion 2% at the base of the trunk.
5. Red ants act as the carrier of mealy bug, thus ant population should be controlled.
6. As pest is covered with waxy coating over it, sticker should be used in spray @0.5 ml/ lit.
7. Application of Monocrotophos is also effective in suppressing mealy bug population.
8. Strips or bands of tin should be clipped around the tree trunk to check migration of the nymphs on tree.
9. Dry sand should be placed at the tree base. Care should be taken that sand remains dry and free.
10. Also alkathene sheets can be wrapped around the trunk a feet above the ground surface. Sheet should be pasted with wet soil on each side leaving no space in the trunk. Besides these sheets can be ties with jute fibers to check crawling of nymphs on tree.
11. Infestation should be controlled before it spread throughout the mango tree. Regular monitoring and acute observation of each mango tree is essential.

Infestation of *Drosicha mangiferae* (Green)
Fig. 4.2.21 Honey dew secretion by *Drosicha mangiferae* (Green)

Fig. 4.2.22 Adult of *Drosicha mangiferae* (Green)

Fig. 4.2.23 Association of *Drosicha mangiferae* (Green) with ants

6. Stone weevil [*Sternochetus mangiferae* (Fabricius)]
Order: Coleoptera
Family: Curculionidae

Stone weevil *Sternochetus mangiferae* (Fabricius) is an important pest on mango crop. Mango seed is referred as stone, as it is hard and resembles stone. As this pest infests mango seed it is termed as stone weevil. Stone weevil infestation is a major limiting factor in export of mango to foreign countries. Also it hampers mango quality and seedling production from mango stone. Late fruiting varieties are more susceptible to this pest attack as compared the early fruiting varieties. Some large mango importing countries like USA, China, Japan and some Arabian Gulf countries have imposed quarantine restriction on trade of mangoes from India due to stone weevil infestation on mangoes.

**Life history:**

Females lay egg beneath the skin of ripening fruits. Injury made by female on fruit during oviposition heals up in due period and fruit appears healthy. Also the injury made to the mango flesh and seed heals gradually and fruit appears healthy. The insect well develop within the stone. The number insects per stone may vary from one to six in case of severe infestation. Infestation of stone weevil began from March on availability of fruits. The incubation period of eggs is 7 to 8 days. The larva is whitish in colour with pinkish head. The larva tunnels into the flesh of tender fruits and reaches the region where seed coat that is still very soft. It then bores through the seed coat and reaches the seed endosperm. It grows into the stone by feeding on the cotyledons. At times number of larva in single stone may be up to four. The larval period is about 20 to 30 days.

The full grown larva pupates inside the infested stone. There is about 6-8 days pupal period. If the infested fruit drops from tree, gradually the pulp portion decays. Then adult cuts the exit hole and directly emerges out of the fruit. If the infested fruit is intact with tree, the adult weevil has to move through the pulp to come out. This makes mango pulp dirty and unfit for consumption. The adult weevil is dark grayish stout and 8 to 10mm long. The dark greyish colour of weevil resembles the bark colour of the mango tree. During non-fruiting season they remain inactive in barks and other niches like soil for a long time. The adult weevils hibernate up to next mango season. The adult of stone weevils hibernate for long time long period even under critical circumstance. The pest infestation is recorded on mango crop only.

**Nature of damage:**

Stone weevil infestation has no adverse impact on mango pulp. But infested seed cotyledons get completely damaged that it cannot be used for plant propagation. Attack of the
pest is major constrain in growing mango seedlings in nurseries. In case of infested fruits
discoloration of pulp adjacent to stone can be observed. Infested fruits appear healthy from
external appearance, infestation can be noted during consumption of mangoes. The pest
attacks at early fruiting stage, when fruits are of marble size which leads to fruit drop at
premature stage. Thus attack of stone weevil attack causes premature fruit drop and hampers
final yield. Infestation of stone weevil is mostly confined to humid area. In South India pest
infestation of stone weevil is severe as compared to Devgad Tehsil. In Devgad Tehsil attack
of stone weevil is very less.

Control:
1. Orchard sanitation is essential for controlling the attack of stone weevil.
2. Collection and destruction of dropped fruits and stone (mango seed) can reduce the pest
attack.
3. Deep ploughing of soil around the tree in orchard to expose the hibernating adults in soil.
4. Spray of Carbaryl 50 WP (20gm/ 10 lit) can be effective in controlling pest attack.
5. One spray of Deltamethrin @ 10ml/ 10 lit. on fruits at 50 to 60% maturity stage can be
taken to reduce infestation.
6. Monitoring the cracks on branches and stem of mango tree to record the hibernating
weevil and kill them prior to mango fruiting season.
7. While applying pesticides of the along with leaves and inflorescences; branches and stem
should be covered as they are hiding sites for adults.
8. Old and damaged branches should be cut and disposed away from the mango cultivation.
9. Old mango tree aged more than 80 years possess cracks and fissures on the branches and
stem. These cracks and fissures on the mango tree should be cleaned and applied with
bordeaux mixture. This will help to destroy the niche for hibernation of the adults.

Infestation of Sternochetus mangiferae (Fabricius)
Fig. 4.2.24 Larva of *Sternochetus mangiferae* (Fabricius)

Fig. 4.2.25 Pupa of *Sternochetus mangiferae* (Fabricius)

Fig. 4.2.26 Adult of *Sternochetus mangiferae* (Fabricius)

7. Shoot borer [*Clumetia transversa* (Walker)]

Order: Lepidoptera
**Family: Pyralidae**

Shoot borer *Clumetia transversa* (Walker) causes serious damage to mango crop by attacking the tender shoots of mango tree. This pest is one of the important insect pests on mango crop. Incidence of shoot borer is recorded each time with emergence of the young shoots on tree. Along with tender shoots this pest also attacks mango inflorescence. Incidence of this pest cause serious damage to mango crop by damaging young emerging shoots. Pest also attacks the new saplings that are at the in vegetative phase.

**Life history:**

Females lay eggs on the tender leaves of tree. The incubation period of eggs is 5 to 6 days. The larva is brownish in colour and measures about 15 to 18mm in length. The larva after hatching enters into the tender shoots by boring through the tender shoots and feed internally. They make tunnels in downward direction measuring about 100-150 mm in length. Through the entrance tunnel they eject out excreta making stem hollow. Newly emerged larva is whitish in colour, later on it turns brownish as it matures. Completely grown larva is about 16mm in length. It takes about 10-13 days for a larva to mature. Larvae consume the new leaves and inflorescence. After complete development mature larvae come of the tunnel for pupation. Pupation takes place in cracks present on branches or stem, crevices, dried shoots or soil. Pupa is reddish brown in colour and measures about 8 to 9 mm in length. Pupa is unaffected by external conditions like humidity and temperature. The pupal period is about 8 to 10 days. After pupation adults emerge, those are blackish brown in colour. It is a medium size moth with wing span of 15 to 17 mm. They hibernate up to emergence of young tender shoots. The arrival of pest exactly matches with the initiation of young shoots. The life cycle of pest completes in one and half month. There are 3 to 4 overlapping generations of pest in a season. Maximum infestation is noted during September and October.

**Nature of damage:**

The attack is noticed when there is new flush on the tree. The infested shoots dies and does not flower subsequently. A prominent hole is seen on the infested shoot. The larva expel out the excreta through entrance of hole and shoot become hollow. The infested shoots shade their leaves and give a wilting appearance. The damaged shoots were found to be shorter and initiated fewer leaves. The emergenceof shoot borer is synchronized with the appearance of the young tender shoots. Wilting of growing tips and dieback are common symptoms of the attack of this pest. Pest infestation constrains the fruit setting and ultimately reduces the final production. Infestation is marked during September to November. Infestation of pest is not
infested to mango tree only, it also other crops like damages litchi trees (Srivastava 1997). Infestation of shoot borer on the young plants and sampling causes death of plants. Infestation of other insect pests is mostly correlated with reproductive parts and phases of mango tree, but in case of shoot borer it is associated with vegetative as well as reproductive phases. Young plants are generally not attacked by insect pests due absence of plant parts like inflorescence and fruit. However attack of shoot borer is major threat to new plantations as the plant shoots are tender, which can be easily attacked by the pest. Infested shoot become hollow and turn black internally mainly due to presence of excreta of larva and consumption of internal tissues by pest. Pest attack limits the growth of tree crown.

**Control:**

1. Infested shoot should be removed and destroyed to control infestation.
2. Regular monitoring of young shoots to note the infestation.
3. Spray Quinalphos 25 EC (20ml / 10 Lit) or Carbaryl 50WDP (20gm/ 10Lit.) should be taken to control pest attack.
4. Sprays should be taken in synchronization with emergence of the tender shoots.
5. Spray of Quinalphos 25 EC (20ml / 10 Lit) should be taken at the interval of 10 days. The interval period may vary according to the level of infestation.
6. Also application of Monocrotophos 36 % and Dimethoate30% can be effective in controlling the pest attack.
7. Shoot borer attacks new plantations also due to availability of tender shoots. Thus regular monitoring and pesticide application is necessary to protect new plantation. In case of sever infestation plants may die.
8. Similarly all mango tree should be kept under acute observation and adopt plant protection measures accordingly.
9. Integrated pest management practices should be adopted by farmer to control the pest attack.
10. Only reliance on chemical pesticides may be insufficient to control the attack of pest on mango crop.

*Infestation of Clumetia transversa* (Walker)
Fig. 4.2.27 Hole on infested shoot

Fig. 4.2.28 Infestation of *Clumetia transversa* (Walker)

Fig. 4.2.29 Infestation of *Clumetia transversa* (Walker) on young shoots
Fig. 4.2.30 Larva of *Clumetia transversa* (Walker)

Fig. 4.2.31 Pupa of *Clumetia transversa* (Walker)

Fig. 4.2.32 Adult of *Clumetia transversa* (Walker)
7. Stem borer [*Batocera rufomaculata* (de Geer)]

Order: Coleoptera

Family: Cerambycidae

Mango stem borer *Batocera rufomaculata* (de Geer) is an important insect pest on mango crop. This is an only pest that does not pose direct damages to fruits, inflorescence and leaves. But it has potential to destruct complete tree within few months in case of sever infestations. Infestation of insect pests like hopper, thrips, mealy bug, fruit borer, shoot borer, etc. damages the fruits, inflorescence, shoots and leaves ultimately affecting crop yield, but doesn’t have potential to kill entire mango tree. Stem borer can destroy entire mango tree, if left unnoticed. A decade before mango stem borer was not a serious threat to mango crop but today it has gained important position in mango industry. A decade before it was marked as a minor pest on mango crop and infestation was very low. In rare cases pest was observed causing damage to very old mango trees but the present scenario is completely different and it has been found that pest infest even 5-8 years old mango tree.

**Life cycle:**

Females lay eggs in the cracks and crevices of tree. The incubation period of eggs is 7 to 13 days. Larvae are slender, creamy white to yellowish in colour and legless. The larvae measures about 5 to 8cm long with well-developed mandibles. Hairs are present on the body of larva and head is dark brown in colour. The larval stage lasts for about 140 to 160 days. After feeding completely larva undergo pupation. The full grown larva pupates inside the stem. The pupa is yellowish brown in colour and 5 to 6 cm in length. The pupal stage lasts for about 20 to 25 days. The adult beetle is stoughtly built with grey colour. It measures about 5-6cm long. The antennae of the beetle are very long. Adults are generally spotted at night, during day time they rest in hiding place.

**Nature of damage:**

Stem borer is serious pest on mango cultivations, as is attack the main stem and branches of mango tree. The Larvae after hatching bore the bark initially and then enter inside. Once the larvae enter in the stem they create tunnels inside the stem. Larvae after hatching bore the bark initially and then enter inside. Once the larvae enter in the stem, they create tunnels inside the stem and damage the stem internally by chewing and cutting. The internal content of stem gets badly damaged and stem become hollow internally. Within a tree stem 2 to 4 larvae are found attacking simultaneously. The damage is not perceptible at early stage but can be noticed by the oozing of sticky fluid and saw dust from the portion of infestation. Often damage is visible by falling of leaves and branches look like burn
ultimately causing heavy reduction in yield. In case of severe infestation tree wilt and ultimately die. Stem borer infestation is recorded throughout the year. Severe stem borer infestation is recorded from the orchards with poor sanitation and management. In some cases it was observed that, if a tree is infested by stem borer, in successive year infestation spreads to neighboring mango trees. Infestation of this pest has increased mainly due unawareness and negligence of farmers. Presently pest is emerging as major pest and responsible for death of mango trees.

Control:

1. Infested branches should be cut and larvae present inside the stem should be removed and killed.
2. The adults found in the mango cultivations should be collected and killed.
3. If infestation is not too deep, larvae should be removed with the help of hook or wires.
4. Kerosene or petrol should be injected through the holes made by the stem borer and the hole should be sealed with tar.
5. Regularly acute and careful monitoring of each and every tree along with orchard is necessary.
6. Orchard sanitation is essential for controlling pest attack. Placing log of wood in orchard should be avoided.
7. Main stem of the branches should not be injured. As the open cuts on plants may turn into site of infestation.
8. Unnecessarily pruning of branches should be avoided. A spray Carbaryl 50 WDP (4 gm/lit) on pruned plants.
9. Consistently observation of tree trunk carefully to note if gum is exuding from stem, immediately remove the grubs from plant body.
10. Trees adjacent to infested one should be monitored thoroughly as they are most likely to be damaged.
11. Trees that are infested by pest or dead should be destroyed to control the pest attack.

Infestation of *Batocera rufomaculata* (de Geer)
Fig. 4.2.33 Larva of *Batocera rufomaculata* (de Geer)

Fig. 4.2.34 Pupa of *Batocera rufomaculata* (de Geer)

Fig. 4.2.35 Adult of *Batocera rufomaculata* (de Geer)
Fig. 4.2.36 Tunnels made by grubs of *Batocera rufomaculata* (de Geer) inside the stem.

Fig. 4.2.37 Death of mango tree due to infestation of *Batocera rufomaculata* (de Geer)
8. **Leaf webber** *Orthaga exuvinacea* (Hampson)

**Order: Lepidoptera**

**Family: Pyralidae**

Leaf webber *Orthaga exuvinacea* (Hampson) has recently become a limiting factor in mango production. The infestation of this pest is observed in the neglected orchards. As compared to other pest attack, incidence of this pest is low on mango crop and causes injury to crop below economical injury.

**Life history:**

Females lay eggs on the leaves of the mango tree from October onwards. Eggs hatch within 4 to 7 days. Larva is grey in colour measuring about 25 to 30 mm in length. Larva feed on the leaves leaving behind the midrib and veins. Larva web together neighboring leaves and form a nest. The larval period is about 40 to 45 days. They pupate on the leaves inside the web. The pupa is brownish black in colour and measures 15 mm in length. The pupal period lasts for 15 to 20 days. Adult emerge in April. The adult is grey coloured medium size moth measuring about 2-4 cm long.

**Nature of damage:**

The webbed leaves gives tent like appearance, thus pest is also commonly known as tent caterpillar. Many larvae are found in a single nest. Larvae feed within the nest and defoliated leaves gradually dry up. Infested leaves become papery due to feeding activity of pest. The nest is full of pest excreta. Tree canopies with more shady conditions are favourable for this pest attack. Usually one to six larvae are found per web. A severely infested tree shows number clusters of webbed and dried leaves giving tree a conspicuous burnt appearance. In case of sever infestation tree completely fails to flower. Pest infestation damages leaves of tree and arrest photosynthetic activity. Infestation is generally noted from October to January.

Management of leaf webber is difficult due to large size of mango tree coupled by micro-ecosystem in orchard in which pest breeds in active period and rest in off season. Humid and wet conditions accelerate the pest population, while higher evaporation during pest incidence coupled by wind speed, low rainfall and maximum temperature resulting in dry conditions arrest the pest population.

**Control:**

1. Pruning of infested branches and burning them.
2. Spray of Quinalphos 25 EC @ 2 ml/lit or Carbaryl 150 WDP @ 2 gm/lit. can effective in controlling pest attack.
Infestation of *Orthaga exuvinacea* (Hampson)

Fig. 4.2.38 Larva of *Orthaga exuvinacea* (Hampson)

Fig. 4.2.39 Pupa of *Orthaga exuvinacea* (Hampson)
Fig. 4.2.40 Adult of *Orthaga exuvinacea* (Hampson)

Fig. 4.2.41 Infestation of *Orthaga exuvinacea* (Hampson) on leaves
9. **Mango scales** [Aspidotus destructor (Newst)]

**Order: Hemiptera**

**Family: Coccidae**

Mango scales are found infesting inflorescence, twigs, leaves and fruits of mango tree. Mango scales are also known as coccids. They survive only on the living plant parts and die if the infested plant part wilt or dry. Mango scales are very minute insect but are easily noted when the congregate in masses on plant parts.

**Life cycle:**

Females lay eggs on the leaves of mango tree. The incubation period lasts for 7-8 days. New hatching take position on the leaves and start sucking the sap. The nymphs remain on the site. The nymphal period is about 20 to 25 days. The life cycle completes within 31 to 35 days. The adult scales measures about 1.5 to 2.0 mm in diameter. They are whitish, circular and papery. The adults have covering of some sort of waxy powdery like white material.

**Nature of damage:**

The infestation is mostly observed on the lower side of mango leaf. On same portion, yellowish spot develop on the upper side of the infested portion on the leaves due to sap sucking by the pest. Later the yellow patches turn brown and leaves drop down. Scale insect secretes honey dew on the leaves, fruits and twigs. This pest arrests the photosynthesis of plant. Scales infestation is also observed on the fruits. White parches develop on the fruit making them unfit for marketing. Mostly the infestation is observed in dense plantation. The infestation is recoded in October- November and then in summer season that is from March to April.

**Control:**

1. Over crowed branches should be thinned so that plant can receive enough sunlight and aeration. Exposure to sunlight helps to reduce the pest infestation.
2. Infested plant parts such as leaves, twigs and branches should be pruned regularly and destroyed.
3. Spray of Dimethoate 30EC @ 1.2 ml/lit. can be effective in controlling pest attack.
4. As scales have waxy coating on their body it is advisable to use sticker in the spray solution @ 0.5/lit.

Infestation of *Aspidotus destructor* (Newst)
10. **Leaf miner** [*Acrocercocops syngamma* (Meyrick)]

*Order: Lepidoptera*
Family: Gracillaridae

Leaf miners are the minute insects that affect the leaves of mango tree. This pest particularly infesting new vegetative flush thereby causing leaf drop and ultimately affecting the fruit yield. As the larva mines the tender leaves, the pest is called as leaf miner. However infestation of this pest is low on mango cultivations and termed as minor pest.

Life cycle:

Females lay eggs on the upper side of the leaves. The eggs hatch out within 3 to 4 days. The larva is whitish coloured and measures about 4 to 5 mm in length. The larval period lasts for 10 to 12 days. Distinct white colour blisters appears on upper side of the infested portion of the leaves. However the same portion appears brown from the lower side.

Full grown larva pupates inside the blisters. The pupa is pale yellow coloured and measures about 3 to 5 mm in length. The pupal period is about 5 to 7 days. The adult is very small and silver coloured moth. After emergence of the adult blister becomes dry and weather off and inner brown portion becomes visible. The infestation is mostly observed during October- November and March April on young leaves.

Nature of damage:

Pest mainly attack leaves of mango crop. After hatching larva mines into the leaf epidermis and feed on chlorophyll content resulting into formation of white blotches on leaves. The larvae feed between the upper and lower surface of the leaves. Its activity leads to formation of crisscross tunnels on leaves. These tunnels are blisterly in appearance. Pest infestation causes leaf drop and lower fruit production.

Control:

1. Infested tender foliage should be removed and burnt.
2. Spray of Qunaiphos 25 EC @ 20ml/10lit. can be effective in controlling pest attack.
3. Similarly application of Monocrotophos 36 % and Dimethoate30% can reduce pest attack on mango crop.
4. Regular and acute monitoring of mango trees is essential.

Infestation of Acrocercocops syngramma (Meyrick)
Fig. 4.2.45 Infestation of *Acrocercocops syngramma* (Meyrick) on leaf

Fig. 4.2.46 Larva of *Acrocercocops syngramma* (Meyrick)

Fig. 4.2.47 Adult of *Acrocercocops syngramma* (Meyrick)

11. *Aphids* [*Aphis gossypii* (Glover)]
Order: Hemiptera  
Family: Aphididae  

Aphids are found to infest mango crop but are considered as minor pest as they are least responsible to damage the crop. However this minor pest at times becomes a serious problem in mango cultivations if left unnoticed.  

Life cycle:  
Females give birth to 8-22 nymphs generally in winter and continue further till rainy season. The nymphal period is about 7-9 days. Their entire life period of aphids is about 3-5 weeks. Young ones take about 7-12 days to attain maturity. The breeding of pest continues throughout the year.  

Nature of damage:  
They are generally recorded in cluster on the ventral side of the leaves and suck sap. They are also observed on the new flush of mango tree. The infested leaves show wrinkling and curling symptoms. Their honey dew secretion on leaves facilitates growth of sooty mould which ultimately affects the photosynthesis mechanism of plant. This pest changes their colour frequently. They may be yellow, yellowish green or greenish black shade. Pest emergence is noted on mango crop in winter season along with development of reproductive plant parts. Aphids damages plants by sucking sap as their sucking tendencies are strong enough to damage mango crop. They puncture tender leaves of plant with help of their proboscis and keep sucking the sap. Although aphids is a minor pest on mango crop but occasionally may cause serious damage to mango crop.  

Control:  
1. Spray of Monocrotophos 36 % can be taken to control aphid infestation.  
2. Also application of Dimethoate30% is effective in controlling the pest attack.  
3. Regular monitoring and close observation of every mango tree is essential.  
4. It is better to control the pest infestation at early stage as it may cause massive destruction of crop if left unnoticed.

Infestation of Aphis gossypii (Glover)
Fig. 4.2.48 Aphis gossypi (Glover) - Apterous

Fig. 4.2.49 Aphis gossypi (Glover) - Winged

Fig. 4.2.50 Infestation of Aphis gossypii (Glover) on mango

12. Ants [Oecophylla smaragdina (Fabricius)]
**Order: Hymenoptera**

**Family: Formicidae**

Like termites, ants are social insects. These ants are commonly called as red ants or tailor ants. They are not direct pest on mango crop or directly cause damage to mango crop. They construct nest on mango trees by swelling leaves together. The nest is composed of living and dead leaves together which gives a burning appearance to a tree. Ants are occasionally important as they bite field workers especially during harvesting fruits and other farm operations. Ants can be classified as the biological agent as it kills the arboreal insects on the tree.

**Life history:**

The adult lay eggs in the nest those are white in colour. *Oecophylla smaragdina* is commonly called as red ants or tailor ants. These ants are arboreal. Ants live inside the nest made by joining the leaves of tree. There are several hundreds of ants in one nest. The nest usually measures up to 20 cm long or even more. On a single mango tree multiple nest of ants were observed. It was observed that if undisturbed the nests last for one or more years on the same location.

**Nature of damage:**

In the spring the adult emerge from the nest and construct new nest with new leaves. They carry nymphs of aphids, mealy bugs and scales with them. They degrade fruit quality by secretion of formic acid. Also they trouble farmers while harvesting fruits as well as other orchard management practices like pruning.

**Control:**

1. Mechanical destruction of the ant nests by cutting or burning it.
2. Application of phorate powder proves effective in controlling the ant population.

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*Infestation of Oecophylla smaragdina* (Fabricius)
Fig. 4.2.51 *Oecophylla smaragdina* (Fabricius)

Fig. 4.2.52 Nest of *Oecophylla smaragdina* (Fabricius) on mango tree

13. **Termites** [*Odontotermesobesus* (Rambur)]
Order: Isoptera
Family: Termitidae

Termites are social insects and also known as white ants. Termites live in colonies called termitaria. They make nest at ground level or in high mounds on trees according to the soil. Their food mainly consists of wood cellulose thus they freely attack all woody matter in both form dead and alive. They attack several host including mango trees.

Nature of damage:

Termites are social insect they live in colony. Termites are medium size, soft bodied insects which varies in colour from dull white to light to dark brown. The colony consists of workers, soldiers, royal pair (King and Queen), nymphs and eggs. Colony produces numerous winged formed in the beginning of the monsoon. Eggs are very small about 0.5mm in length. Nymphs are yellowish white in colour and about 1mm long. Queen is 6-8cm in length. Queen attains large size due to enlargement of abdomen that consist eggs. Kings are small in size as compared to Queen.

The food of termites principally includes cellulose. Thus they attack mango tree on braches and stem by forming soil channels under which they live. The queen generally lives in soil below tree. Pest presence is mainly influenced by the moisture content in soil. Termites preferred sandy and unirrigated soil. Pest flourishes well in soil with bad aeration and poor drainage. Termites feed on main trunk that arrest plant growth and affects fruit setting. In case of severe infestation, the entire trunk look like it is plastered with soil up to few meters.

Control:
1. Plantation of mango trees in sandy and loamy soil should be avoided.
2. Partially decomposed soil should not be applied to mango trees.
3. Orchard sanitation, deep ploughing, frequent irrigation should be exercised by farmers.

Infestation of Odontotermes obesus (Rambur)
4.3 Evaluation of infestation pattern of each insect pest on mango crop with respect to selected location:
The study was carried out to evaluate the insect pest diversity and zoogeographical distribution of insect pests in Alphonso mango cultivations in Devgad tehsil. For present study five different locations namely; Devgad, Wada, Kunkeshwar, Talebazar and Waghotan were selected. Insect pest diversity and level of pest infestation was evaluated. Observation of each mango cropping season were noted separately. Infestation level of each pest was mainly categorized into three different levels like low, medium and high. The infestation level of each pest was ascertained by observations and discussion with the farmers. Status of each insect pest at each location was evaluated from year 2014-15 to 2016-17.

The insect pest status on Alphonso mango cultivations at selected sites was evaluated. Pest emergence, life cycle and mode of infestations were studied in detail during study period. Along with this the geographical features, climatic factors like rainfall, fluctuations in temperature and humidity influencing the pest attack were studied. Emergence of insect pest and abundance of all pests was recorded at each location. Such observations were noted during study period. Also control measures necessary to check pest attack were studied. Insect pest diversity on mango crop was evaluated where fourteen insect pests’ activities were studied at each location. These insect pests attacked mango cultivations and affected the yield by degrading fruit quality or decreasing final yield. Insect pest attack each part of plant namely leaves, inflorescence, fruits, shoots and stem.

Location wise infestation level of each insect pest is discussed in the tables. The tables contain the details information about the infestation level of pest in particular area. Such details about all five selected locations are discussed below. Pest diversity was found to be same at all five locations but the infestation level was different. Also every year there was changes in pest infestation pattern due to climatic changes. Mainly unseasonal rainfall and temperature fluctuations govern the pest attack pattern.

4.3.1 Status of important insect pests on mango crop in Devgad during 2014 -15 to 2016-17:

Devgad is located on the coastal region and land is covered with hard rock. Mango cultivations in Devgad are done mainly on hard rook due to unavailability of land. Pest infestation pattern is influenced by the geographical fractures of the area, particularly like soil
The land in Devgad is mainly covered by hard rock, humidity is high and strong wind blow from the western side. In year 2014-15, infestation of mango hopper, fruit fly and thrips was high. Climatic conditions of this year were suitable for the growth and development of these insect pests. Attack of stem borer was medium. However it was observed that attack of stem borer depends on orchard sanitation and management. While attack of fruit borer, mango mealy bug, leaf webber, mango scales, miner aphids, ants and termites was low. The loss caused by these insect pests to mango crop was comparatively low. Maximum damages were caused by insect pests such as mango hopper and thrips.

While in year 2015-16, attack of mango hopper and thrips continued to be high. Whereas the infestation of fruit fly was found to medium as there was no post monsoon rainfall after October. The climatic conditions were not much suitable for the growth of the fruit fly. Similarly infestation of fruit borer, stem borer and mango scales was medium. While attack of mango mealy bug, stone weevil, shoot borer, leaf webber, mango scales, miner aphids, ants and termites was low.

In year 2016-17, infestation of mango hopper and thrips was high. While attack of mealy bug, shoot borer and stem borer was medium on mango crop. Whereas the infestation of fruit fly, fruit borer, stone weevil, leaf webber, mango scales, miner aphids, ants and termites was found to be low.

During study period in Devgad region it was observed that mango hopper and thrips are two most noxious pest on mango crop. They are prominently responsible for the yield loss. They not only reduce the production but also degrade the fruit quality. Farmers in this region have to spend considerable amount to control the attack of these insect pests. Controlling the attack of mango hopper and thrips is crucial job for farmers in this region. Infestation of insect pests like stone weevil, mango scales, termites, ants is low in this region. These pests do not cause much harm to the mango crop. Pest infestation pattern is mostly influences by the climatic condition of each year. Stone weevil, termites, leaf webber and ants are minor pest in this region.

Table 4.3.1.1: Status of important insect pests on mango crop in Devgad during 2014-15 to 2016-17:

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of pest</th>
<th>Intensity</th>
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</table>
### 4.3.2 Status of important insect pests on mango crop in Wada during 2014-15 to 2016-17:

Wada site is another site selected for proposed study. Wada region was purposefully selected as it is well known for mango cultivations. Considerable land in this region is under mango cultivation. Wada is situated 12 km away from Devgad tehsil in north; it is away from

<table>
<thead>
<tr>
<th>#</th>
<th>Insect</th>
<th>2014-15</th>
<th>2015-16</th>
<th>2016-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mango hopper</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>2.</td>
<td>Fruit fly</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
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<tr>
<td>3.</td>
<td>Thrips</td>
<td>High</td>
<td>High</td>
<td>High</td>
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<tr>
<td>4.</td>
<td>Fruit borer</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
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<tr>
<td>5.</td>
<td>Mango mealy bug</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
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<tr>
<td>6.</td>
<td>Stone weevil</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>7.</td>
<td>Shoot borer</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
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<tr>
<td>8.</td>
<td>Stem borer</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>9.</td>
<td>Leaf webber</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>10.</td>
<td>Mango scales</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>11.</td>
<td>Leaf miner</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>12.</td>
<td>Aphids</td>
<td>Low</td>
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<tr>
<td>13.</td>
<td>Ants</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>14.</td>
<td>Termites</td>
<td>Low</td>
<td>Low</td>
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</table>
sea shore and slightly located in the interior region. The land is fixed type slightly covered by hard rock. The region is lined by the Wadatar creek on southern side. Pest infestations of in Wada region was different to that of Devgad. In year 2014-15, attack of mango hopper and thrips was high. Whereas, the attacks of shoot borer, stem borer and aphids were medium on mango crop. Infestation of fruit fly, fruit borer, mango mealy bug, stone weevil, leaf webber, mango scales, leaf miner, ants and termites was low in Wada region. In year 2015-16, infestation of mango hopper, thrips, stem borer and shoot borer was high. Whereas infestation of mango mealy bug and mango scales was medium. Moreover the attack of fruit fly, fruit borer, stone weevil, leaf webber, leaf miner, aphids ants and termites was low. In year 2015-16, infestation of mango hopper, thrips, stem borer and shoot borer was high. Whereas the infestation of fruit fly mango and mealy bug was medium. However the attack of fruit borer, stone weevil, leaf webber, leaf miner, aphids ants and termites was low.

During study period it was observed that mango hopper, thrips, stem borer and shoot borer were the dominant insect pest on the mango crop. These insect pests are responsible for maximum yield loss. Stem borer was one of the prominent insect pests in Wada region. Many mango tree of different age were infested by stem borer. Farmers mentioned that a decade before attack of stem was low and restricted to few sites but now the infestation is increasing at alarm rate. Many productive trees of 30-40 year are drying and consequently dying due to attack of stem borer. Attack of stem borer is a major threat to mango cultivation. In Wada region attack of fruit fly is low to medium, as humidity in this region is not high. The climatic conditions are not suitable for the growth and development of fruit fly. Here climate is moist which favours the attack of mango hopper. Attack of stem borer is also high is this region. The shoots appear wilted and dry which arrest the growth of mango tree crown. Wada region are one of the important mango producing site in Devgad tehsil. Mangoes grown in this region are of good quality and gain sufficient returns.

Table 4.3.2.1: Status of important insect pests on mango crop in Wada during 2014-15 to 2016-17

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of pest</th>
<th>Intensity</th>
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<td></td>
<td></td>
<td>2014-15</td>
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<td></td>
<td>Insect</td>
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</tr>
<tr>
<td>1</td>
<td>Mango hopper</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>Fruit fly</td>
<td>Low</td>
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<tr>
<td>3</td>
<td>Thrips</td>
<td>High</td>
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<tr>
<td>4</td>
<td>Fruit borer</td>
<td>Low</td>
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<tr>
<td>5</td>
<td>Mango mealy bug</td>
<td>Low</td>
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<td>6</td>
<td>Stone weevil</td>
<td>Low</td>
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<tr>
<td>7</td>
<td>Shoot borer</td>
<td>Medium</td>
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<td>8</td>
<td>Stem borer</td>
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<td>9</td>
<td>Leaf webber</td>
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<td>10</td>
<td>Mango scales</td>
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<tr>
<td>11</td>
<td>Leaf miner</td>
<td>Low</td>
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<tr>
<td>12</td>
<td>Aphids</td>
<td>Medium</td>
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<tr>
<td>13</td>
<td>Ants</td>
<td>Low</td>
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<tr>
<td>14</td>
<td>Termites</td>
<td>Low</td>
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</tbody>
</table>
4.3.3 Status of important insect pests on mango crop in Kunkeshwar during 2014-15 to 2017-18:

Kunkeshwar was one of the selected sites for study area. This region is well known for Lord Shiva temple situated on the sea coast and is 14 km away in south, from Devgad. Considerable area in this region is under mango cultivations. Kunkeshwar is situated on the coastal region like Devgad, but most of the mango cultivations are located in the interior portion away from the sea coast, very few plantations are done on the slopes. Climatic conditions are not similar to that of Devgad. Therefore insect pest incidence also varies accordingly. In the year 2014-15 incidence of mango hopper and thrips was high, whereas attack of fruit fly, fruit borer, mango mealy bug, stone weevil, shoot borer, stem borer, leaf webber, mango scales, leaf miner, aphids, ants and termites was low on mango crop. In year 2015-16, incidence of mango hopper and thrips was high on mango crop, whereas attack of shoot borer was medium and attack of fruit fly, fruit borer, mango mealy bug, stone weevil, stem borer, leaf webber, mango scales, leaf miner, aphids, ants and termites was low on mango crop rest all pest was low in Kunkeshwar. In year 2016-17, incidence of mango hopper and thrips was high, whereas shoot borer, stem borer, leaf webber and mango scales was medium. However attack of fruit fly, fruit borer mango mealy bug, stone weevil, leaf miner, aphids, ants and termites was low on mango crop.

In Kunkeshwar region incidence of fruit was found to be low even though is situated on the coastal area. Attack of mango hopper and thrips is more than other pests. However attack of stem borer was also low, very few mango plants were infested by the stem borer. Presently stem borer infection is low in Kunkeshwar. Farmers exercise new techniques to increase production and control pest attack. Mango cultivation in this region are mostly old, plants are tall with large crown. Orchard management practices adopted by farmers including orchard sanitation help to control the pest attack on mango crop. Attack of peat like fruit fly, fruit borer, mango mealy bug, stone weevil, shoot borer, stem borer, leaf webber, mango scales, leaf miner, aphids, ants and termites are generally low in this region. Incidence of spongy tissue is major issue as the land is hard rock. Kunkeshwar region is one of the prominent areas in mango production in Devgad Tehsil. Here the climate is hot and humid, thus infestation of thrips is more. Whereas old mango trees that are large in size supports the growth of mango hoppers.

Table 4.3.3.1 Status of important insect pests on mango crop in Kunkeshwar during 2014-15 to 2017-18
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of pest</th>
<th>Intensity</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>2014-15</td>
</tr>
<tr>
<td>1.</td>
<td>Mango hopper</td>
<td>High</td>
</tr>
<tr>
<td>2.</td>
<td>Fruit fly</td>
<td>Low</td>
</tr>
<tr>
<td>3.</td>
<td>Thrips</td>
<td>High</td>
</tr>
<tr>
<td>4.</td>
<td>Fruit borer</td>
<td>Low</td>
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<td>5.</td>
<td>Mango mealy bug</td>
<td>Low</td>
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<tr>
<td>6.</td>
<td>Stone weevil</td>
<td>Low</td>
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<td>7.</td>
<td>Shoot borer</td>
<td>Low</td>
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<td>8.</td>
<td>Stem borer</td>
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<tr>
<td>9.</td>
<td>Leaf webber</td>
<td>Low</td>
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<tr>
<td>10.</td>
<td>Mango scales</td>
<td>Low</td>
</tr>
<tr>
<td>11.</td>
<td>Leaf miner</td>
<td>Low</td>
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<tr>
<td>12.</td>
<td>Aphids</td>
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<tr>
<td>13.</td>
<td>Ants</td>
<td>Low</td>
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<td>14.</td>
<td>Termites</td>
<td>Low</td>
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4.3.4 Status of important insect pests on mango crop in Talebazar during 2014-15 to 2016-17:
Talebazar is situated 10 km away from Devgad and is one of the prominent mango producing regions in Devgad Tehasil. Talebazar region is situated 14km away from the sea shore in east and is covered by flat plateau. This region is rich in freshwater resources like lakes, rivers and streams. In this region mango plantations are located mostly on plateau region and rarely on the slopes. In year 2014-15, attack of mango hopper and thrips was high in Talebazar region. Whereas incidence of stem borer and mango scale on mango cultivation was medium. While attack of fruit fly fruit borer, mealy bug, stone weevil, shoot borer, leaf webber, leaf miner, aphids, ants and termites was low. In this year mango hopper and thrips were responsible for maximum damage of mango crop. In year 2015-16, incidence of mango hopper and thrips was high on mango crop. Whereas attack of mealy bug and stem borer was medium. However, attack of insect pest such as fruit fly, fruit borer, stone weevil, shoot borer, leaf webber, leaf miner, aphids, ants and termites was low on mango cultivation. In year 2016-17, attack of mango hopper, thrips and stem borer was high. In this year incidence of stem borer was found to increase as compared to successive years. Many mango trees were found to be affected by the stem borer. Also deaths of some severely infested mango plants were reported from Talebazar. Incidence of fruit fly and shoot borer on mango cultivation was medium. Whereas attack of fruit borer, mealy bug, stone weevil, leaf webber, mango scales, leaf miner, aphids, ants and termites was low on mango cultivation.

During study period it was observed that mango hopper and thrips are major pests on mango cultivation in Talebazar region. They are responsible for damage of mango crop on large scale. Recently stem borer is emerging as major pest. Gradually the level of infestation is increasing in successive years. Presently farmers only use mechanical method to control the attack of pest, that by removing the larva from the infested site. But this method damages the tree as the larva tunnels are deep and long in stem. On other hand this method is too lengthy and requires skilled labours. Thus some new methods should be developed to arrest the attack of stem borer. Infestation was stem borer was more in mango orchards which had poor sanitation and lacked proper management practices. On other hand well maintained and clean mango orchards were less prone to attack of stem borer.

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<thead>
<tr>
<th>Sr. No</th>
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<th>Intensity</th>
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Table 4.3.4.1: Status of important insect pests on mango crop in Talebazar during 2014-15 to 2016-17
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<tr>
<th></th>
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<th>2016-17</th>
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<td>1.</td>
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</tr>
<tr>
<td>2.</td>
<td>Fruit fly</td>
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<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>3.</td>
<td>Thrips</td>
<td>High</td>
<td>High</td>
<td>High</td>
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<tr>
<td>4.</td>
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<tr>
<td>5.</td>
<td>Mango mealy bug</td>
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<tr>
<td>6.</td>
<td>Stone weevil</td>
<td>Low</td>
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<td>Low</td>
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<tr>
<td>7.</td>
<td>Shoot borer</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>8.</td>
<td>Stem borer</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>9.</td>
<td>Leaf webber</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>10.</td>
<td>Mango scales</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>11.</td>
<td>Leaf miner</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>12.</td>
<td>Aphids</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>13.</td>
<td>Ants</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>14.</td>
<td>Termites</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

4.3.5 Status of important insect pests on mango crop in Waghotan during 2014-15 to 2016-17:

Waghotan region is 35 km away from Devgad. It is one of the prominent areas under mango cultivations. Waghotan is 35 away from Devgad and situated in north-east direction.
It is surrounded by estuaries and mangrove vegetation. Majority of mango plantations are located on plateau region where as few are located on hilly regions. Also there are hard rock plantations in this region. Mango is major crop in this region. This region is also popular for laterite stone mining. In year 2014-15, infestation of mango hopper and thrips was high on mango crop, while attack of stem borer and mango scales was medium. Whereas attack of fruit fly, fruit borer, mango mealy bug, stone weevil, shoot borer, leaf webber, leaf miner, aphids, ants and termites was low. In year 2015-16, infestation of mango hopper, thrips and stem borer was high, while that of shoot borer as medium. Whereas attack of fruit fly, fruit borer, mango mealy bug, stone weevil, leaf webber, leaf miner, aphids, ants and termites was low on mango cultivations. In year 2016-17, infestation of mango hopper, thrips and stem borer was high, while attack of fruit shoot borer and leaf webber was medium. Whereas, infestation of fruit fly, fruit borer, mango mealy bug, stone weevil, leaf miner, aphids, ants and termites was low.

In Waghotan, attack of thrips on mango crop is severe. Thrips is responsible for damaging mango crop and reducing its productivity. Farmers here are unaware about the life cycle and stages of the thrips. They apply various pesticides on mango crop to control attack of thrips but are unsuccessful in suppressing the thrips population. Along with thrips infestation of stem borer is increasing in this region at alarming rate. Many dead mango trees were reported during study period due to attack of stem borer. Attack of stem borer has increased in this region due to negligence of the farmer. Furthermore farmers do not have sufficient knowledge about insect pest life cycle. Farmers mostly rely on pesticides to control pest attack, only few farmers adopted integrated pest management practices. New orchard management practices like rejuvenation, canopy management etc. are not practiced by farmers. They follow traditional methods in pest control. Infestation of fruit fly in this region is low that is below economic damage. As this area is away from the tehsil place, farmers do not get sufficient knowledge about the innovation in mango industries. Also they cannot attend the awareness programs and demonstration arranged for the farmers due to distance concern.

Table 4.3.5.1: Status of important insect pests on mango crop in Waghotan during 2014-15 to 2016-17

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of pest</th>
<th>Intensity</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>Insect Pest</th>
<th>2014-15</th>
<th>2015-16</th>
<th>2016-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango hopper</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Fruit fly</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Thrips</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Fruit borer</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Mango mealy bug</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Stone weevil</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Shoot borer</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Stem borer</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Leaf webber</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Mango scales</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Leaf miner</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Aphids</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Ants</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Termites</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

4.4 Infestation pattern of each insect pest on mango crop with respect to selected location:

Pest infestation pattern is different at each location owing to their geographical location and climate. Also the pest infestation varies every year due to climatic changes.
Different infestation patterns were observed at same location. The climatic conditions during mango cropping season that is from October to April have significant impact on insect pests. Every year there are climatic uncertainties like post monsoon rainfall, temperate fluctuations, storms, etc. these factors affect mango production. Similarly these factors have impact on insect pest population. The climatic uncertainties either support the pest population or it may also arrest the pest incidence. The effect of climatic conditions on each pest is different. The climatic changes may support some population but as same times other insect pest can be affected. This phenomenon can be well explained with the following example. Rainfall in December and January decreases the population of mealy bug as the rain washes the mealy bug nymphs crawling up the tree. Thus nymphs die and mealy bug population cannot invade the mango tree to complete further life cycle. Rainfall cannot completely suppress the mealy bug population but considerable amount id checked. The mealy bug batches coming out during rainfall are washes. The former and later batches survive and infest mango tree in their further life cycle. It was observed that mealy bug population was less in year when there was rainfall in November and December. On other hand exactly opposite observations were noted in case of fruit fly. Rainfall in December and January supports fruit fly population. Rainfall in this period increase humidity in the region this conditions favours the fruit fly infestation. Consequently the attack of fruit fly increases in successive period.

During studies it was observed that geographical features as well as the climatic condition of the respective year govern the pest infestation pattern on mango crop in that year. However it was observed that every year are more or less changes in insect pest infestation pattern. In case of some pest there are drastic changes in pest population. Farmers mentioned that a decade before attack of thrips was low and thrips was termed as minor pest. But today it is the most destructive pest on mango crop. One important observation noted during studies is that infestation of fruit fly is increasing gradually. In near future is may emerge as major pest on mango crop. Similar observations were mentioned by farmers, that attack of fruit borer may increase on large scale. Studies revealed that mango hopper and thrips are the most dominant insect pest on mango crop. They contribute to maximum yield loss every year. During study period at each location high infestation level was noted every year. It was observed that the infestation level is high irrespective to the geographical features and climatic condition. The climatic conditions are varied every year but attack of these two pests is high. This depicts that, these pest are almost adapted to all climatic conditions and can survive in all odds. Climatic uncertainties like post monsoon rainfall, increase or decrease
4.5 Active period of insect pests on mango crop:

During studies each insect infesting mango crop was evaluated in detail to reveal its active period, damaging stage and plant part infested. Active period of each insect pest is unique and well synchronized with the availability of the respective plant parts.

1. Mango hopper:
   Active period of mango is from November to February. Peak infestation of hopper on mango crop is noted in this period. Mainly nymphs and adult are responsible for damaging the crop. They attack inflorescences, leaves and fruits.

2. Fruit fly:
   Fruit flies are mainly active from April to June. Adult and larva damage the fruits. Infestation is noted during availability of mature fruits.

3. Thrips:
   Attack of thrips is mainly from November to January. Adult and larva are the main damaging stages. They infest plant parts like leaves, inflorescence and fruit.

4. Fruit borer:
   Fruit borer infestation is mainly recorded from March – May. Larvae are mainly responsible for damaging the fruits. Generally pea to marble sized fruits are infested.

5. Mango mealy bug:
   Maximum population of mealy bug is recorded from March to May. Nymphs are adults are responsible for damaging mango crop. They attack leaves, inflorescence and fruits.

6. Stone weevil:
   Stone weevil infestation is mainly noted in May and June. Larvae are the responsible for damaging the fruits. Mango stone is particularly damaged by this pest. This is a only pest noted on mango crop that has potential to damage mango seeds.

7. Shoot borer:
   Shoot borer infestation is mainly recorded in September and October. Larvae of the pest are damage the crop. This pest particularly attack tender shoots of the mango plants.

8. Stem borer:
   Stem borers are active throughout the year. Larval stage of the pest severely damages the mango trees. This pest damages the stem on mango tree. Infestation of this pest is not restricted for certain period, it is noted throughout the year.

9. Leaf webber:
Leaf webber is mainly active period from October to January. Nymphs and adult of this pest damage the mango crop. Infestation of this pest is particularly observed on the leaves.

10. **Mango scales:**
Active period of mango scales in October, November, March and April. Nymphs are adults of this pest damage the crop. Infestation is mainly recorded on leaves and fruits.

11. **Leaf miner:**
Active period of leaf miner is from October to December. Adults of this pest attack the leaves of mango tree.

12. **Aphids:**
Aphids infestation is mainly noted from December to March. Nymphs and adults of this pest cause harm to crop. Leaves and fruits of mango crop are damaged by the pest.

13. **Ants:**
Attack of ants on mango crop is from December to June. Nymphs and adult damage the mango crop. Ants damage the leaves of mango tree.

14. **Termites:**
Active period of termites is from April –June and October-December. Nymphs and adults of termites damage the mango crop. Infestation of termites is noted on stem of mango trees.

Table 4.5.1: Active period on insect pests on mango crop
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of pest</th>
<th>Active Period</th>
<th>Damaging Stage</th>
<th>Plant part infested</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mango hopper</td>
<td>November – February</td>
<td>Nymph and Adult</td>
<td>Inflorescence, fruits and leaves</td>
</tr>
<tr>
<td>2.</td>
<td>Fruit fly</td>
<td>April – June</td>
<td>Larvae and Adult</td>
<td>Mature fruits</td>
</tr>
<tr>
<td>3.</td>
<td>Thrips</td>
<td>November – January</td>
<td>Nymph and Adult</td>
<td>Leaves and fruits</td>
</tr>
<tr>
<td>4.</td>
<td>Fruit borer</td>
<td>March – May</td>
<td>Larvae</td>
<td>Pea to marble size fruits</td>
</tr>
<tr>
<td>5.</td>
<td>Mango mealy bug</td>
<td>March – May</td>
<td>Nymph and Adult</td>
<td>Leaves and fruits</td>
</tr>
<tr>
<td>6.</td>
<td>Stone weevil</td>
<td>May – June</td>
<td>Larvae</td>
<td>Mango stone</td>
</tr>
<tr>
<td>7.</td>
<td>Shoot borer</td>
<td>September – October</td>
<td>Larvae</td>
<td>Tender shoots</td>
</tr>
<tr>
<td>8.</td>
<td>Stem borer</td>
<td>Year-round</td>
<td>Larvae</td>
<td>Stem</td>
</tr>
<tr>
<td>9.</td>
<td>Leaf webber</td>
<td>October – January</td>
<td>Nymph and Adult</td>
<td>Leaves</td>
</tr>
<tr>
<td>10.</td>
<td>Mango scales</td>
<td>October, November, March, April</td>
<td>Nymph and Adult</td>
<td>Leaves and fruits</td>
</tr>
<tr>
<td>11.</td>
<td>Leaf miner</td>
<td>October – December</td>
<td>Adults</td>
<td>Leaves</td>
</tr>
<tr>
<td>12.</td>
<td>Aphids</td>
<td>December - March</td>
<td>Nymph and Adult</td>
<td>Leaves and fruits</td>
</tr>
<tr>
<td>13.</td>
<td>Ants</td>
<td>December - June</td>
<td>Nymph and Adult</td>
<td>Leaves</td>
</tr>
<tr>
<td>14.</td>
<td>Termites</td>
<td>April - June, October- December</td>
<td>Nymph and Adult</td>
<td>Stem</td>
</tr>
</tbody>
</table>

4.6 Climatic effect and zoogeographical distribution of insect pests at each selected location:
Zoogeographical distribution is referred to the geographical as well as climatic conditions of the given area to which the organism is perfectly suited for its survival. Especially the microenvironment and ecological niche of the zone is responsible for the successful sustenance of the species. Hence with reference to the pests discussed above, a brief discussion of their zoogeographical distribution becomes necessary as microclimatic conditions and status of ecological niche are not exactly similar in all the habitats of the same Devgad tehsil.

During studies it was observe that insect pest diversity on mango crop was similar at each location but the level of infestation varied. Also there were variations in infestation pattern every year. Thus infestation pattern of each pest was evaluated at each selected location. Also the environmental factors influencing the pest attack were evaluated. Effect of post monsoon rainfall, humidity and temperature fluctuations were observed with respect to each location at selected sites. Infestation level of each pest was categorized as low, medium and high. It was determined on basis of field observations by noting the damage caused by insect pest and discussion with farmers. Simultaneously all selected locations were visited to record the infestation level. Observations regarding insect pest attacking mango crop were initiated from October and lasted up to April during study period. Each climatic factor has different impact of each insect pest. All such observations were noted at each location. Mango tree parts like branches, stem, leaves, fruits and inflorescences were acutely observed to note the observations. Data is represented in tabular form of each pest infestation pattern based on each location and remark is noted corresponding impact of climatic change on pest attack. From year 2014 -2015 to 2016-17 effect of climatic condition on each pest at selected locations were noted. Similarly the geographical factors of the locations influencing the pest incidence were noted during study period.

Table 4.6.1: Comparative zoogeographical distribution of Mango Hopper -
*Idioscopus niveosparsus* (Lethierry), *Idioscopus clypealis* (Lethierry) and *Amritodus atkinsoni* (Lethierry)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>High infestation at all five locations.</td>
<td>Cloudy atmosphere and scanty rainfall in October, November and December 2014 have accelerated the hopper population.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>High infestation at all five locations.</td>
<td>Scanty Rainfall in October and November 2015 coupled by rise in temperature had favoured hopper population.</td>
</tr>
</tbody>
</table>

Table 4.6.2: Comparative Zoogeographical distribution of
Fruit fly- *Bactrocera dorsalis* (Hendal)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Infestation of Fruit fly was highest in Devgad and low in remaining site.</td>
<td>Rainfall in March and April 2015 favored fruit fly infestation. Consequent rise in temperature and humidity after the odd season rains accelerated the fruit fly attack.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Fruit fly population was comparatively low in this year. There was trace rainfall in May in Devgad, while low in remaining locations.</td>
<td>Less rainfall in May was not much favourable for fruit fly population. Also the humidity was low in this season.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Fruit fly attack was low in all locations due to no rainfall after October 2016 till June 2017.</td>
<td>No rainfall after October 2016 resulted in less humidity. Hence the fruit fly attack was low.</td>
</tr>
</tbody>
</table>

Table 4.6.3: Comparative zoogeographical distribution of
## Thrips *Scirtothrips dorsalis* (Hood)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Thrips population was high at each location.</td>
<td>Increase in temperature and subsequent rise in humidity accelerated thrips population</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Thrips population was high at each location.</td>
<td>Increase in temperature and subsequent rise in humidity accelerated thrips population</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Thrips population was high at each location.</td>
<td>Increase in temperature and subsequent rise in humidity accelerated thrips population</td>
</tr>
</tbody>
</table>

### Table 4.6.4: Comparative zoogeographical distribution of Fruit borer – *Noorda albizonalis* (Hampson)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Infestation was low at all locations.</td>
<td>Marble size fruits are susceptible to pest. No effect of unseasonal rainfall.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Attack was medium in Devgad and low at rest of the locations</td>
<td>Marble size fruits are susceptible to the pest. No effect of unseasonal rainfall.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Infestation was low at all location.</td>
<td>Marble size fruits are susceptible to the pest. No effect of unseasonal rainfall.</td>
</tr>
</tbody>
</table>

### Table 4.6.5: Comparative zoogeographical distribution of
### Mango mealy bug *Drosicha mangiferae* (Green)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Infestation was low at all locations.</td>
<td>Scanty rainfall in November and December decreased the mealy bug population.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Low infestation was recorded at all locations</td>
<td>Little rainfall in October and November decreased the mealy bug population.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Medium infestation in Devgad and low in rest of the locations</td>
<td>No rainfall after October 2016. Thus infestation was found to be comparatively high.</td>
</tr>
</tbody>
</table>

### Table 4.6.6: Comparative zoogeographical distribution of Stone weevil *Sternochetus mangiferae* (Fabricius)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Infestation was low at all locations.</td>
<td>No any ecological correlation with the odd season rainfalls, consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Infestation was low at all locations.</td>
<td>No any ecological correlation with the odd season rainfalls, consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Infestation was low at all locations.</td>
<td>No any ecological correlation with the odd season rainfalls, consequent rise in temperature and humidity.</td>
</tr>
</tbody>
</table>

### Table 4.6.7: Comparative Zoogeographical distribution of
**Shoot borer – *Clumetia transversa* (Walker)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Incidence was medium in Wada and comparatively lower in Devgad, Kunakeshwar, Talebazar and Waghotan</td>
<td>Scanty rainfall in November and December 2014 increased shoot borer population</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Attack was high in Wada but comparative low in Kunakeshwar, Talebazar, Waghotan and Devgad.</td>
<td>Scanty Rainfall in October and November 2015 accelerated pest population.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Incidence was high in Wada and comparatively lower in Devgad, Waghotan, Talebazar and Kunakeshwar</td>
<td>Even though there was no rainfall after October 2016 season but infestation was notable.</td>
</tr>
</tbody>
</table>

**Table No 4.6.8: Comparative zoogeographical distribution of Stem borer- *Batocera rufomaculata* (de Geer)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Medium infestation in Wada, Talebazar, Devgad, Waghotan and low in Kunakeshwar</td>
<td>Farmers failed to observe trees acutely and to adopt orchard management practices. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>High infestation in Wada and Waghotan while medium in Devgad and Talebazar. But low in Kunakeshwar</td>
<td>In successive year, infestation was found to be spread on adjacent tress. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>High infestation in Wada, Waghotan and Talebazar and medium in Devgad and Kunakeshwar</td>
<td>Stem borer is emerging as a major pest. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
</tbody>
</table>

**Table 4.6.9: Comparative zoogeographical distribution of**
### Table 4.6.10: Comparative zoogeographical distribution of

**Leaf webber – Orthaga exuvinacea (Hampson)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Low infestation at all locations</td>
<td>Infestation is mostly confined to old and neglected cultivations. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Low infestation at all locations</td>
<td>Infestation is mostly confined to old and neglected cultivations. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Medium infestation in Kunkeshwar and Wada whereas low in Devgad, Talebazar and Waghotan</td>
<td>Infestation is mostly confined to old and neglected cultivations. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
</tbody>
</table>

### Table 4.6.11: Comparative zoogeographical distribution of

**Mango scales – Aspidotus destructor (Newst)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Medium infestation in Waghotan and Talebazar. But low at Kunkeshwar, Wada and Devgad</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Medium attack in Devgad and Wada. However low at Waghotan, Talebazar and Kunkeshwar.</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Medium attack at Kunkeshwar but comparatively low at Devgad, Talebazar, Wada and Waghotan.</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
</tbody>
</table>
Leaf miner - *Acrocercopssyngramma* (Meyrick)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Low attack at all locations</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Low attack at all locations</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Low attack at locations</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
</tbody>
</table>

Table 4.6.12: Comparative zoogeographical distribution of Aphids - *Aphis gossypii* (Glover)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Medium attack at Wada whereas low at Talebazar, Devgad, Waghotan and Kunkeshwar</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Low attack at all locations</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Low attack at all locations</td>
<td>Minor pest and low incidence. No any ecological correlation with the odd season rainfalls and consequent rise in temperature and humidity.</td>
</tr>
</tbody>
</table>
Table 4.6.13: Comparative zoogeographical distribution of

*Ants – Oecophylla smaragdina* (Fabricius)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Low attack at all locations</td>
<td>Infestation was noted in neglected mango cultivations which were deprived of pesticides.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Low attack at all locations</td>
<td>Infestation was noted in neglected mango cultivations which were deprived of pesticides.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Low attack at all locations</td>
<td>Infestation was noted in neglected mango cultivations which were deprived of pesticides.</td>
</tr>
</tbody>
</table>

Table 4.6.14: Comparative Zoogeographical distribution of

*Termites – Odontotermes obesus* (Rambur)

<table>
<thead>
<tr>
<th>Year</th>
<th>Year wise analysis/location</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>Low attack at locations</td>
<td>Infestation was confined to sandy and unirrigated soil with poor drainage.</td>
</tr>
<tr>
<td>2015-2016</td>
<td>Low attack at locations</td>
<td>Infestation was confined to sandy and unirrigated soil with poor drainage.</td>
</tr>
<tr>
<td>2016-2017</td>
<td>Low attack at locations</td>
<td>Infestation was confined to sandy and unirrigated soil with poor drainage.</td>
</tr>
</tbody>
</table>
4.7 Diseases on mango crop:

Although insect pests are principally responsible for low yield, mango crop is also attacked by various diseases throughout the year. Infection of diseases is also responsible for considerable yield loss and low productivity. Disease attacks fruits, braches and inflorescence of mango tree and damage them. Diseases are also one of the important constrain in mango production. Causal organism and nature of damage of each disease is different. Also the infection period of each disease varies. However, disease infection is on large scale that damages mango crop and affect fruit production. There are various disease that infest mango crop, some important disease are discussed below

1. Diseases on stem/ branches:

1. Name of Diseases: Pink diseases

Causal agent: *Botryobasidium salmonicolor*

Infected parts: Branches

Period of Infection: During or just after rainy season.

Symptoms:

The fungus grows on the branches and twigs. The pink coloured encrustations with irregular cracks are formed on the shoots and ultimately kill the branches. Generally the thin branches are affected and ultimately die. This disease is very common in southern states of India. Pinkish powdery coating develops on the twigs and branches. Affected branches wilt and gradually dry.

Control measures:

1. Cut and remove the infested branches to minimize inoculum of *Botryobasidium salmonicolor*.
2. Eliminate the entire infected end. Cut end should be protected with Bordeaux paste.
3. Two or three sprays of Copper-oxychloride (0.25%) or Bordeaux mixture (1%) should be taken after rainy season on infected branches.
4. Once before rainfall and 2-3 sprays at 10-15 days interval.

2. Name of Diseases: Branch drying

Causal agent: *Botryodiplodia theobromae / Rhizoctonia solani*

Infected parts: Twig and branches

Period of Infection: During and after rainy season

Symptoms:
Young plantations are severely infested by this disease. Discoloration and rotting of the bark and gum oozing from the stem bark are the typical symptoms of diseases infestation. Finally the infected branches completely dry along with leaves but there is no leaf drop.

**Control measures:**

Infestation of this disease can be controlled by practicing preventive and curative measures.

**i. Preventive measures:**

Spray of Copper-oxychloride (0.25%) or Bordeaux mixture (1%) or Mancozeb (0.3%) should be taken during after rainy season.

**ii. Curative measures:**

a. Infested branches should be removed and applied with Bordeaux (10%) or Copper-oxychloride (0.25%) or Mancozeb (0.3%).

b. Cut and remove the infested branches to minimize incidence of *Botryodiplodia theobromae*.

c. One spray before rainfall and 2-3 sprays at 10-15 days interval.

**3. Name of Diseases: Shoot blight**

**Causal agent:** *Colletotrichum gloeosporioides*

**Infected parts:** Young shoots of plants

**Period of Infection:** During rainy season

**Symptoms:**

Infection starts from the tender foliage and gradually infested tender shoots start dying from top and progresses downwards.

**Control measures:**

Spray of Carbendazim (0.1%) or Thiophanate methyl (0.1%) or Propinneb (0.2%) with systematic insecticides such as Monocrotops (12ml/ 10lit.) or Diamethoate (10ml/ 10lit.) on young vegetative flush during rainy season.

**4. Name of Diseases: Black banded**

**Causal agent:** *Rhinocladium corticolum*

**Infected parts:** Old branches, stem, twigs

**Period of Infection:** Throughout the year

**Symptoms:**
Disease is noticed on twigs and branches of mango tree. A black velvety fungal growth covering major part of the bark gives appearance of black band on the branches.

**Control measures:**

Thinning of overcrowded branches and spraying with Bordeaux mixture (1%) or Copperoxychloride (0.3%) after rainy season on the infested branches.

5. **Name of Diseases: Phanerogamic Parasites**

**Causal agent:** *Dendrophthoe falcata*

**Infected parts:** Stem and twigs

**Period of Infection:** Throughout the year

**Symptoms:**

Seeds of the parasite germinate and produce haustoria’s in the bark. Infected host tissues sometimes swell to form tumors. Under severe infestation parasite may damage complete tree.

**Control measures:**

1. Parasites on mango tree should be removed at its early stage of infection.
2. Loranthus on big tree must be removed completely and Glyphosate (1%) should be sprayed on infested parts.
3. Application of cashew nut shell oil directly on haustoria’s can be effective in controlling attack.

6. **Name of Diseases: Gummosis**

**Causal agent:** Physiological / Nutritional

**Infected parts:** Main stem

**Period of Infection:** After rainy season

**Symptoms:**

Profuse gum oozes out of the main stem infested by this disease. Mostly young plantations are susceptible to this disease.

**Control measures:**

Application of 2 kg Dolomite pre tree along with chemical fertilizers is necessary.

2. **Diseases of vegetative flush**

1. **Name of Diseases: Red rust**

**Causal agent:** *Cephaleuros mycoidea*

**Infected parts:** Older leaves

**Period of Infection:** After rainy season

**Symptoms:**
The diseases can be recognized by the rusty red spots mainly on the leaves and sometimes on petioles and it is epiphytic in nature. Initially the spots are greenish grey in colour and velvety in texture. Later, they turn reddish brown. The circular and slightly elevated spots sometimes coalesce to form larger and irregular spots.

**Control measures:**

Two to three spay of Bordeaux mixture (1%) or copper oxychloride (0.25%) after rainy season that is November to December.

2. **Name of Diseases: Anthracnose**  
   **Causal agent:** *Colletotrichum gloeosporioides* and *Phoma* sp.  
   **Infected parts:** Tender foliage  
   **Period of Infection:** During rainy and winter season.  
   **Symptoms:**  
   Numerous oval or irregular brown or deep brown spots of variable size are notices on the infected leaves. Under sever infestation all the leaves on twig dry nad drop. This disease mainly attack tender plant parts like inflorescence, shoots, fruits and shoots. Incidence of the disease can be recorded by appearance of black necrotic areas on shoots, leaves and fruits. The affected shoots show die back symptoms and developing fruits drop down. Occurrence of diseases on mango tree can be noticed by necrotic patches on leaves that are dark brown in colour. Similarly black patches develop on fruits and twigs. Mango cultivations from all regions are infested by this disease.

   **Control measures:**
   1. Young leaves infested with insects like hopper, gall midge and thrips gives ready opening for the fungus resulting in heavy incidence of the diseases. Hence spraying of insecticides along with fungicides is most effective.
   2. Spray of Carbendazim (0.1%) or thiophanate methyl (0.1%) or Propineb (0.2%) mixed with Monocrotophos (1.2 ml/ lit).
   3. Remove affected branches and burn them.
   4. Maintain clean sanitation in mango orchard.

3. **Name of Diseases: Powdery Mildew**  
   **Causal agent:** *Oidium mangifera*  
   **Infected parts:** Tender foliage  
   **Period of Infection:** In January to March rarely during season.  
   **Symptoms:**
The grayish white powdery mass appears on the flowers and fruits. The panicles get dried and turn black with failure of the crop. Powdery mildew is responsible for great loss on mango crop. The infestation becomes severe with increase in humidity during flowering phase. During flowering phase infestation becomes sever when temperature drops down at nights. At the beginning stage grayish white colour powder appears on the inflorescences, fruits and buds. In later stage the infested plant parts turn brown. All mango varieties are susceptible to this disease but level of infestation varies with each variety.

**Control measures:**

The disease is very sporadic in Konkan region. If the disease is noticed on mango tree spray of Sulphur (0.2%) or Karathane (0.1%) or Carbendazim (0.1%) or hexaconazole (0.05%) should be taken.

4. **Name of Diseases: Phoma Blight**

**Causal agent:** *Phoma glomerata*

**Infected parts:** Old leaves

**Period of Infection:** Winter and summer season

**Symptoms:**

Only old leaves are attacked by the disease. At early stage scratches on the lamina are yellow to light brown in colour, small and unequal. Completely grown spots are with bark margin possessing necrotic centers. In case of sever infestation shots wither and defoliate.

**Control measures:**

i. Spray of Copper oxychloride (0.3%) should be taken.

ii. Also spray of Benomyl (0.2%) can be taken. If necessary another spray of Miltox (Copper oxychloride + Zineb at 0.3%) should be taken.

3. **Diseases on blossom**

1. **Name of Diseases: Blossom Blight**

**Causal agent:** *Colletotrichum gloeosporioides*

**Infected parts:** Blossom

**Period of Infection:** Winter and summer season

**Symptoms:**

The typical symptoms of the diseases are the production of blackish brown specks on the peduncle and flowers. Small black spots appear on the open flower, which gradually enlarge and coalesce to cause the death of flower either directly by drying up of flowers stalks. Under favourable condition the whole flower stalk is infested it becomes black and fruit setting is affected. The infested flowers and marble size fruits drop down.
Control measures:
i. The disease is mostly observed on early flowering flush of October in Konkan region. Intermittent sprays of Carbendazim (0.1%) or Thiophanate methyl (0.1%) or Hexaconazole (0.05%) control the disease effectively.

ii. Take spray on blossoms at interval of 15 days.

2. Name of Diseases: Powdery mildew

Causal agent: Colletotrichum gloeosporiodes

Infected parts: Blossom

Period of Infection: Winter and summer season

Symptoms:

The characteristic symptoms are the white superficial, powdery appearance of the fungal growth on stalk of the inflorescence and young fruits. The mildew attacks mango flowers and young fruits which results into dropping of flowers and fruits. Cracks are developed on the infected fruits and ultimately fruits drop from the tree. Cracks are also noticed on the infested stem and corky tissues are formed.

Control measures:
i. Early flowering flush of October escapes from the powdery mildew infection. But diseases attack second and subsequent flushes. Hence spraying should be started immediately after initiation of second flowering flush.

ii. The recommended effective fungicides are Sulphur (0.2%) or Hexaconazole (0.05%) or Carbendazim (0.1%) or Triademefon (0.1) or Tridemorph (0.1%).

iii. Spray fungicides at 15 days interval.

3. Name of Diseases: Black sooty mould

Causal agent: Capnodium mangifera

Infected parts: Blossom

Period of Infection: Winter and summer season

Symptoms:

The disease is common in the orchards where honey dew secreting insects such as mealy bug, scale insect and hopper are not controlled efficiently. The disease is recognized by the presence of a black velvety growth of sooty mould on the panicle, leaves and young shoots where the honey dew is present. In severe cases tree gives blackish appearance. Fruit setting is also affected.
Control measures:

i. Population of honey dew secreting insects such as mealy bug, scale insect and hopper should be controlled.

ii. Spray of Quinolphos (20ml) or Carbaryl (20gm) or Imidachloprid (3ml) or Dimethoate (10ml) or Cypermethrine (3ml) in 10 lit of water.

4. Diseases on fruits

I. Before harvest

1. Name of Diseases: Anthracnose

Causal agent: *Colletotrichum gloeosporioides*

Infected parts: Tender and mature fruits

Period of Infection: During cropping season

Symptoms:

Numerous oval or irregular brown to deep brown spots of variable size appear on the tender and mature fruits. Pea size to mature fruits, are affected by the diseases. Infested fruits turn black. Heavy fruit drop occur during severe infestation.

Control measures:

Spray of Carbendazim (0.1%) or thiophanate methyl (0.1%) or Hexaconazole (0.05%) as per weather condition.

2. Name of Diseases: Black sooty mould

Causal agent: *Capnodium mangifera*

Infected parts: Fruits

Period of Infection: During the cropping season.

Symptoms:

The disease is common in the mango orchards where honey dew secreting insects such as mealy bug, scale insect and hopper are not controlled efficiently. The disease is recognized by the presence of a black velvety growth of sooty mould. In case of severe infestation top half of fruits become black. However mango pulp remains unaffected.

Control measures:

1. Population of honey dew secreting insects such as mealy bug, scale insect and hopper should be controlled.

2. Spray of Quinolphos (20ml) or Carbaryl (20gm) or Imidachloprid (3ml) or Dimethoate (10ml) or Cypermethrine (3ml) in 10 lit of water.

3. Wash the infested fruits by dipping for two minutes in Bleaching solution.

II. After Harvest
1. **Name of Diseases: Stem end rot**

**Causal agent:** Diplodia natalensis / Rhizoctonia solani

**Infected parts:** Ripen fruits

**Period of Infection:** Ripening and storage

**Symptoms:**

In the initial stage, the epicarp darkens around the base of the pedicel with irregular margin. The infected fruits turn watery and air bubble oozes out from the stalk end. Later the affected area is enlarged to form brownish patch which extended rapidly and turned the whole fruit brownish within 2 to 3 days. Frequently, the epicarp shows cracks from which a light tan or brown watery fluid oozes out from the damaged area. Fruits as well as plant shoots are affected by this disease. Wounds on the plants acts as the entry routes for the parasites. But this disease is not prevalent on mango crop.

**Control measures:**

i. Preharvest spray of Carbendazim (0.1%) fifteen days before harvest.

ii. Harvest the fruits with intact stalk.

iii. Dip the fruits in Carbendazim (0.1%) solution for ten minutes, dry the fruits and keep for ripening in well ventilated paddy straw.

2. **Name of Diseases: Anthracnose**

**Causal agent:** Colletotrichum gloeosporioides

**Infected parts:** Fruits

**Period of Infection:** Ripening and storage

**Symptoms:**

The sunken, roundish, black spots are produced on the epicarp mostly on or around the shoulder area of the fruits, it progress towards the stalk and downwards with ripening. The infection at the stalk end also shows typical stem end rot symptoms. The infestation spreads fast with deep black coloured depress skin. The infected fruits became black, soft and rot without any exudation. The pink masses of conidia are always seen on the infected fruits.

**Control measures:**

i. Preharvest spray of Carbendazim (0.1%) fifteen days before harvest.

ii. Harvest the fruits with intact stalk.

iii. Dip the fruits in Carbendazim (0.1%) solution for ten minutes, dry the fruits and keep for ripening in well ventilated paddy straw.

3. **Name of Diseases: Black rot**

**Causal agent:** Aspergillus niger
**Infected parts:** Ripen fruits

**Period of Infection:** Ripening and Storage

**Symptoms:**

The infection starts mostly from the stalk end. Initially there is depression around the stalk. The colour of the infected mesocarp has whitish mycelial growth which further developed in to black necrotic area and show copious growth of black mould. The fruits are rotten at the advanced stage with typical foul odour.

**Control measures:**

i. Preharvest spray of Carbendazim (0.1%) fifteen days before harvest.

ii. Harvest the fruits with intact stalk.

iii. Dip the fruits in Carbendazim (0.1%) solution for ten minutes, dry the fruits and keep for ripening in well ventilated paddy straw.

**Physiological disorders in mango:**

1. **Malformation:**

   Malformation in mango is caused mainly due attack of fungi and virus. It affects normal growth and development of leaves and inflorescences. It also arrests fruit setting. However it is not caused due to deficiency of essential elements. Shot initiation and development is affected adversely. Shoots possess small internodes and few weak leaves. Shoots of old mango tree are malformed and damages. In case of young plants, growth of plant remains stunted. It leads to imbalance in growth promoting hormones like auxin and growth retarding hormones like gibberellin. Flower initiation is more than the normal plant. But plant produces more male flowers and less perfect flowers. Fruit setting is arrested by malformation.

2. **Spongy tissue:**

   Spongy issue is a non-consumable sour part adjacent to seed that is faint yellow in colour and resembles sponge. Spongy may be present in some part mango or even complete fruit. Consumers often get cheated due to spongy tissues as it cannot be detected by the outer appearance of fruit. Fruit with spongy tissue appears normal and healthy. It can be only noticed after cutting ripe fruits. Alphonso mango variety is most susceptible to this disorder and nearly 20-40% fruit are affected by spongy tissue. This disorder alters fruit flavor and make it unsuitable for consumption. Spongy tissue is faint yellow and porous that can be easily noticed after cutting.
3. **Black tip:**

   It is mainly caused due to adverse effect on air pollutants like carbon dioxide, sulphur dioxide and ethylene. This disorder is mainly prevalent in polluted area where especially coal and bricks production is common. Fruits are adversely affected by this disorder. Initially yellow spots develop on fruits, later they turn brown and ultimately become black. Fruits become soft and start ripening at premature stage. Affected fruits fail to attain maturity.

4. **Scorching of leaves:**

   This disorder principally affects old leaves of mango tree. Red colour develops at the tip and margin of leaves. Thus finally damage the leaf tissues. However young leaves are not affected by this disorder. Symptoms are similar to that of potassium deficiency in plant. In winter season all leaves are affected.