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Report on Hemipteran pest diversity on apple plantations (*Malus domestica* Borkh.) in Jammu and Kashmir State of India

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Abstract

Twelve species belonging to different families of Hemiptera viz. Aphididae (*Eriosoma lanigerum* Hausmann, *Aphis pomi* De Geer), Reduvidae (*Reduvius delicatula* Distant), Dictyopharidae (*Putala rostrata* Melichar), Diaspididae (*Quadraspidiotus perniciosus* Comstock), Pentatomidae (*Nezara viridula* (Linnaeus), *Halyomorpha halys* Stal, *Halys dentatus* Fabricius, Scutelleridae (*Chrysocoris purpureus* Westwood), Fulgoridae (*Borysthers sp.)*, Jassidae (*Empoasca sp.*) and Membracidae (*Oxyrachis rufescens* Walker) have been reported infesting apple plantations from different apple growing districts viz. Bhaderwah, Batote, Kishtwar, Udhampur, Poonch and Rajouri districts of Jammu province of Jammu Province. Their distribution, host plants, diagnostic features and damage caused by these pests to apple plantations are also discussed in the present paper.

Keywords: Apple Plantation, Diversity, Hemiptera, *Malus domestica,* Pest

Introduction

Apples are grown over several years in the same habitat which serves as a permanent abode for the multiplication of various pests. About a thousand insect pests have been recorded from temperate fruit plants all over the world (Chadha & Awasthi, 2005). Of them, 600 pests are found on apples alone. Hemiptera included *Eriosoma lanigerum* Hausmann (most serious pest), *Aphis pomi* De Geer and *Quadraspidiotus perniciosus* Comstock, as abundant amongst all whereas others including *Reduvius delicatula* Distant, *Putala rostrata* Melichar, *Nezara viridula* (Linnaeus), *Halyomorpha halys* Stal, *Halys dentatus* Fabricius, *Empoasca sp. Borysthers sp, Oxyrachis rufescens* Walker *and Borysthers sp.* are less abundant.. Amongst the recorded Hemipterans, three new records are made by the investigator in Jammu province viz. *Reduvius delicatula, Putala rostrata* Melichar *and Borysthers* belonging to families Reduvidae, Dictyopharidae and Fulgoridae respectively. There are chances that a minor pest of today may become major tomorrow, it is therefore necessary to study them as well.

Material and Methods

Regular visits were made to stations viz. Bhaderwah, Batote, Kishtwar, Udhampur, Poonch and Rajouri districts of Jammu province during the study period to record the distribution, extent of damage, biological and ecological observations regarding the insect pests associated with apple plantations.

The specimens were collected by the net sweeping method on the apple plantation from various localities of the Jammu Province. After collection each specimens were placed in the Insect collection bottles. Some samples are collected directly from the seed and others part of the plants. They are pinned and labled and stored in well fumigated insect cabinet of the Laboratory. All photographs have been taken with Sony cyber shot T 70 digital camera with macro function. The photographs

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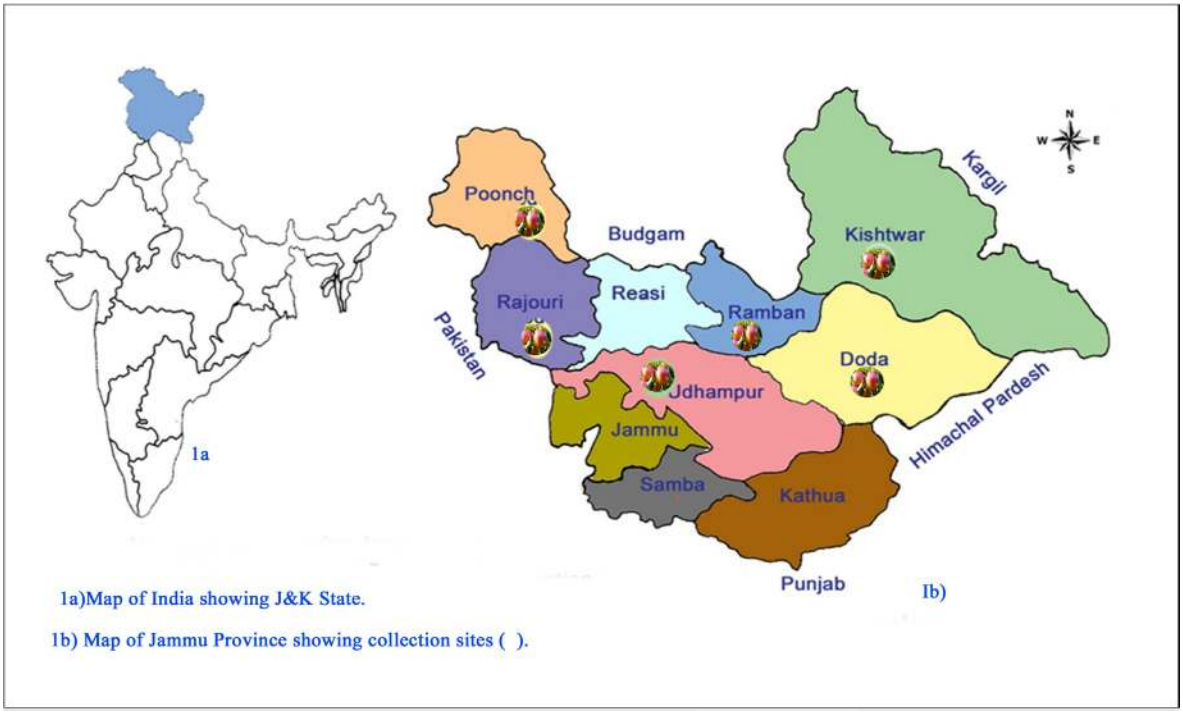
were later scanned using HP Scan jet 4400 while making plates.

Map of Jammu and Kashmir showing collection sites



1a)Map of India showing J&K State.

1b) Map of Jammu Province showing collection sites ( ).

Observations

Eriosoma lanigerum Hausmann (Plate-1, Figure. a)

Taxonomic status: Hemiptera: Sternorrhyncha: Aphidoidea: Aphididae

Distribution: They are commonly known as woolly apple aphid and one of the most destructive ones of *Malus* plantations throughout the world. This pest is a native of America (Baker, 1915). It has been reported from .Arunachal Pradesh, Assam, Darjeeling, Jammu and Kashmir, Meghalaya, Nagaland, Sikkim, Tamil Nadu (Conoor) and Uttar Pradesh (Gupta *et al*., 2015).

Present Locality: Eriosoma lanigerum was recorded as a main pest throughout the studied districts viz. Doda, Ramban, Poonch, Rajouri, Udhampur and Kishtwar of Jammu Province

Host plants: Eriosoma lanigerum Hausmann completes its life cycle on two host plants in certain areas of the world like Europe, Canada, Japan and China. In these places this aphid reproduces by parthenogenesis on *Ulmus campestris* (Elm tree) where the elm tree acts as its primary host and on *Malus* sp., Prunus and some other trees that act as its secondary hosts (Gautam & Verma, 1983; Adlakha & Hameed, 1972 and Bhardwaj & Bhardwaj, 2005). Due to absence of elm trees in India, these aphids have adapted to pass their entire life only on its secondary host plant i.e. *Malus* sp. (Gupta, 2007). The common host plants for wolly apple aphid includes Apple, Almond , Cotoneaster, Crab apple, Crataegus, Hawthorn , Mountain ash, Pear, Peach, Pyracantha and Quince (Gupta *et al*., 2015; Gupta *et al*., 2015a, b).

Diagnostic features: Woolly apple aphids are polymorphic i.e., there are three different morphs of aphids. They are virginoparae, sexuparae and sexuals. Adult aphids of virginoparae morph are brownish or purple, 1.5 to 3.0 mm long, found in patches of variable dimensions covered by woolly secretions of fine filaments through their skin. This cottony cover makes them identifiable from shorter distances. Talus 2-segmented bearing two claws, feelers filiform bearing 6-segments, well

developed mouthparts, 2 pairs of membranous wings, Median vein in front wing branched, thoracic tubercles 4 to 6, well defined. Sexuparae morphs are wingless, arostrate and undergo 4 moults before becoming mature sexually; pair of claspers and aedegus present in male. Sexual forms wingless, mouthparts attenuated, wax glands exuberant, antennae 5-segmented. They do not feed during their whole life span and survive only on reserve fats.

Damage: It has been recorded as one of the most dangerous pest of *Malus* sp. Pest remains active throughout the year and infestation mainly starts from the roots and straggle towards the trunk and other parts of the plant. Pest causes severe damage to plant by imbibing cell sap from soft parts of the plant that results in the creation of nodule like structures or galls on the infested parts of the plants. Establishment of galls upset the physiological processes of the plant (Rahman & Khan, 1941; Lal & Singh, 1947; Thakur, 1970; Nair, 1970; Adlakha & Hameed, 1972; Butani, 1979; Sachan & Gangwar, 1980; Gautam & Verma, 1983; Atwal & Dhaliwal, 1999 and Bhardwaj & Bhardwaj, 2005). As a result of sap sucking, the affected tree loose vigour which ultimately decelerate tree growth which in turn become fallible to the attack of secondary pests like wood borers etc. The infestation by *Eriosoma lanigerum* sometimes becomes nuisance to the pickers at the time of harvesting (Gupta et al, 2015a,b).

Aphis pomi De Geer (Plate-1, Figure. b)

Taxonomic Status: Hemiptera: Sternorrhyncha: Aphidoidea: Aphididae

Distribution: Britain (Kicker,1974; Dicker, 1974), Bulgaria (Pelov, 1977), China (Chai, 1998), Colorado (Gillette,1998), North America, Europe, India (Gautam & Kumari, 2004; Rishi, 1979; Butani, 1979 and Nair,1970), Lithuania (Rakauskas & Rupais , 1983; Baker & Turner, 1916), Poland (Wilkaniec *et al.*,1999; Olszak, 1991), Soviet Union (Smol, 1970) and India (Gupta, 2015a, b) .

Present Locality: Aphis pomi de Geer has been recorded from all apple growing districts (Doda, Ramban, Poonch, Rajouri, Udhampur and Kishtwar) of Jammu Province.

Host Plants: Apple plants are the main host of green apple aphid in Himachal Pradesh, Lithuania, Soviet Union, Britain and Poland respectively. (Gautam & Kumari, 2004; Kicker, 1974; Rakauskas & Rupias, 1983; Smol, 1970; Olszak, 1991; Wilkaniec *et al.*,1999) Minor infestation of these aphids has however also been observed by Butani (1979) on Citrus and by Gautam and Kumari (2004) on pear and quince.

Diagnostic Features: Yellowish green with head and thorax distinctly yellowish and sometimes dusky; possesses cornicles, eyes, tarsi, genital plates and cauda; distal end of tibiae and joints of the antennae dusky brown to deep black; 2-segmented talus with two pointed claws; feelers long, filiform comprising of six segments, mouthparts well developed, beak arising between front coxae, 2 pairs of membranous wings with hind wings smaller than fore wings, cornicles distinct, thoracic tubercles 4-6; well developed; cornicles straight and slightly tapering towards outer ends, cauda upturned tail like, antennal tubercles generally very slight; body pyriform and varies from 1.60 to 2.00 mm in length.

Damage: Considered as an important pest of *Malus* sp. the infestation of green aphid is most commonly found in nurseries than in orchards by sucking the sap as well as by transmitting the viral diseases. Both nymphs and adults suck the plant juice and result in the curling up of the leaves, shedding of blossoms and dropping of the young fruit untimely that leads to the impairment and degradation of the quality of fruits. Heavily affected plants do not proliferate normally. Green aphids lie close to major veins on the ventral surface of the leaf. Sap sucking deteriorates bud size and causes curling of leaves. These aphids secrete honeydew on the plants that encourages the growth of fungi on them that reduces the market value of the fruit.

Halyomorpha halys Stahl (Plate-1, Figure. c)

Taxonomic status: Hemiptera: Pentatomidae: Pentatominae

Distribution: Japan, Korea and China, United States (Hamilton, 2009) and India (Gupta, 2013).

Present Locality: The pest has been recorded from Bhaderwah (Distt. Doda), Kishtwar (Distt. Kishtwar), Budhal (Distt. Rajouri) and Mandi (District Poonch) areas of Jammu Province of Jammu and Kashmir State.

Host plants: Found on a variety of plants viz. peach, Asian pear, apple, cherry, raspberry, grape, currant, soyabean, corn, green bean, pepper, crab apple, persimmon, catalpa, walnut, maple, rose (Welty *et al.*, 2008; Gyeltshen, 2005 and Gupta, 2013).

Diagnostic features: Body light brown, punctuate, shield shaped; head freely movable, ophisthognathus, punctate, shorter and narrower than the dorsal sclereite of the thorax (pronotum), free, with side margins generally expanded over bases of antennae; compound eyes prominent, bulged, placed sideways, fits in between the lateral gap formed of head and pronotum; ocelli 2, oval, red, placed in between and towards the base of the eye, inwardly directed; Feelers 5-segmented filiform, hairy. Beak arises from front of the head, medium sized, 4-segmented,, extends to hind coxae reaching second abdominal segment, placed within the post sternal groove extending to mid coxae; pronotum hexagonal, punctuate, does not cover the base of the scutellum; lateral margins entire except a small spine at the anterolateral angle, a pair of impunctate markings with a smooth yellow spot below it towards the anterior margin; pronotum with posterior margin convex and proclinate anteriorly; scutellum large, convex, punctuate, broad, more or less triangular, narrows towards end and slightly covers the edges of the membranes of the forewing, spot at anterolateral angles dark brown with impunctate area at the base; forewing punctuate, embolium present between corium and clavus, corium does not extend at the apical margin of the membrane; legs unequal, meta legs largest, front coxa round and smaller than the mid and hind coxa, femora pubescent with brown spots except at the basad, tibia pubescent, spotted, not armed with strong spines; tarsus segmented, hairy; bearing pointed nails or claws; abdominal margins slightly visible dorsally through the wings, trichobothria present.

Damage: Bug is a sap sucker found feeding on apple leaves and twigs. Bug infestation can be estimated by a pithy area beneath the skin of the fruit which is white to brown lesions on the leaves indicated Leaf feeding. These bugs produce a specific irritant acidic odour that many humans find offensive. They are harmless and do not cause damage to humans.

Nezara viridula Linneaus (Plate-1, Figure. d)

Taxonomic status: Hemiptera: Pentatomoidea: Pentatomidae

Distribution: Southern green stink bug has worldwide distribution and found in New Zealand, America Africa, Australia, Asia and Europe and India (Waterhouse & Norris, 1987; Hoffmann *et al.*, 1991 and Gupta, 2013).

Present Locality: Nezara viridula is found as a main pest throughout the studied districts viz. Doda, Ramban, Poonch, Rajouri, Udhampur and Kishtwar of Jammu Province.

Host plants: Polyphagous pest feed on soyabean, *Phaseolus vulgaris, Riccinus communis, Desmodium* sp., *Crotolaria* sp., *Raphanus raphanistrum* L., mustard , wheat, *Dalbergia sissoo* (Kalia & Lal,1999), beans, cabbage, corn, crucifers, cucurbits, cotton, green beans, mango, oats, orchids, okra, peppers, potatoes, pigeon peas, peanuts, rye, sorghum, tomatoes, tobacco, clover, small gram, spring vegetable, corn, leguminous weeds, cruciferous plants, (Panizzi *et al.*, 2000), paddy (Pal, 2006), citrus (Chhetry, 2009) and apple (Bhardwaj and Bhardwaj, 1983; Gupta, 2013).

Diagnostic features: Body light green, punctuate, spotless, shield shaped, ovoid, dorsal surface dull, closely punctuate especially on pronotum and scutellum; head closely punctuate, elongate with poster lateral margins slightly elevated upward, constructed apically, horizontal; antennae 5-segmented, longer than head, ventrally located; pedicel small, visible from dorsum, first flagellomere green at base, distal part black; finely pubescent, apical and antepenultimate antennal segments spindle shaped; Eyes prominent, bulged, placed on lateral sides of the head; ocelli, oval, inwardly directed, at the base of the head; proboscis 4- segmented, lasts till hind coxae; basal segment of proboscis lies between the mentum (bucculae); pronotum proclinate, large, punctuate, hind margin straight, a small toothed projection at the anterolateral angle, lateral margin entire; scutellum large, green, punctuate, convex, broad, more or less triangular; elytra punctuate, membrane with few lateral veins; legs unequal, hind legs long. Tarsi three segmented; claws apically placed, lateral sides of abdomen visible dorsally.

Damage: The bug feeds on the entire plant but it specifically prefers young tender shoots. Attacked portions usually become pale and die. Damaged fruit suffers brownish perforations or spots. These pierced spots affect the fruit's quality and reduce its commercial value.

Halys dentatus Fabricius (Plate-1, Figure. e)

Taxonomic position: Hemiptera: Heteroptera: Geocorisae: Pentatomidae

Distribution: Pakistan and India (Yasmin *et al.*, 1991; Yousuf & Gaur, 1993 and Gupta, 2013).

Present Locality: The pest is found as a main pest throughout the studied districts viz. Doda, Ramban, Poonch, Rajouri, Udhampur and Kishtwar of Jammu Province**.**

Host plants: Gum Arabic tree, Mimosa tree, Horsetail (Australian pine), Mulberry, khejri *(Prosopis sp),* Sandal tree, Neem, golden shower tree, Mango, Pine, guava, ber, citrus and apple ((Distant, 1908; Dhiman *et al.,* 2004; Chhetry, 2009 and Gupta, 2013).

Diagnostic features: Adult bug pale, rough, punctuate, 21 mm in length and 9 mm in width; head dark with black spots, pronotum and scutellum with light and dark stripes, Feelers (antenna) 5-segmented, cylindrical; head longer than pronotum; rostrum extends upto the fifth abdominal segment. Compound eyes dark brown, thorax brown with black spots, reaching over half of the abdomen, indistinct basal angular spots; forewing brown with dark brown spots, wing membrane bears dark brown area from where basal vein of the membrane arises; hind wing transparent; pro, meta and mesothoracic legs brown with dark brown spots, tibiae anteriorly cylindrical having dark brown spots, femur also with dark brown spots, first abdominal segment light brown dorsally and upto 3rd segment median light brown, remaining segments brown with dark brown spots.

Damage: These insects infest apple plantations by sucking sap from leaves and fruits.

Chrysocoris purpureus Westwood (Plate-1, Figure. f)

Taxonomic status: Hemiptera: Geocorisae: Scutelleridae

Distribution: Sikkim, Kolkata, Assam, Pondicherry and Jammu and Kashmir (Gupta, 2013).

Present Locality: The pest has been recorded from Mandi and Budhal areas of Jammu Province of Jammu and Kashmir State.

Host Plants: Poplar, Jatropha, Shisham, litchi, citrus and apple ((Nair, 1970; Chhetry, 2009; Kalia & Lal, 1999; Gupta, 2013).

Diagnostic features: Body iridescent bluish green with golden tinge bearing dark spots; medium sized, 15-17 mm long, shield shaped, head smaller than the pronotum, roughly triangular with poster lateral margin slightly bulged for the placement of the compound eyes, impunctate. Head continuous with the pronotum, eyes prominent, do not touch the pronotum; ocelli two, small, oval, inwardly directed, basal in position; antennae 5-segmented, longer than the head, visible dorsally, filiform, dark brown, antennal segments finely pubescent, arising ventrally between the bucculae and the compound eye, pronotum large, broad, roughly hexagonal, punctuate, anteriorly proclinate, posteriorly bulged; scutellum large and extending to the apex of the abdomen, U-shaped, convex, covering most of the abdomen, posteriorly decumbent, punctuate except on a raised convex area at the proximal end; wings visible only at the edge of the abdomen, corium of hemi elytra narrow and do not extend to the anal margin of the wing; legs unequal, metalegs largest, pubescent, coxae circular, front coxae smaller, trochanter light brown, femur longer little broader, light brown, distal end black; tibia black, spiny, tarsi 3-segmented, claws two, apical arolia present; abdomen ventrally finely pubescent, orange, 5 black spots on elytra, one at each abdominal segment; seven abdominal segments visible ventrally.

Damage: The pest is a sap sucker and sucks sap from soft parts of apple plants.

Putala rostrata Melichar (Plate-1, Figure. g)

Taxonomic status: Homoptera: Hemiptera: Auchenorhynca: Fulgoroidea: Dictyopharidae

Distribution: Madhya Pradesh, Tamil Nadu (Song & Liang, 2011 Distant, 1906 and Gupta, 2013) in India. Few pests have also been recorded from Pakistan (Mushtaq, 1984).

Present Locality: The pest has been reported from stations viz. Bhaderwah (District: Doda), Batote (District: Ramban), Budhal (District: Rajouri) and Mandi (District: Poonch).

plants: It sucks the sap from leaves and soft parts of the apple plantations from all apple growing regions of Jammu Province.

Diagnostic features: Body ochraceous; head slightly longer, projected infront into a strongly convex anterior tip; head with lateral carine, central carina indistinct; pronotum tricarinate, lateral carinae incomplete, knob like; scutellum tricarinate, with lateral carinae complete; clypeus with lateral oblique striations; eyes, clypeus and parts of venter blackish brown; tegmina with a longitudinal dark brown patch at apex; anal segment in lateral view, broad with ventral margin strongly convex, possessing a longitudinal ventral cleft; pygofer flat, truncate, convex; aedeagus in dorsal view with short and broad phallobase, sclerotized lobes absent, membranous lobes two pairs, leaf like, unequal; dorsal apical process in the form of a hook, located in middle or basal to mid length; spinose process along dorsal margin slightly distal to dorsal apical process; tarsi 3-segmented.

Damage: The insects draw secretion from the soft parts of plants thereby giving them a pale appearance.

Reduvius delicatula Distant (Plate-1, Figure. h)

Taxonomic status: Hemiptera: Reduviidae: Reduviinae

Distribution: Reduvius delicatula has been reported for the first time (new record) as a harmful pest by Gupta (2007) and Tara and Gupta (2009) from Jammu, India.

Host plants: Malus domestica Borkh (Gupta, 2007 and Tara & Gupta, 2009)

Present Locality: The pest has been recorded from apple plantations from Doda, Ramban, Poonch and Kishtwar districts of Jammu Province of Jammu and Kashmir State.

Diagnostic features: Adult orange brown, about 8 mm. in length and 3 mm. in width. Head longer than width, opisthognathus, often freely movable; possesses large paired compound eyes and paired occelli; mouth elongated forming a short curved rostrum; mouthparts piercing and sucking type, Mandibles and maxillae present as stylets with in the sheath of labia; antennae filiform, 4-segmented; prosternum with a median, finely striated longitudinal groove; beak short, 3-segmented, its tip fitting into the prosternal groove; antenna with last segment not swollen; front femora not more than moderately enlarged; head with a transverse suture near eyes; thorax wider than length, shining, covered with pits or pores, possesses long pubescence on the lateral sides, well developed wings with forewings harder than hind wings which possesses red spots on the posterior portion and a well developed V-shaped scutellum; abdomen well developed, dorsally concave to accommodate the wings.

Damage: As the summer season commences, the population of these bugs starts building and maximum population has been observed during May to September. These bugs are important pests of apple plantations and are found highly destructive as they suck the juice from leaves, shoots and soft branches which makes the tender shoots and leaves to dry up that ultimately reduces the fruit yield.

***Borysthenes* sp**. (Plate-1, Figure. i)

Taxonomic status: Homoptera: Auchenorhynca: Fulgoridae: Cixiinae

Distribution: Recorded from China, Taiwan and Japan (Ai Ping Liang, 2005) and India.

Present Locality: The pest has been recorded from Bhaderwah (District: Doda) and Batote (District: Ramban) of Jammu province on apple plantations.

Diagnostic features: Purple, active; body short possessing fragile large wings, forewings membraneous, rostellum arising from the head, 3-jointed tarsus; feelers (antennae) small, stiff, present on both sides of head and separated from head by a straight carina, antennal flagella small, bristle like; IInd tarsomere beset with spines; tegulae present; 2 anal veins in fore wing meeting apically to form a "Y" shaped vein; posteriormost end of hind wings not reticulate; IInd segment of hind tarsus with series of crowning spines; eyes dark, stemma (ocellus) yellow, mesonotum fulvous, legs and thorax dark brown; oblong rostrum, terminal beak segment at least twice as longer as wide; fore wing non-overlappings, abdominal terga 6-8, rectangular, widely distributed.

Damage: The insects are sap suckers and affect leaves and soft twigs of apple plantations.

Oxyrachis rufescens Walker (Plate-1, Figure. j)

Taxonomic status: Hemiptera: Homoptera: Auchenorrhynca: Cicadoidea: Membracidae

Distribution: West Bengal, Chennai and Jammu and Kashmir (Chettry, 2008; Badan, 1986; Distant, 1908; Gupta, 2013)

Present Locality: The pest was recorded from Poonch and Mandi areas of Jammu region.

Host plants: Acacia arabica, A. nilotica, A. auriculiformia, Prosopis spicigera, Erythrina indica, Poinciana regia, Caesalpinia pulcherrima, C. Coriaria, Butea frondosa, Albizzia lebbek, Gliricida maculosa, Sesbania aegyptica, Cassia sp., *Crotolaria junicia, Tamarindus indicus*, (Ananthasubramanium & Ananthakrishnan, 1975), *Dalbergia sissoo*, Citrus (Badan, 1986) and apples (Gupta, 2013).

Diagnostic features: Ferruginous brown, eyes dark brown, tegmina rusty, veins dark brown; abdomen dorsally dark reddish brown; tarsi deep brown, legs testaceous; males smaller and darker than females, tip acute with anterior carina more backwardly curved; pygofer posteriorly oblong, sparingly beset with macrosetae, microsetae distributed over entire surface; shaft gradually tapering to apex, finner serrated on its inner side; head vertical, nearly two times as wide as length of vertex, punctuate with short silvery hairs; ocelli crystalline, humeral angles prominent, tips sub acute, suprahumeral horns broad; hind wings with dark brown veins.

Damage: The pest does not cause significant damage to apple plantations as it seemed to be an occasional visitor. It sucks the sap of twigs and causes damage to twigs by laying eggs on them.

***Empoasca* sp.** (Plate-1, Figure. k)

Taxonomic status: Hemiptera: Cicadellidae

Distribution: Commonluy known as jassids/leafhoppers found in Europe, Africa, the Middle East, Central Asia (Ossiannilson, 1981), Western and Eastern United States and Canada (Delong, 1938) and India (Gupta, 2013)

Present Locality: Recorded from all apple growing districts of Jammu Province

Host plants: They have restrictive host ranges (Putnam, 1941; Delong, 1965). Backus and Hunter (1989) found that adults on alfalfa fed on vascular tissues, whereas on beans they fed on mesophyll tissues. It has also been recorded to feed on Vine, tomatoes, cotton and apple plants (Schmidt & Rupp, 1997; Hosny & El-Dessouki, 1969; Gupta, 2013).

Diagnostic features: Small, pale green, wedge-shaped insect, broadest at head, restricted at wing tips; mouthparts suctorial; nymphs smaller; yellow to pale green. Adults possess translucent wings, while the immatures apterous; third pair of legs slender that helps in jumping.

Damage: This pest causes injury to plants. Main concern for apple growers is a type of damage known as "hopper burn" which is caused by the drawal of fluids from vascular tissues and insertion of toxins into the plant. In apples, hoppers are a threat to new delicate, tender foliage of young fruit trees. Injured leaf margins generally curl downward. The pest defoliates leaves by feeding on mesophyll of the cells that leads to stippling of the leaves that ultimately reduce photosynthetic capacity, tree vigour, fruit set and size.

Quadraspidiotus perniciosus Comstock (Plate-1, Figure. l)

Taxonomic status: Hemiptera: Sternorrhyncaidae: Diaspididae

Distribution: Sanjose scale is most destructive pest of deciduous orchards, occurring in almost all temperate fruit growing countries of the world. It is thought to be indigenous to North China (Marlatt, 1906), Soviet East and North Korea (Rosen & De Bach, 1978), USA world (Alam, 1962; Konstantinova & Mordkavich, 1982), Kullu valley, Srinagar and Jammu (India) (Pruthi & Rao, 1951; Bhardwaj & Bhardwaj, 2005; Gupta, 2013).

Present Locality: The pest has been reported from stations viz. Bhaderwah, Batote, Kishtwar, Kud, Mandi and Budhal areas

Host Plants: Polyphagous pest infesting a wide range of fruits, ornamental plants and shrubs (Vasseur and Schvester, 1957). More susceptible species are of *Prunus, Pyrus, Malus, Cydonia, cotoneaster, Crateagus, Populus, Salix, Sorbus, Ligusturn, Syringa, Tilia, Ulmus, Morus, Juglans* and *Quercus* (Gupta, 2013).

Diagnostic features: Adult female yellow, encapsulated by a dark gray scale, 1-2 mm in diameter, flattened, nearly circular with a raised central nipple, completely covered by circular yellow scales.; female has black abdominal apex which is 4 lobed; male scale oval, light amber with brownish markings having a pair of wings, 10 segmented functional antennae, 3 pairs of legs and an anal style.

Damage: It attacks all above ground parts. It forms dense colonies, mostly overlapping encrustations on branches and trunks, stems and spurs. It has a tendency to attack new and undamaged parts of the plants. In initial stages the scurfy encrustations are normally overlooked due to superficial covering of the insects by wax coating resembling lenticels of the bark. Twigs and fruits are most severely infested and even leaves may be attacked. Following heavy infestations, the feeding sites of the pests coalesce with nearby spots and become red. Heavily infested plants look as if sprayed with ash. The pest permanently impairs the structure, vigour and productivity of the plant.

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PLATE 1

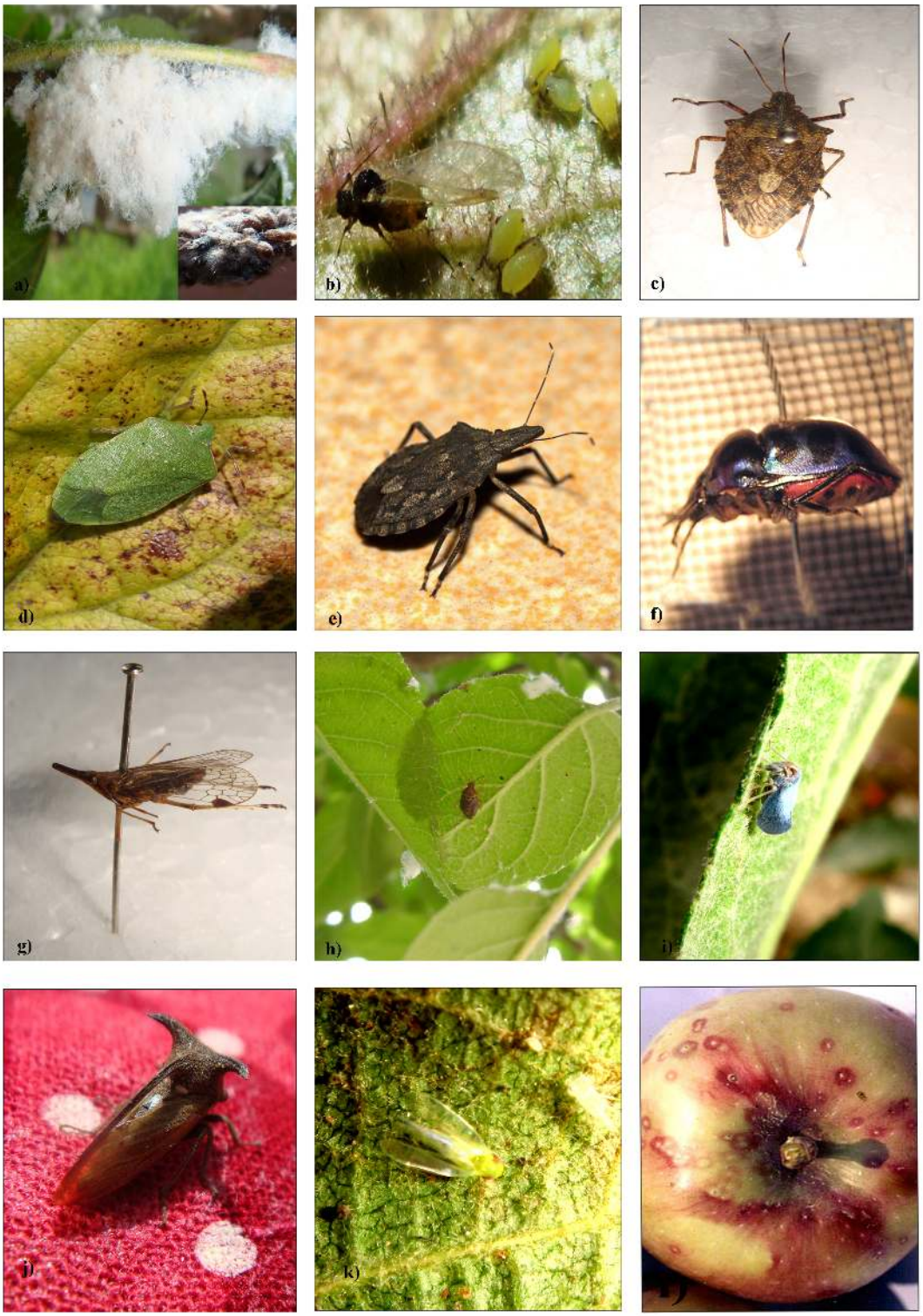

Fig.a) *Eriosoma lanigerum* (Hausmann); b) *Aphis pomi* (De Geer); c) *Halyomorpha halys* (Stal.); d) *Nezara viridula* (Linnaeus); e) *Halys dentatus* (Fabricius); f) *Chrysochoris purpureus* (Westwood); g) *Putala rostrata* (Melichar); h) *Reduvius delicatula* (Distant); i) *Borysthens* sp.; j) *Oxyrachis rufescens* (Walker), k) *Empoasca* sp.; l) *Quadraspidiotus perniciosus* (Comstock)