

Studies on insect pests of apple in Kashmir and its integrated management approaches

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Abstract

The present study was conducted during the year 2019-2020, in various apple orchards belonging to the southern region of the state of Jammu and Kashmir. A total of ten insect pests of apple with different orders were recorded i.e., San jose scale, Woolly apple aphid, Apple stem borer, green apple aphid, Apple blossom thrips, Gypsy moth, Bark beetle, Tent caterpillar, Codling moth, Apple root borer. Among these pests, San jose scale damages all parts of the plant like leaves, flowers, stem, branches, roots, and fruits, while Woolly apple aphid and Apple stem borer cause serious damage to the apple nurseries.

Keywords: apple orchards, loamy soil, insect pests, jammu and kashmir

Introduction

Apple is grown worldwide, particularly in temperate regions because it requires a temperate climate, loamy soil that is rich in organic matter, proper drainage and aeration facilities. Worldwide the Kashmiri apples are famous for its unique look, taste, flavor, size and color. It is cultivated throughout the Kashmir and accounts for about 49 percent of total area of 1.63 lac hectares under all temperate fruits grown in this state. The annual apple production in the state is 18.82 lac metric tons (Anonymous, 2020; Islam & Modi, 2021) ^[2, 6]. Districts like Anantnag, Budgam, Baramullah, Doda, Kulgam, Kupwara, Pulwama, Srinagar and Shopian are the major producers of apples.

Apple crops have been damaged by a large number of insects and some of them are very serious pests and need awareness to control them. In addition to insect other arthropods, such as European red mite, stained spider mites damage the leaves by piercing the cell walls and dissolve their contents, including chlorophyll. Injury results in encountering colorful plants, which in severe cases, turn bronze (Agnello, 2008) ^[3].

The aim of present study was to investigate the important insect pest infesting the apple crops. A total of ten insect pests were recorded from different apple orchards. These pests were San jose scale, Woolly apple aphid, Apple stem borer, green apple

aphid, Apple blossom thrips, Gypsy moth, Bark beetle, Tent caterpillar, Codling moth and Apple root borer.

Material and Methods

The present studies on apple pests were carried out in Kashmir valley of Jammu & Kashmir state, during the year 2019-2020. The surveys were conducted in different locations of districts Baramulla, Bandipora, Budgam and Kupwada of Kashmir to detect different types of insect pests that spread to orchards at different stages i.e., pre to post bloom. These pests were active from the month of March till October. Study samples of insect pests were collected by hand picking and sweeping methods.

Result and Discussion

The Apple production and quality are poor as compared to developed countries due to several factors, including pest and crop diseases. Although a large number of pests attack apple crops in Kashmir, some of them are very excessive and need awareness to their control. Apple trees are attacked by number of pests at almost all the phonological stages of growth, which collectively effect its population qualitatively and quantitatively. The major pests of apple crop in Jammu and Kashmir are listed below:

Table 1: Different insect pest of Apple in Kashmir Valley

S. No.	Common Name	Scientific Name	Order	Family	Status of Pest
1	San jose scale	<i>Quadraspidiotus perniciosus</i> (Comstock)	Hemiptera	Diaspididae	Key pest
2	Woolly apple aphid	<i>Eriosoma lanigerum</i> (Hausmann)	Hemiptera	Aphididae	Major pest
3	Apple stem borer	<i>Apriona cinerea</i> (Cheverlot)	Coleoptera	Cerambycidae	Major pest
4	Green apple aphid	<i>Aphis pomi</i> De Geer	Hemiptera	Aphididae	Minor pest
5	Apple blossom thrips	<i>Thrip carthami</i> Shumsher	Thysanoptera	Thripidae	Minor pest
6	Gypsy moth	<i>Lymantria obfuscata</i> Walker	Lepidoptera	Erebidae	Minor pest
7	Bark beetle	<i>Scolytus nitidus</i> (Schedl)	Coleoptera	Scolytidae	Minor pest
8	Tent Caterpillar	<i>Malacosoma indicum</i> (Walker)	Lepidoptera	Lasiocampidae	Major pest
9	Codling moth	<i>Cydia pomonella</i> (Linnaeus)	Lepidoptera	Tortricidae	Major pest
10	Apple Root Borer	<i>Dorystenes hugelii</i> (Redtenbacher)	Coleoptera	Cerambycidae	Minor pest

a) San jose scale (*Quadraspidiotus perniciosus* (Comstock))
(Figures 1, 2, 3)

Diagnostic Features

San Jose scale females are yellow, wingless and legless, have a soft, globular shape and are approximately 1/12 inch long. Male scales are 1/25 inch long, are yellowish-tan with a dark band across the back and have wings and long antennae. Immature San Jose scales (called nymphs) go through three stages (crawler, white cap, and black cap). Crawlers are roughly the diameter of the tip of a pin, are yellow, and have six legs and antennae. Crawlers develop into the white cap stage as they become immobile and secrete hard, white, waxy coverings. The black cap stage follows as the waxy coverings turn gray-black. While feeding, they secrete a white waxy material and this stage is known as a white cap stage. The waxy material later changes to black colour and this stage are named as the black hat stage. Later the cover turns different colors from gray to black.

The crawlers disperse to other parts of the plant and start feeding. They moult after about ten days and begin to lose their eyes, legs and antennae. The adult female appears after the next moult and the scale develops, incorporating the larval exuviae. The development of the male involves three moults. The male nymph is more elongate than the female and the adult male is orange colored and has wings. It lives only for a few hours.

Damage

In case of heavy scale infestations are left unchecked, trees may be seriously damaged, resulting in reduced vigor, thin foliage, cracked or dying branches, and the eventual death of the tree. Young trees may be killed before fruiting. Affected fruits form a reddish-purple ring around each place where a scale settles.

Distribution

Kashmir valley and Himachal Pradesh (Hussain *et al.*, 2018) [5].

Management

- Avoid plantation of infested nursery, graft materials, plantation of shade trees around fruit orchards and regular pruning of heavily infested branches during dormant period should be performed.
- Use biological agents like *Encarsia perniciosi* (parasitoids) and *Chilocorous infernalis* (predator) to control the pest.
- Spray diesel oil emulsion + Bordeaux mixture (Diesel oil 68 liters + Copper sulphate 15 kg without lime 3.75 kg), before spraying emulsified it and diluted 5-6 times.
- Spray the trees with any of the insecticides i.e. Dimethoate 30 EC or Quinalphos 25 EC @ 100 ml in 100 liter of water.
- During summer, spray 1.25 liters of Chlorpyrifos 20 EC or 625 ml Malathion 50 EC in 500 liter of water per hectare.

b) Woolly apple aphid (*Eriosoma lanigerum* (Hausmann))
(Figures 4, 5)

Diagnostic features

The adults are small to medium-sized aphids, about, 2mm long. Both nymphs and adults are reddish- brown to purple in colour, which is normally hidden by white, wool-like, waxy materials

which give it common name of woolly apple aphid. They feed on trunks, tender branches, and twigs of apple trees. During the autumn season, winged aphids develop from both the aerial and the root colonies. Male and female are wingless. During unfavorable winter season nymphs migrate downwards towards the root zone for hibernation. It is multi-voltine insect, several generations of woolly aphid occur throughout the year.

Damage

This is a piercing and sucking type pest, both the nymphs and adults suck the sap from trunk, branches, stems, twigs, leaf petioles bark of twigs and on roots. Knots on roots and twigs become swollen due to the feeding by this aphid. In case of severe infestations, it causes yellowish foliage and short fibrous root system.

Distribution

Jammu and Kashmir, Nadu, Utter Pradesh and West Bengal, Punjab, Assam, Karnataka, Meghalaya, Skim and Tamil-Nadu (Hussain *et al.*, 2018) [5].

Management

- Remove the excessive water sprouts and cover all the cracks, crevices and wounds caused by pruning with Chaubatia paste.
- To avoid the aphid attack, use resistant root-stock such as Golden Delicious, Northern Spy and Merton Stock 778, 779, 789 or Malling Merton MM.106, MM.111.
- Use parasitoid *Aphelinus mali* in the orchards to check the aphid population and avoid application of insecticides to prevent their damage from insecticides.
- Spray the trees with 100 ml Chlorpyrifos 20 EC or Dimethoate 30 EC per 100 liters of water.
- In hot months, spray 800 ml Malathion 50 EC in 500 liters of water per hectare.
- Use horticultural oil, in order to significantly increase insecticide efficacy.

c) Apple stem borer (*Apriona cinerea* Cheverlot)
(Figures 6, 7)

Diagnostic features

Adult beetles are large sized, 35-50mm in length and greyish in colour. Female lays egg inside cavity on a shoot. Grubs are dirty white with a reddish-brown head. They get bored inside the trunk. Grubs remain inactive in winter and resume feeding in March and remain active for two years. They feed by boring the woody portion of stems and branches. Pupal stage passes inside a tunnel made in the woody tissue by the infested grubs.

Damage

Damage caused by both grub and adult. Generally, grub makes a gallery and reaches close to stem of tree which results in diminished the strength and productivity of plant. Adult feed on bark and have an unusual habit of cutting more than they consume.

Distribution

Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Hariyana and Punjab (Anonymous, 2014) [1].

Management

- Apply the balanced dose of fertilizers and proper irrigation to upkeep the vigour of plant.
- Collection and destruction of grub and beetle to decrease the insect population.
- In case of heavily infestation branches, twigs and completely dried trees should be uprooted and removed from the orchard.
- Locate the feeding holes, clear the passage and plug it with cotton impregnated with any of the insecticides: Dimethoate 0.03%, Dichlorvos 1%, formalin 4% or phenyl balls, one ball in each hole and seal with mud plaster.
- Spray Chlorpyrifos @ 100 ml/100 liter of water during last week of April at the time of adult emergence of the pest.

d) Green apple aphid (*Aphis pomi* De Geer)

(Figures 8, 9)

Diagnostic features

Adults are 2 mm in length, oval shaped and bright green with black cornicles and legs. Adults may be winged or wingless. Female lays eggs which are 1 mm long, shiny, black and oval shaped. Nymph is about 1.5 mm long yellow-green to dark green and oval shaped, generally found on smooth branches or leaf undersides. Immature green apple aphids are usually found in colonies on young terminals of apple trees and have shorter antennae and less developed cornicles in comparison to immature rosy apple aphids.

Damage

Usually green apple aphid sucks the sap from the leaf and soft stem. In case of heavy infestations vigor and growth of shoots are stunted. Continuous feeding reduces bud size and internodes length, and causes leaf curling. It also stimulates the lateral branch growth and affects tree shape. Aphids produce honeydew on fruit allowing sooty fungi to grow. The fungus blemishes fruit and lowers market value.

Distribution

Assam, Himachal Pradesh and Jammu & Kashmir (Gupta & Tara, 2015) [4].

Management

- Spray the trees with 100 ml Dimethoate 30 EC or 28 ml Imidacloprid 17.8 SL in 100 liters of water during late May or early June.
- Delayed dormant spraying with HMOs @ 2 % provides an adequate control aphid.
- Prefer flonicamid, as it is selective and partially systemic.

e) Apple blossom thrips (*Thrip carthami* Shumsher)

(Figures 10, 11)

Diagnostic features

It is a minute pest. Adults are about, 0.01 inch in length, with two pairs of fringed wings. The flower blossom thrips are smaller in size, generally 1mm to 1.5mm in length. They are pale yellow, black or brown in colour with silver strips. Female lays kidney-shaped eggs on the flowers or leaves. Nymphs are pale yellow, thin and wingless, up to 1 mm in length. They

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begin feeding immediately after hatching. They feed on soft tissues of plant.

Damage

Both nymph and adult feed by rasping the petal, vital flower parts and leaves of apple tree. They damage the fruit before petal fall by puncturing and egg-laying. The egg-laying site bulge out and form yellow patch which is known as Pansy Spot. Pre bloom feeding of thrips weakens the flowers by sucking the sap, resulting in poor fruit set. In case of dense population of thrips, the orchard fruit production is reduced.

Distribution

Himachal Pradesh, Jammu & Kashmir (Hussain *et al.*, 2018) [5].

Management

- Generally, thrips are attracted to weeds blooming on the orchard floor, so open, weedy land adjacent to orchards should be disced to prevent thrips development and migration in orchards.
- In case serious infestation, spray the trees at pink bud stage with 40 ml Thiocloprid 21.7 SC @ 100ML/ 100 liter of water.
- Apply 100gms of Thiamethoxam per 100 liters of water at pink-bud stage.

f) Indian gypsy moth (*Lymantria obfusate* (Walker))

(Figures 12, 13)

Diagnostic features

Adult female has a wingspan of about 2 inches and creamy white. Male has a wingspan of 1-1.5 inch and brownish. Males are greyish brown and can fly; females are larger, whitish with black marks and cannot fly. Female lays eggs in masses which appear as buff-colored hairs on tree trunks. The caterpillars of gypsy moth can be easily identified, because they possess characteristics not found on other leaf-feeding caterpillars. Caterpillars are approximately 1.5 to 2.0 inches long and are dark colored.

Damage

Gypsy moth is considered a serious pest of apple. Caterpillar is voracious feeder which damage the fruits. In case of heavy infestation entire leaf is eaten by pests and sparing only hard vein.

Distribution

Himachal Pradesh, Kashmir, Punjab (Hussain *et al.*, 2018) [5].

Management

- Upkeep the vigour of plants by applying balanced dose of fertilizers and proper irrigation.
- To check the infestation all the egg bands should be collected and destroyed of egg at the time of pruning in December-January.
- Orchard should be kept clean because caterpillars hidden in grasses and grown at the lower level of tree.
- Release egg parasitoid: *Anastatus kashmiriensis* or larval parasitoid: *Cotesia melanoscela*, *Glyptapantelos indiensis* in the orchards.
- Caterpillars hide during the day on main trunk in loose

bark, crevices, therefore to attract the larvae for hiding put gunny burlap (dipped in 1ml Chlorpyrifos 20 EC in 1litre of water) around the tree trunk and finally collect and killed them.

- Mix 500 liters water with 500 ml Dimethoate 30 EC or 2.0 kg Carbaryl 50 WP and spray the trees per hectare.

g) Bark Beetle (*Scolytus nitidus* (Schedl))

(Figures 14, 15)

Diagnostic features

The minute adults are in average 4.6 cm long, slender, one armed longitudinal and often black or brownish coloration. Adults make tunnel into the heartwood of the host plant and create a system of galleries in which eggs are laid. The eggs hatch in 5 to 7 days. The larvae have 5 instars and their development is completed in 38 to 50 days constructing larval galleries up to 5-8 cm in length. Adults live for 45-60 days.

Damage

It is an important pest of apple which causes severe economic loss to trees and reduction in yield and foliage density. Infected branches or sometimes the entire tree may be killed by this insect. In case of severe infestation, it also attracts fungal diseases. This is a polyphagous pest and beside the apple, it causes severe damage to peach and plum.

Distribution

Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh (Hussain *et al.*, 2018) [5].

Management

- Regular pruning and destruction of infested branches or trees during autumn and new orchard should not be planned near infested forest trees.
- Application of balanced dose of fertilizers shall help to reduce the attack of borers.
- Clean the holes and plastered them with mixture of Carbaryl 50 WP and soil in the ratio of 1: 6.
- Spray 100 ml Dimethoate 30 EC in 100 liters of water should be done to check the pest population.

h) Tent Caterpillar (*Malacosoma indicum* (Walker))

(Figures 16, 17)

Diagnostic features

Tent caterpillar is a major pest of an apple in north-western India, especially in the Kashmir valley and Shimla hills. The major pest is found on a number of fruits, apple being its preferred host plant. In addition to apples, almond, apricot, cherry gooseberry, peach, pear, walnut is also occasionally attacked. Caterpillars are hairy with areas of blue, white, black and orange. The blue and white colors are structural colors created by the selective filtering of light by microtubules that arise on the cuticle.

Damage

During day time, caterpillar hides in a nest which is formed by web at the forking of twigs. At night the caterpillars gather on leaf lamina and feed voraciously leaving behind only the

midribs and portions of hard veins. In severe cases, 40-50 % plants of apple in a garden can be defoliated.

Distribution

Jammu & Kashmir and Himachal Pradesh (Malik *et al.*, 1972) [7].

Management

- Destroy all the egg bands to check the breeding of this pest, in December-January.
- The caterpillar can be inactivated by consume the tents with a pole and some rags dipped in kerosene tied on its end. Kerosene water in an open container should be kept under the tree infested with larvae so that the falling of larvae may also get killed.
- Spray 500 ml of Dimethoate 30 EC in 500 liters of water per hectare.

i) Codling moth (*Cydia pomonella* (Linnaeus))

(Figures 18, 19)

Diagnostic features

The adult moth is greyish with light grey and copper stripes on its wings, with a wingspan of 17 mm. Adults are separate with other insects by dark, brown copper bands on the tips of their wings. Forewings are dark grayish with waxy lines with a copper-colored eye like circle toward margin. The females lay eggs on fruit or leaves. The larvae are white to light pink colour with dark brown heads, attack the fruit immediately upon hatching.

Damage

Caterpillars make gallery through the fruits by eating away the pulp, fills these galleries with debris or excrement produced by insects, and making them unsuitable for human consumptions. The new laying larva enters the fruit and feeds the seeds.

Distribution

Jammu & Kashmir (Hussain *et al.*, 2018) [5].

Management

- Remove the loose bark from trunks to eliminate shelter for over wintering caterpillars.
- Band the trees with gunny bag/ corrugated card board, for larval hibernation, attach the rope or bag cloth 3-4 times before landing. Collect the overwintering larvae and kill them.
- All debris, weeds and falling fruit should be removed from the garden to prevent hibernating larvae from seeking refuge.
- Release the parasitoids like *Trichogramma cacoeciae*, *T. embryophagum*, during the 1st and 2nd generation of the pest.
- Spray 100 ml Chlorpyrifos 20 EC or 100 ml Dimethoate 30 EC in 100 liter of water after complete petal fall and repeat it after 2-3 weeks of the first spray.
- Spray the trees with 0.02% Chlorpyrifos 20EC followed by 3-4 cover sprays of 0.02% Methyl oxydemeton 25 EC fruits with an interval of 15 days and two months before gathering of fruits.

j) Apple Root Borer (*Dorysthenes huegelii* (Redtenbacher)

(Figures 20, 21)

Diagnostic features

Body large, robust and reddish brown in color with long serrated antennae. Elytra converged toward apex and longitudinal striate, basally prominent. Legs elongate, femur flattened, serrated tibia serrated, with apical spine. Grubs are pale-white in colour and eruciform. Under 10 larval stages, the larval stage develops in 20-21 months. Adult larvae are approximately 80 mm in length and 12 mm in width have 8–9 instars. Length of full-grown grub is 7.5-10 cm and longevity 3.5 years. Development period 1-2 years. All the stages feed on the root.

Damage

Grubs feeding the roots and shrouding the roots. The main roots

are severely damaged by the base and the trees become weak which fall down with strong winds. Tree becomes shaky and may die.

Distribution

Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Punjab and Tamil-Nadu (Hussain *et al.*, 2018) ^[5].

Management

- Avoid dry sandy soils, use well-rotted farm yard manure and adopt inter culturing method for apple orchards.
- Remove the adjacent wild hosts and burn trees that are severely weakened or killed by borer infestations.
- To stop the female egg laying, trunk area should be painted with undiluted external white latex paint and repeat it annually.
- In case of infestation, treat the tree basins with Phorate granules, 100 grams per tree.

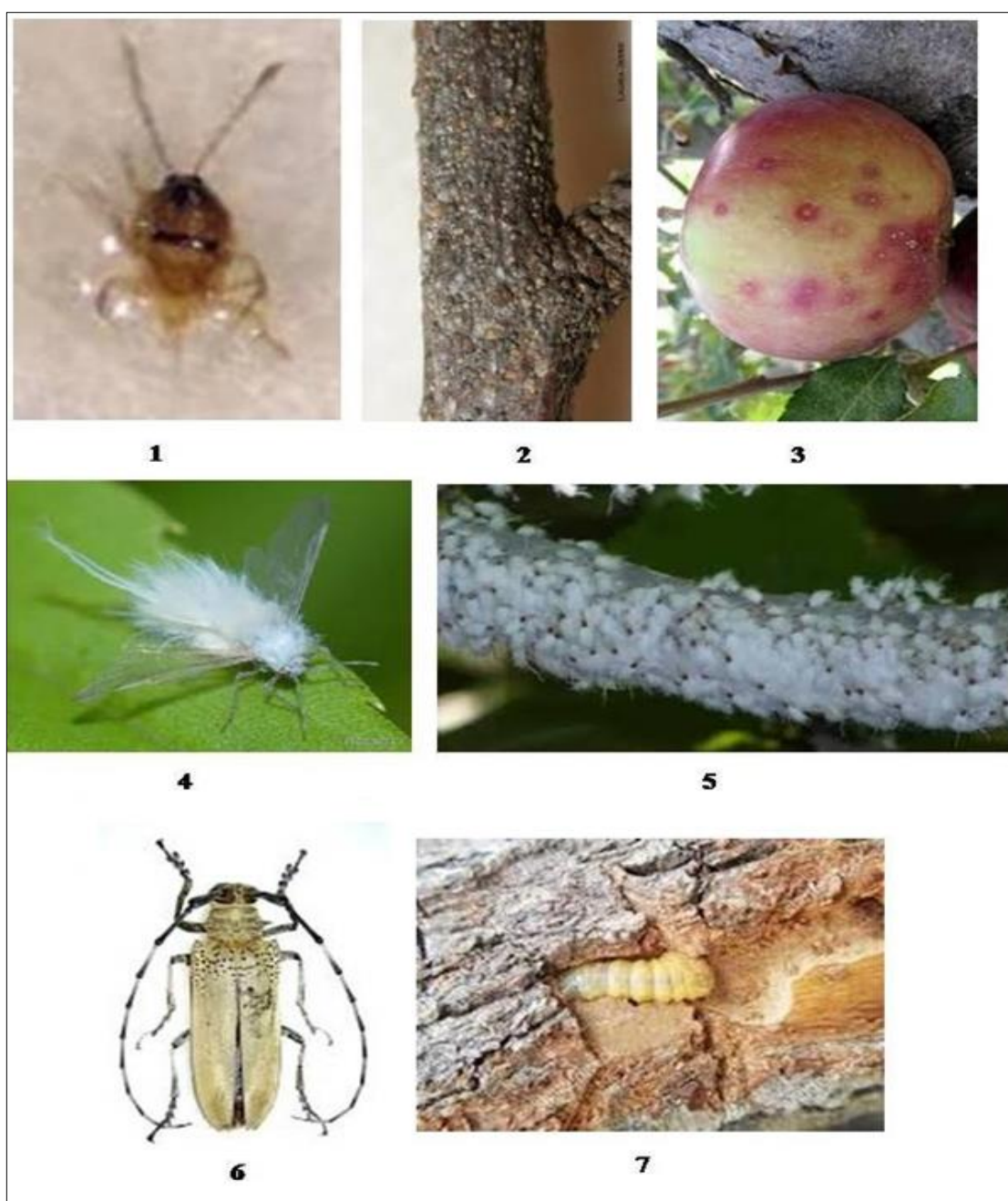


Fig 1: 1. Adult San Jose scale (SJS), 2. SJS infestation on apple twig, 3. SJS infestation on Apple fruit, 4. Adult Woolly apple aphid (WAA), 5. WAA infestation on apple twig, 6. Adult Apple stem borer, 7. Adult Apple stem borer larva

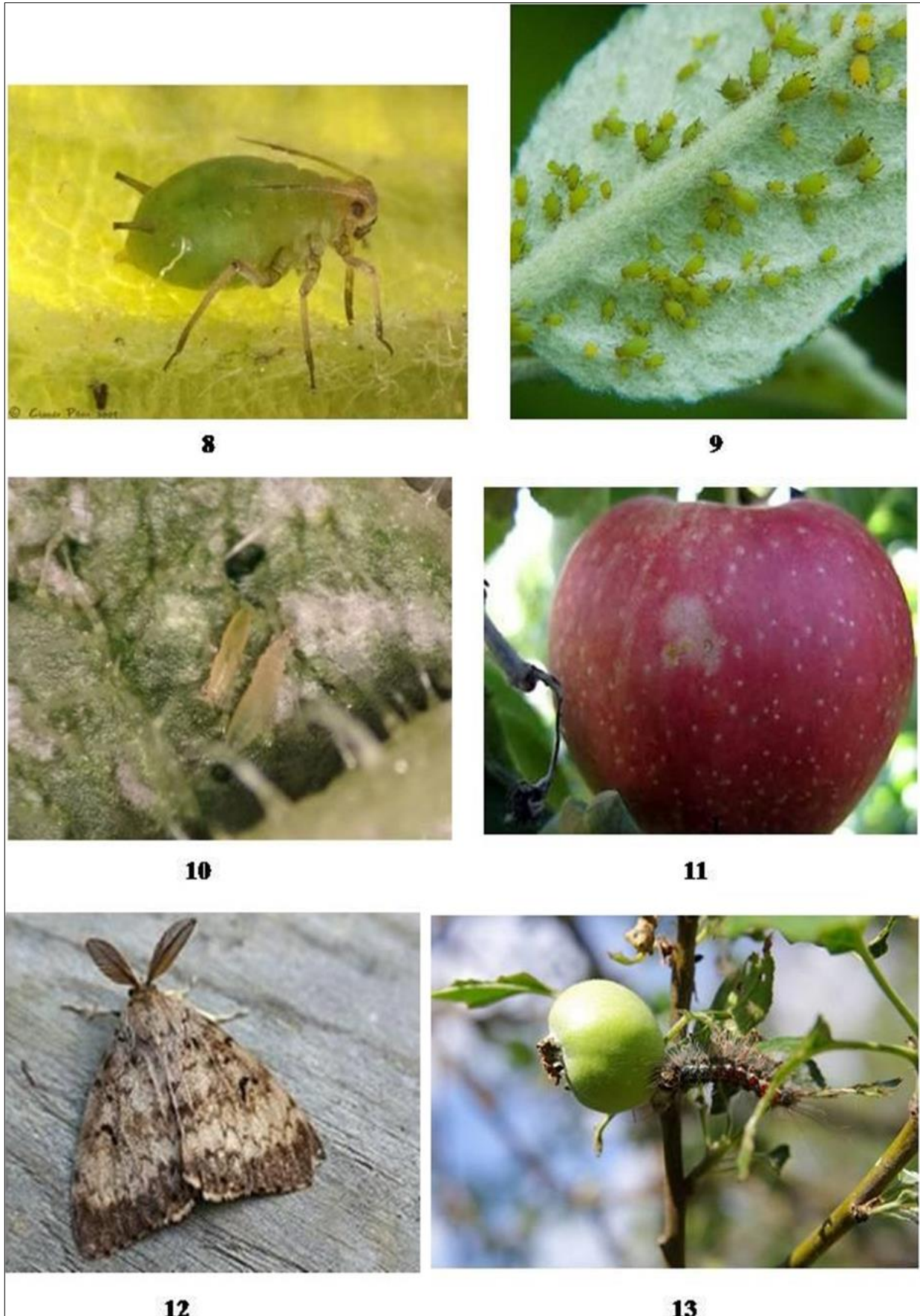


Fig 2: 8. Adult Green apple aphid (GAA), 9. GAA infestation on apple leaf, 10. Apple blossom thrips (ABT), 11. ABT infestation on apple fruit, 12. Adult Gypsy moth, 13. Gypsy moth larva on apple fruit

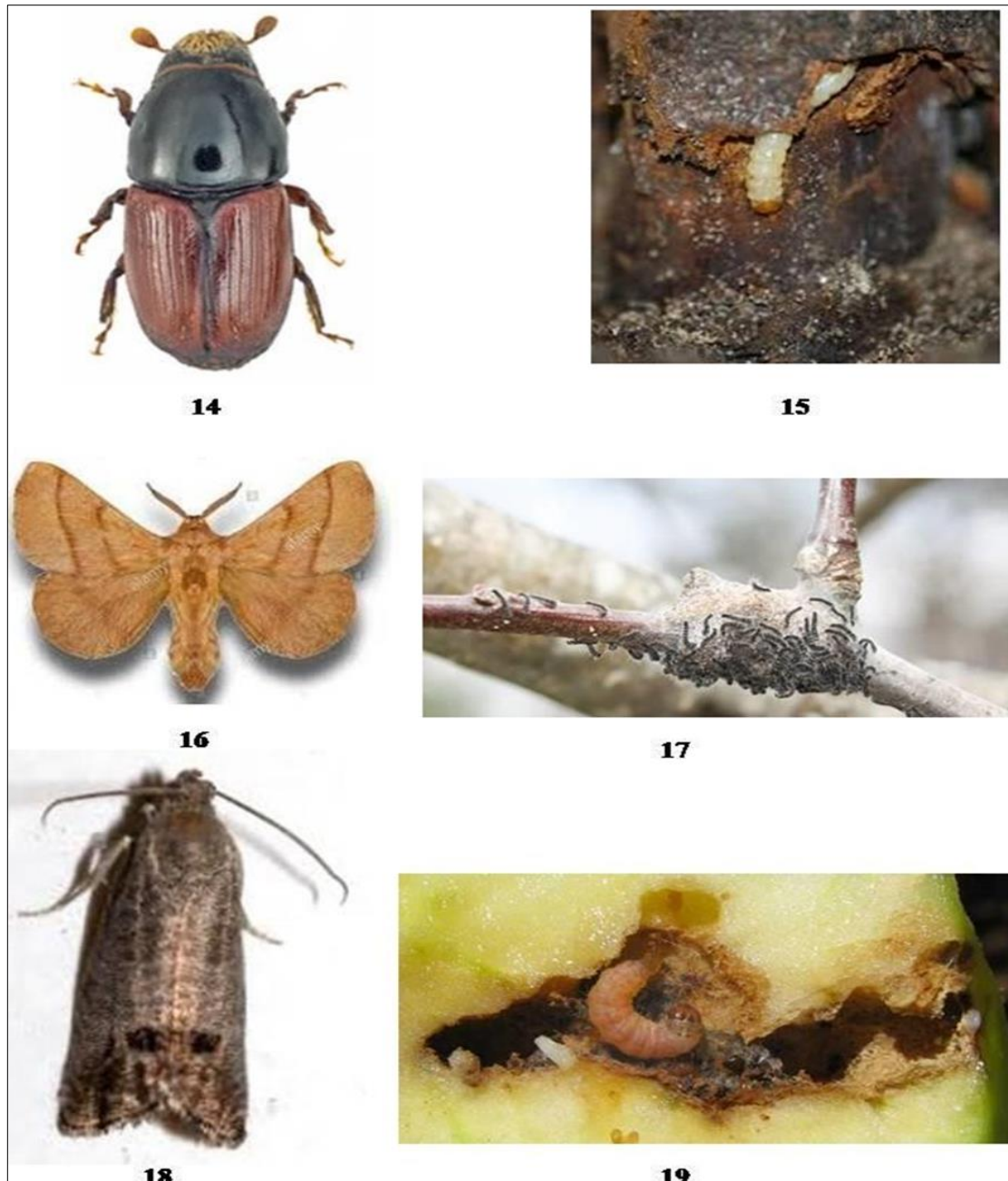


Fig 3: 14. Adult Bark beetle, 15. Bark beetle larva, 16. Adult tent caterpillar (ATC), 17. ATC infestation on apple twig, 18. Adult Codling moth, 19. Codling moth larva on apple fruit



Fig 4: 20. Adult apple root borer, 21. Apple root borer larva

Conclusion

Apple is the principal fruit crop of Jammu and Kashmir cultivated throughout the Kashmir region. These apples are damaged by a large number of insects and some of them are very serious pests. A total of ten insect pests of apple with different orders were recorded i.e., San jose scale, Woolly apple aphid, Apple stem borer, green apple aphid, Apple blossom thrips, Gypsy moth, Bark beetle, Tent caterpillar, Codling moth, Apple root borer. These pests belong to four insect orders viz. Hemiptera, Lepidoptera, Coleoptera and Thysanoptera. Among these pests, San jose scale were key pests belong to order Hemiptera, the pest damage to all of the plant like leaves, flowers, stem, branches, roots, and fruits were damaged by foliage feeders while sucking insect pests sucked the plant sap. Woolly apple aphid and Apple stem borer caused serious damage to the apple nurseries. Woolly apple aphid, Apple stem borer, Tent caterpillar, Codling moth are major pest of apple. Green apple aphid, Apple blossom thrips, Gypsy moth, Bark beetle, Apple root borer are minor pest of apple. Further investigations are needed in this regard so that apple growers and nursery growers would be able to produce a quality material to the market.

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