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Research Article

A REPORT ON THE INVASIVE ALIEN INSECT SPECIES OF ORDER HOMOPTERA OF DISTRICT RAJOURI, JAMMU AND KASHMIR

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ABSTRACT

The concept of Biological Diversity is from times immemorial. It constitutes an essential part of our planet. But nowadays it is facing many threats throughout the world and one of the major threats to the native biological diversity is now acknowledged by scientists and governments to be Biological Invasions caused by the Invasive Alien species. These species have profound impacts on the regional economy and ecological integrity of natural communities. Amongst these, invasive alien insects are the most numerous invaders worldwide. The scope of biological invasion by these invasive insects is global and the cost is enormous in both environmental and economic terms. They are thus a serious impediment to conservation and sustainable use of global, regional and local biodiversity with significant undesirable impacts on the goods and the service provided by ecosystems. In view of this, studies were conducted to enumerate the invasive alien insect species in Rajouri District of the Jammu region of J&K. The main objective of the study was to find out their origin, spread, introduction pathway, invasive status and their impact on native species. A total of seven (07) invasive insect species viz., *Eriosoma lanigerum* (Hausman) (Homoptera: Aphididae), *Myzus persicae* (Sulzer) (Homoptera: Aphididae), *Icerya purchasi* Maskell (Homoptera: Margarodidae), *Quadraspidiotus perniciosus* (Comstock) (Homoptera: Diaspididae), *Pterochloroides persicae* (Cholodkovsky) (Homoptera: Aphididae), *Brachycaudus helichrysi* (Kaltenbach) (Homoptera: Aphididae) and *Heteropsylla cubana* (Crawford) (Homoptera: Psyllidae) were recorded in the survey.

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INTRODUCTION

Species that become established in a new environment, then proliferate and spread in ways that are destructive to human interests and natural systems are considered "Invasive Alien Species" or IAS. These species are introduced from outside their natural range of distribution (other countries or other regions of the country) by either intentional or unintentional human activity, has established self-reproducing populations in the wild and has caused obvious changes in the local, artificial or natural ecosystems. Convention for Biological Diversity (1992) visualize biological invasion of alien species as the second worst threat after habitat destruction". These are the non-native species that are introduced intentionally or unintentionally in areas outside their natural range where they grow, survive, reproduce and produce self sustaining populations of themselves that are destructive to human interests.

Biological invasions may be considered as a form of biological pollution and significant component on human-caused global

environmental change and one of the major causes of species extinction. Globalisation of the Earth's biota, due to drastic breaching of the biogeographic barriers that isolated continental biotas for millions of years, is transforming local and regional floras and faunas (Davis, 2003). Such biotic homogenisation is a result of increasing global trade and transport because of which the number of plant and animal species translocated by humans, either deliberately or by accident, has drastically increased (Drake *et al.*, 1989, Williamson 1996, Mack *et al.*, 2000, Kowarik 2003, Perrings 2005) and such invasions have the potential of altering the composition of the Earth's biodiversity (Vitousek *et al.*, 1996; Mack *et al.*, 2000). Throughout the United Nations Decade on Biodiversity, governments are encouraged to document status survey of biodiversity for its overall conservation at Regional, National and International level. The present work in part will support the implementation of the Strategic Plan for the Conservation of the Biodiversity.

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Once unappreciated as “sleeper environmental issue”, invasions are now considered as one of our most serious environmental and economic problems worldwide. These species are causing enormous damage to biodiversity and the valuable natural agricultural systems upon which we depend. Direct and indirect health effects are increasingly serious and the damage to nature is often irreversible. Taking note of the importance of studies on the alien invasive species, present study was aimed at compiling the first ever inventorisation of the alien fauna and flora of Rajouri district, along with supplementation of each species with information on origin, spread, habit, mode of introduction and the invasion status.

MATERIALS

Study area

Rajouri is the district headquarter, which is 160 km from Jammu, the winter capital of Jammu and Kashmir. It is situated in the west of Jammu division. Rajouri district is located between 70 and 74° 4' East longitude and 32° 58' and 33° 35' North latitude. It offers a representative character of the state in climate, culture and secular outlook. The general elevation of the district is in the range of 562-4800 m above mean sea level. It is located in the foothills of Pir Panjal Range. The average annual rainfall is 500-1150 mm and average temperature varies from 7.42° to 37.4° Celsius. The maximum rainfall in the area is received through southwest monsoon during July-September. The climate varies from semitropical in the southern part to temperate in the mountainous northern part of the district. The sub-tropical southern region receives regular monsoons whereas the northern part prone to hailstorms experiences excessive rains. Owing to the vast variety of edapho-climatic and physiographic heterogeneity, the district harbours diverse habitats, including swamps, marshes, rivers, streams, nalas, agriculture fields, orchards, lakes and wetlands, which support equally diverse floristic and faunistic elements.

METHOD

The present investigation aims to inventorise and identify the Invasive Alien Insect Species (IAS) present in the Rajouri district of the Jammu region of J&K state. During the course of field study the authors have selected different tehsils of Rajouri district. During this period enquiries were conducted from farmers and agriculturalists of each site about these insect species. All the survey sites were intensively sampled for the invasive alien invaders.

The survey and data collection on the invasive alien insect species of Rajouri district was carried out from 2012 to 2013.

The field books were maintained to note down the informations regarding, the collection number, date of collection, local name, family, habit, habitat and impacts on the native species. The species were collected systematically and preserved for identification. Existing literature and information from web based data; online identification system and ISSG database were used to determine the alien origin of the species. An exhaustive study was carried out to record the invasive insects in Rajouri district.

RESULTS

During the period of observation, a total of 07 insect belonging to order Homoptera were recorded by the investigator from Rajouri district of the Jammu region of J&K state.

Eriosoma lanigerum (Hausman) (Fig. 1)

Order: Homoptera **Family:** Aphididae

Common Name: Apple root aphid, American blight, Woolly apple aphid.

Host Plants: Occurs on apples with susceptible rootstock and susceptible varieties, almond, pear, peach.

This pest was introduced in India during 18th century with imported apple rootstock from China. It was first recorded in Conoor during 1889 and in 1909 reported from Kuman Hills of Uttar Pradesh and in 1910 from Simla. During 1920 it reached apex status in India. (Mishra, 1920).

They are generally small, pear shaped apterous individuals; about 2 mm long; reddish brown but this coloration is concealed by white waxy strands. The wax filaments give the insect a fluffy, cottony appearance, as though they are covered with wool.

Brief description: The adult female aphid can occur in winged and wingless asexual forms. Wingless aphids predominate and they have a reddish-brown to purple appearance beneath the white cottony wax filaments that cover the end of the abdomen. The wingless adult aphid is about 2.0 mm long. Winged adult female aphids are dull blue-grey to black with a banded abdomen and slightly larger than the wingless form. The winged forms are often found amongst woolly apple aphid colonies between February and April. Like the wingless females, the winged females produce live young but, in contrast, these are few in number and a mix of sexual males and females. On reaching adult, these males and females mate and the females each produce a single egg.

Habitat: The aphids live together in dense colonies. These form at damage sites on trunks and twigs, where they feed on

Table List of invasive alien insects

S No.	Name of the Species	Common Name	Order	Native Range
1.	<i>Eriosoma lanigerum</i> (Hausman)	Woolly apple aphid	Homoptera	North America
2.	<i>Myzus persicae</i> (Sulzer)	Green peach aphid	Homoptera	Palaeartic origin
3.	<i>Icerya purchasi</i> Maskell	Cottony cushion scale	Homoptera	Australia
4.	<i>Quadraspidiotus perniciosus</i> (Comstock)	San Jose scale	Homoptera	Eastern Asia
5.	<i>Pterochloroides persicae</i> (Cholodkovsk)	Clouded peach bark aphid.	Homoptera	Central Asia
6.	<i>Brachycaudus helichrysi</i> (Kaltenbach)	Peach leaf curl aphid.	Homoptera	Europe
7.	<i>Heteropsylla cubana</i> (Crawford)	<i>Leucaena</i> psyllid	Homoptera	Central and South America.

tender bark. The aerial colonies can be found in several locations on the tree, but shoots and water sprouts are favoured locations. Overwintering colonies are usually found in old pruning scars.

Native Range: The woolly apple aphid (WAA), reportedly native to North America.

Introduction Pathway: Transportation.

Impact: Woolly apple aphid is a sucking insect pest that weakens the infested trees by feeding on stem and roots. Injury caused by the woolly apple aphid consists of gall-like formations and swollen enlargements on roots. It feeds mainly on apple, but can also be found on pear, peach and apricots. It feeds on new terminal leaves, causing them to curl or form rosettes. It can also infest the stem and calyx end of the apples. Heavy infestation may cause deformed twigs and branches. Subterranean aphid colonies cause the most damage. Roots of infested trees have large, abnormal swellings. Continued feeding can kill roots and cause reduced growth or even death of young trees. Honeydew produced by these aphids can drip onto the fruit resulting in sooty mould and downgrading of fruit because of blackened or necrotic areas. High populations of woolly apple aphid can create sticky and unpleasant working conditions for harvest crews.

Myzus persicae (Sulzer) (Fig. 2)

Order: Homoptera **Family:** Aphididae

Common Name: Green peach aphid, Peach-potato aphid.

The green peach aphid, *Myzus persicae*, is found throughout the world, including all areas of North America, where it is viewed as a pest principally due to its ability to transmit plant viruses. In addition to attacking plants in the field, green peach aphid readily infests vegetables and ornamental plants grown in greenhouses. This allows high levels of survival in areas with inclement weather and favours ready transport on plant material. When young plants are infested in the greenhouse and then transplanted into the field the fields will not only be inoculated with aphids but insecticide resistance may be introduced. These aphids can also be transported long distances by wind and storms.

Brief description: Adult green peach aphids appear in the summer and are 1.8 to 2.1 mm long, the head and thorax are black and the abdomen yellow-green with a dark patch on the back. The nymphs are at first greenish, then turn yellowish, those that become winged females may be pinkish. Wingless adults resemble nymphs and are 1.7 to 2.0 mm long.

Native Range: Palaearctic origin.

Impact: It is the most significant aphid pest of peach tree, causing decreased growth, shriveling of the leaves and the death of various tissues. It is also hazardous because it acts as a vector for the transport of plant viruses, such as Potato Virus Y and Potato Leafroll Virus to members of the nightshade/potato family solanaceae and various mosaic viruses to many other food crops. It is also a pest of potato, sugar beet, brassica and legumes.

Green peach aphids can attain very high densities on young plant tissue, causing water stress, wilting and reduced growth rate of the plant. Prolonged aphid infestation can cause

appreciable reduction in yield of root crops and foliage crops. It develops resistance when insecticides are used to control it. *Myzus persicae* populations can increase rapidly under favourable conditions. It is found all over the world, often as a pest on vegetables in greenhouses in colder climates.

Icerya purchasi (Maskell) (Fig. 3)

Order: Homoptera **Family:** Margarodidae

Common Name: Cottony cushion scale, Fluted scale, White scale.

Host Plants: Citrus plantations. It was accidentally introduced into India in 1921.

Brief description: The mature females have bright orange-red, yellow or brown bodies. The body is partially or entirely covered with yellowish or white wax. The most conspicuous feature is the large fluted egg sac, which is 2 to 2.5 times longer than the body. The egg sac usually contains about 1000 red eggs (Gossard, 1901). Males are small (3mm), slender, reddish-purple insects with 2 metallic blue wings. The mouthparts are piercing/ sucking type.

Native Range: Originated in Australia.

Impact: It feeds on several species of woody plants, most notably on citrus and pittosporum. It decreases the vitality of its host by sucking phloem sap from the leaves, twigs, branches and trunk. Feeding can result in defoliation and dieback of twigs and small branches when infestations are extremely heavy. Most damage occurs from the feeding of the early immature stages of the scale on the leaves, where they settle in rows along the midrib and veins and on the smaller twigs. Heavy populations can severely reduce the yield of citrus trees. Like soft scales, cottony cushion scale excretes honeydew which is usually accompanied by blackish sooty mould growth and ants. It cause the premature loss of fruits and leaves and heavily infested plants may die during periods of stress.

Quadraspidiotus perniciosus (Comstock) (Fig. 4)

Order: Homoptera **Family:** Diaspididae

Common Name: San Jose scale, Pernicious scale, California scale.

Host Plants: Polyphagous, preferred host plants include apples, pears, peaches, and plums.

The scale was native of China, reached India in 1911, and by 1933 had attained pest status in fruit orchards and plantations of poplars and willows.

San Jose scale is a major pest of fruit trees. This species is found in both temperate and subtropical climates. It is a sucking insect that injects a toxin into the plant and while it feeds causes localized discolorations. The presence of reddish necrosis on fruit at harvest indicates potentially damaging numbers on the trees. San Jose scale can kill the entire tree in a couple years.

Brief description: Female scale insects are apterous, tiny, orange, sac-like insects beneath 1/16 inch diameter, circular, grey, waxy coverings marked with concentric rings surrounding a central, raised nipple. Male scale insects have a pair of wings, smaller, 1/25 inch long oval coverings with a circular, raised dot located near one end. Young nymphs are

mobile, yellow, provided with 3 pairs of short legs, once fixed, secretes a white scale which becomes grey and then black.

plantations. Young trees may be killed before fruiting. All parts of the host plant except roots may be attacked.

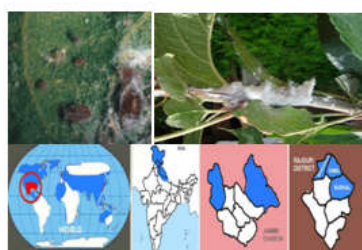


Fig 1 *Eriosoma lanigerum*

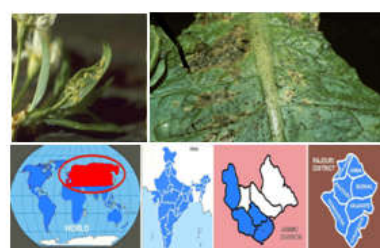


Fig 2 *Myzus persicae*



Fig 3 *Icerya purchasi*



Fig 4 *Quadraspidiotus perniciosus*



Fig 5 *Pterochloroides persica*



Fig 6 *Brachycaudus helichrysi*



Fig 7 *Heteropsylla cubana*

Figures 1- 7 Native range and the introduced range of the insect species in the world, in India, in J&K and in Rajouri district (study area). Red area (encircled) shows the place of origin and the sky blue area shows the introduced range.

Habitat: It is found on the trunks, branches, twigs, leaves and fruits of the plant.

Native Range: Native of Eastern Asia.

Introduction Pathway: International spread is liable to occur through human transport of planting material of host trees and shrubs or fruits.

Impact: It is a horticultural pest of economic significance as it causes damage and crop losses to many fruit crops. Damage is caused when nymphs and adult females pierce plant tissue with their long thread-like mouthparts and suck out plant fluids. The host tissue of shoots and leaves around the scale often turns red. On twigs and small branches, the red colour necrosis extends deeply into the inner bark to the xylem, but the colour is not visible at the surface of thick bark. If heavy scale infestations are left unchecked, trees may be seriously damaged, resulting in reduced vigour, thin foliage, cracked or dying branches and eventually results in die back of the

However, the greatest populations occur on twigs and branches where the buildup of scale cover forms a grey crust. Infested fruit develops a reddish purple ring surrounding each spot where a scale settles. This species is known to infest over 60 species of fruit and ornamental trees and shrubs.

***Pterochloroides persicae* (Cholodkovsky) (Fig. 5)**

Order: Homoptera

Family: Aphididae

Common Name: Clouded peach bark aphid.

Host Plants: The principle hosts of this species include almond, apricot, peach etc., however it has also been recorded from other plants including citrus and *Malus*.

Brief description: Wingless adult 3.5-4.7 mm, oval body, large dark brown to black with some white patches, dorsum of abdomen with a double row of large tubercles. Antennae 6 segmented. Winged adult measure about 2.7-3.6 mm and body colour similar to wingless adult female.

Habitat: It is found living on large branches and trunks of its host (Blackman and Eastop, 1994).

Native Range: Central Asia.

Impact: Damage is caused by the aphids sucking the sap from the bark and branches. As a result, fruit falls prematurely and trees become weakened. In extreme cases no fruit is produced and growth is retarded. The large amount of honeydew secreted by these insects, accumulates on the trees and promotes the attack of the fungus that causes the mould, which reduces the photosynthetic capacity of the plant. It also reduces production and crop quality severely. They may also obscure areas of the branches. Persistent attacks have lead to the death of trees over 10-15 years. Severe infestations have been reported in many parts of the world.

Brachycaudus helichrysi (Kaltenbach) (Fig. 6)

Order: Homoptera **Family:** Aphididae

Common Name: Leaf-curling plum aphid, Beet leaf aphid, Peach leaf curl aphid.

Host Plants: Polyphagous, preferred hosts include apple, plum, cherry, peach, almond, sunflower, aster and *Chrysanthemum*, beans, alfalfa, parsley, celery, and a variety of ornamentals.

Brief description: The adult wingless form is 0.9 - 2.0 mm long, egg-shaped, usually green to yellowish or brownish green. The tail is pale, short and blunt. The antennae are shorter than the body with dusky tips. The winged form is 1.1 - 2.2mm long. Winged adult smaller than wingless form.

Native Range: Europe.

Introduction Pathway: Transportation.

Impact: It is a serious pest of apple, plum, cherry, peach, almond, sunflower, aster and *Chrysanthemum*, but also attacks a broad range of other crops such as beans, alfalfa, parsley, celery, and a variety of ornamentals. This aphid cause leaves to roll up tightly perpendicular to the mid-rib, thus severely damaging leaves. It is also a notable pest of glasshouse crops and house plants. Tree growth and fruit sugar contents can both be reduced by populations of this aphid.

Heteropsylla cubana Crawford (Fig. 7)

Family: Homoptera **Order:** Psyllidae

Common Name: *Leucaena* psyllid, Jumping lice of *Leucaena*.

The *Leucaena* psyllid was described from Cuba by Crawford in 1914 and it started its journey in 1983 when outbreaks occurred in Florida and it was also intercepted in Hawaii in 1984. Within a short span of two years it reached Sri Lanka in 1986 crossing the Pacific Ocean and was noticed in Chengalpattu district of Tamil Nadu, India during 1988 and Bangalore during May 1988 (Anonymous, 1989).

Brief description: Adult psyllids are aphid-like, approximately 2 mm in length, winged and light green to yellow in colour. It is very active, jumping and flying readily. Adults feed on young growth and occasionally older growth and flowers.

Native Range: It is native to Central and South America.

Introduction Pathway: Transportation.

Impact: Adults and nymphs inflict injury to *Leucaena* plants by de-sapping young shoots, leaves and flowering structures. This can cause wilting of foliage, especially the new shoots and complete defoliation of susceptible varieties. In severe cases, plants die. Damage ranges from physical effects on the plants by defoliation to indirect, adverse effects on companion crops and reduced biomass for animal feeding, resulting in instability of the production system and financial loss. The socio-economic impact of the infestation is alarming. Repeated attacks cause wilting, defoliation, branch die back or death of host trees.

CONCLUSION

In conclusion, our study indicates that such anthropogenic influences along with wanton axing of forests, unregulated grazing, pollution, climate change etc, have promoted invasion by non-native species.

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