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Research Article

Inception report of San Jose scale (*Diaspidiotus perniciosus*) on cherry plants in Nomal valley Gilgit-Baltistan, Pakistan.

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ABSTRACT

This first instance of the San Jose scale (*Diaspidiotus perniciosus*) on cherry (*Prunus avium*) plants in the Nomal Valley, Gilgit-Baltistan (GB), Pakistan, was reported in the research Paper. Infestation of the pest was found on different parts of the plants such as the main tree trunk, twigs branches and the difference was extremely high among the different locations such as Batot, Majini Mohlla, Kamalabad, Jigot, Sigal, Das and Ishpish. The thick layer of the scale shell formed by the main trunk infestation disturbed the vascular processes of the plant, and caused its gradual death. The poor growth, absence of vigor and waxy secretions characterized infestations of the branches, whereas twig infestations were characterized by morphological anomalies, poor fruit quality, and early fruit fall. Batot had the highest levels of infestation amongst the locations that were surveyed. The results highlight the importance of specific pest control measures, especially in places with high densities, and the need to focus on twig based control regimes.

Keywords: Pest; Cherry; report; scale insects; signs; symptoms.

INTRODUCTION

Gilgit-Baltistan (GB) is one of the important fruit-producing regions of Pakistan; however, it is not as fruit-producing as other parts of the country due to different factors such as remote location, lack of infrastructure (roads), lack of markets and traditions diversification. In comparison, fruit yield is low (Ali et al., 2011). Factors leading to the decline in fruit production include: insufficient transportation facilities, insufficient market information, falling prices, climate change, insufficient arable land, traditional production methods, insufficient government support, pests and diseases, and lack of production capacity. Industry and technical expertise. The China-Pakistan Economic Corridor will lead to land degradation. It is believed that after the implementation of the China-Pakistan Economic Corridor, the local fruit industry will not be able to compete with China's exports (Zulfiqar et al., 2019).

Cherry production in the Gilgit-Baltistan is associated with smallholder farmers, who typically sell their production to wholesalers and retailers. The cherry production and sales system is still dominated by traditional models. Although there is no organized marketing system, the existing marketing system is quite competitive-based, with neither large growers nor wholesalers influencing market prices. Cherries from Gilgit in the Nomal Valley, Hunza and Nagar regions are considered best cherries from the interior regions because of their shape, color and taste. Most of the production is lost due to the short shelf life of cherry main trunk and weak infrastructural network. The cherries are sold to market personnel, who then sell the cherries at the farm gate.

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Wholesalers in national markets purchase main trunk from local wholesalers. Retailers further sell the cherries to local consumers, shopkeepers and tourists. Retailers, on the other hand, sell their products to other local shopkeepers, tourists, and local consumers (Ahmad et al., 2008). Further, interventions are needed to establish a strong cherry marketing channel from producer to consumer level. Nutritionally cherry is composed of, antioxidant, phenols, flavonoids, melatonin, Beta-sitosterol, vitamin C, ellagic acid, fibers and perillyl alcohol. All these factors are attributing antioxidant activity of cherry (Goa and Mazza, 1995; Guillen; 2005, Toma, 2007).

Scale insects are considered some of the most fascinating and terrifying insects. Their unusual approach to plant-dependent relationships results in many peculiar modifications (Miller and Kosztarab, 1979). As metabolic insects, male scales have independently evolved unusual complete metamorphoses, including those unique among higher coccidia. As a member of the order Homoptera, the male scale is unusual in that the metathoracic wings always degenerate into a truncate, and usually only the mesothorax is well developed. With maturity in contrast to nymphs, adult females have no wings and are essentially integumentary pouches that serve as reproductive factories (Miller and Kosztarab, 1979).

Among the scale insects, San Jose scale is a plant sap-sucking parasite that can be found almost anywhere plants grow. They get their name from the protective waxy secretions most species produce. Currently, at least 8194 species have been described, divided into 50 families. Scale insects play a key role in ecosystems. Keeping in view the importance of cherry plants and San Jose insects, the present study was conducted with the following objectives;

This study aims to:

1.Quantify the severity of San Jose scale infestation on various parts of cherry trees in Nomal valley.

2.Compare infestation levels across different sites to inform targeted pest management strategies.

MATERIALS AND METHODS

Study area

The study was conducted in the Nomal Valley, located in the Gilgit District of Gilgit-Baltistan, Pakistan as shown in figure (1). The Nomal valley is known for its Agricultural Potential, Particularly Fruit Production. The Valley is divided into various Mohallahs, including Jagot, Majini Mohallah, Batot, Kamal Abad, and Das. These areas have diverse climates, ranging from cool and mild to cold, providing ideal growing conditions for fruit crops such as cherries. However, these climates also contribute to the spread of pests, such as the San Jose Scale insect found on cherry trees in the summer of 2023.

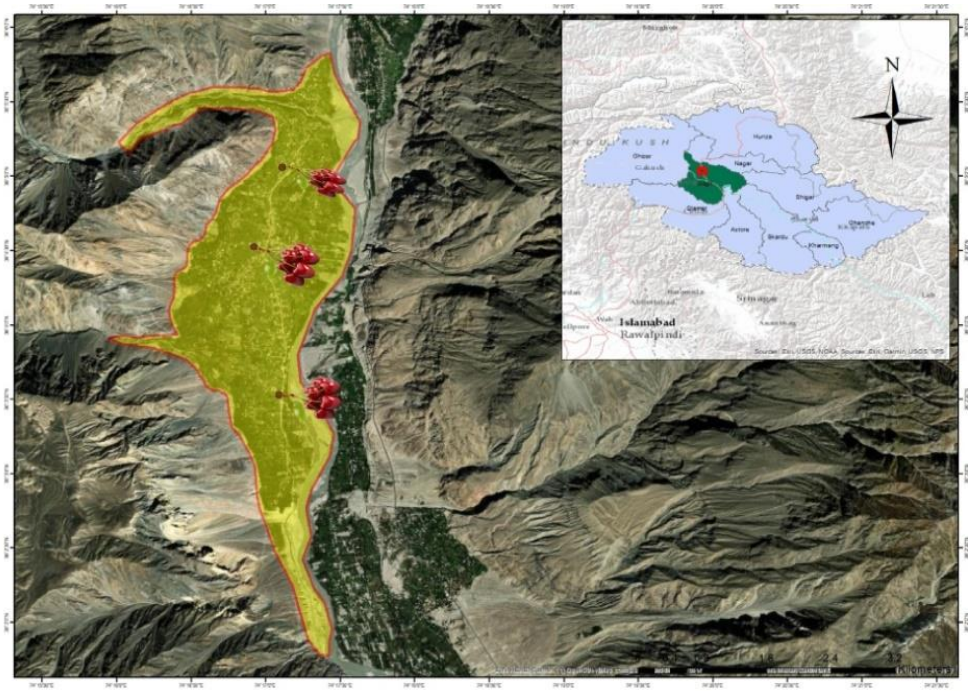

Figure 1. Study area, of Nomal valley, Gilgit.

Symptoms and signs assessment

Data on symptoms and signs were collected through direct field observations in the Nomal Valley, with a focus on the presence of Scale insects and the extent of their infestation on cherry plants. All observed symptoms were recorded and photographed for further analysis.

Pest Infestation assessment

The following methods were used to determine the pest situation on the trunk, twigs and branches. Three (3) Cherry trees were randomly selected from orchards in the study area (Batot, Majini Mohallah, Kamalabad, Jagot, Sigal, Das and Ishpish) and observed for a period of time. Pest infestation was visually inspected on three different parts of each tree (trunk, twigs and branches).

The percentage infestation for each plant part was calculated using the formula:

$$Infestation\ Percentage = \pi \frac{Number\ of\ Infected\ Parts}{Total\ Number\ of\ Parts\ Examined} \times 100$$

The severity of San Jose scale infestation was assessed on a scale from 0 to 5:

- 0: No visible infestation.
- 1: Minor infestation (fewer than 10% of twigs, branches or main trunk affected).
- 2: Moderate infestation (10-30% of twigs, branches or main trunk affected).
- 3: Severe infestation (30-50% of twigs, branches or main trunk affected).
- 4: Very severe infestation (50-70% of twigs, branches or main trunk affected).
- 5: Complete infestation (over 70% of twigs, branches or main trunk affected).

Pest infestation data for main trunk, twigs, and branches were collected for each mohallah. Each set of data (main trunk, twigs, and branches) was treated separately

Taxonomic identification of *D. perniciosus*

D. perniciosus was Identified by Kosztarab & Kozár (1988) & CABI compendium data base (CABI., 2022).

1. Scale cover shape and position of exuviae	Female scale cover is almost circular, slightly convex, with exuviae central or sub central	Go to step 2	If scale cover strongly elongate/oval, or exuviate markedly eccentric, possibly male or other species
2.presence of Perivulvarpores in adult females	Absent in *D. Perniciosus*	*D. perniciosus*	If present →other Diaspidiotus/Quadraspidiotus species.
Number of lobes on pygidium of female, shape of plates between lobes	Two pairs of well –developed lobes, with plates between lobes partly pointed or fimbriated.	*D. perniciosus*	If lobes less well –developed, or plate shape markedly different →other species.
Morphology of first – instar larva (crawlers)	For *D. perniciosus*, first – instar female larvae difference: an extra pair of dorsal setae on the second segment compared with other species.	Useful for distinguishing female first – instar stage	If lacking that extra pair→ likely different species.
5. Scale color, size etc.)female)	Diameter ca.1.5-2.2 mm, light to dark grey cover, body of female yellow when uncovered.	*D. perniciosus*	If small or very different coloration→ check other scale species.

Data analysis

Statistical analysis

Infestation data were subjected to one-way ANOVA to identify statistically significant differences in pest severity among villages. Each plant part was analyzed independently.

RESULTS AND DISCUSSION

Signs and symptoms

The infestation of San Jose scale in cherry plants in the Nomal Valley was observed on multiple plant parts, including the branches, twigs, and main trunk (Figure 1, 2 and 3). On the main trunk, the infestation is most prominent on the

main trunk and branches of the cherry trees, where a sheet-like layer of scale insect shells is evident. This pest hinders the plants absorption of nutrients and water, leading to a decline in plant health and eventual wilting. On branches, the presence of the San Jose Scale insect causes stunted growth, reduced vitality, and branch death, with a characteristic waxy secretion appearing at the infected sites. Finally, on the branches, have poor growth and may have deformed shapes. The scale insects suck the sap, resulting in low quality of the fruits and early dropping of fruits. This is a multi-infestation, which has significant impacts on the health and productivity of the cherry plants in the area.

Figure 2. Sanjose scale identified on cherry plants.

Figure 3. Symptoms of scale insects affecting main trunk and branches of cherry plants at Nomal valley.

Infestations

The pest survey results showed significant differences in the severity of San Jose scale in insect infestation across different Mohallahs, with varying degrees of damage on the trunk, branches and twigs. Batot had the highest infestation rate, with 35.4% affecting branches, followed by the trunk (22/1%) and twigs (18.3%). This indicates that in Batot, branches were the most severely affected part of the plant, making them the area with the greatest pest stress. The Majini Mohallah had the second highest infestation rate, with (32.7%) affecting branches, (19.8%) on the trunk, and (16.4%) on the twigs. Other Mohallahs, such as Kamalabad and Jigot, showed similar trends, with branches being the most severely affected part. Sigal had a relatively low infestation rate, with (13.8%) affecting the trunk, (22.7%) on branches, and (11.4%) on twigs. The Das and Ishphish, had the lowest overall pest infestation rates. In Das, the main

Figure 4. Symptoms of infected branches of cherry plants at Nomal valley.

trunk infestation rate was (11.2%), the branch infestation rate was (18.65), and the twig infestation rate was (9.5%). In ishpish, the main trunk infestation rate was (18.6%), and the twig infestation rate was (9.5%). In Ishpish, the main trunk infestation rate was (10.9%), the branch infestation rate was (18.2%) and the twig infestation rate was (11.2%) the branch infestation rate was (9.1%). These results indicate that the branch infestation rate was significantly higher than other parts, with Batot and Majini Mohallah being the most severely affected areas. This recommends that targeted pest control approaches are needed in the areas.

Table 1. Main trunk Infestation, twigs and branches of cherry tree by Sanjose scale.

Mohallah	Main Trunk Infestation (%)	Twigs Infestation (%)	Branches Infestation (%)
Batot	22.1^{b}	35.4^{a}	18.3^{a}
Majini Mohallah	19.8^{b}	32.7^{b}	16.4^{b}
Kamalabad	17.4^{c}	28.9^{c}	14.2^{c}
Jigot	16.2^{c}	27.3^{c}	13.1^{c}
Sigal	13.8^{ɕ}	22.7^{ɕ}	11.4^{ɕ}
Das	11.2^{ð}	18.6^{ð}	9.5^{ð}
Ishphis	10.9^{ð}	18.2^{ð}	9.1^{ð}

The findings of the present study reveal a considerable difference in infestation of San Jose scale on the various Mohallas in the Nomal valley and twigs always exhibited the highest level of infestation, followed by the main trunk and branches. This is in line with the earlier observations of San Jose scale infestations, which tend to have twigs as the most vulnerable part of the plant. The delicate tissues of the twigs are scale insect food, causing stunted growth, loss of vigor, and dieback, which were seen in the most severely infested places. The greatest infestation rates occurred in Batot and Majini Mohallah especially on twigs, which imply that the areas are greatly pressured by pest. The highest infestation rate of (35.4%) on twigs was observed in Batot, which was the highest rate of infestation in all Mohallahs, hence local environmental conditions or pest reservoirs might be contributing to the rate of pest proliferation in Batot. Likewise, the twigs appeared to be infested significantly in Majini Mohallah (32.7%), indicating that these areas have common vulnerability. The low infestation in Sigal, Das and Ishpish indicate that the localities might not be as conducive to the pest or may have been more efficient in curbing the pest. This might be attributed to a number of factors such as environmental factor, pest management methods or natural predators that might be decreasing the number of pests within these habitats. The high variation in the levels of infestation among the Mohallahs especially, in twigs highlights' the importance of region-specific pest management strategies. Those areas that have highlight levels of pest pressure and control further transmission. Additionally, given that the infestation levels on branches and the main trunk were lower, it is essential to prioritize twig protection while also monitoring other plant parts. Sanjose Scale is a plant sap-sucking pest that can be found almost anywhere plants grow. They get their name from the

protective waxy secretions most species produce. Currently, at least 8194 species have been described, divided into 50 families. Scale insects play a key role in ecosystems (Douglas, 2006). They, like most other herbivorous members of the order Hemiptera, are the only insects that feed exclusively on phloem sap (although beetles primarily feed on parenchyma cells) (Douglas, 2006), Phloem is rich in sugars but low in amino acids, and phloem feeding is an ineffective process. These waste products are large amounts of honeydew, and the sugar-rich excreta are birds, mammals, especially other insects (Douglas, 2006). Honeydew availability can influence insect communities, thereby altering ecological processes such as herbivore assemblages, soil arrangement, and predation (Stilsky and Eubanks, 2007; Stadler et al.,1998). Many scale insects are agricultural pests that damage plants through sap sucking and promote the development of sooty mold Growth for example, scale insects make up 1% of the total insect flora in the United States, but account for 13% of presented insect flora, and there is an average of one new invasive species in the United States every year. The host plant associations of scale insects are well recorded, and these associations are well documented. The breadth of the species is unusually variable (Normark, 2003). Like other herbivorous insects, most scale insect species are hosts. However, for plant experts, some scale insect species are also known for their unparalleled diversity of genetic systems Known for the diversity and complexity of sex and its relationship with endosymbiosis (Normark, 2003). Scale insect populations depend on a variety of factors, such as biological factors such as mating patterns, life cycles, number of offspring per generation, mortality, and availability of survival resources, all of which influence insect populations (Godfray, 1994; Hall et al., 2017; Nair, 2001; Wallner, 1987).

Gilgit-Baltistan has an important position in agro- ecological zoning due to its relatively low use of agrochemicals. In the region, horticulture, which includes high-value horticulture crops, is a major source of livelihood. The land is productive, but prevalent conditions are harsh and small landholdings prevent farming groups from producing main trunk and vegetables on large tracts of land. Instead, fruit production is carried out on smaller plots of land, near farmland, or at the household level. As a result, for centuries, relatively little fruit and vegetable production were produced all over the region. Due to poor infrastructure links, the full natural potential for commercial production of horticultural corps could not be fully exploited. The agro ecosystem of Gilgit-Baltistan (GB) was free from Agricultural pests. The suddenly changing climatic conditions are promoting the threats of pests and diseases in horticultural crops of this region, which is posing an alarming situation for food security in GB. Mainly the pest and disease have been transmitted from other parts of the country to Gilgit-Baltistan through different sources of planting materials, nursery plants, main trunk, and vegetables. The Indigenous disease-resistant plant cultivars are diminishing due to the introduction of high-yielding commercial varieties. As a result, diseases and insect –pests are emerging and their consequences are being noticed from minor level damages to catastrophic events, this situation leads to food insecurity in Gilgit-Baltistan. To monitor all these emerging threats, it is imperative to involve all relevant stakeholders of plant protection units to devise Integrated Pest Management based plant protection strategies by involving research institutions to investigate the uprising pest population in horticultural crops of Gilgit-Baltistan. Furthermore, this study shows how biotic agents are impacting Horticultural crops in Gilgit Baltistan. (Abbas et al., 2023).

Management implementation plan

Season	Focus	Key Actions
Year 0/off –season immediately following detection	Establish baseline & contain	Intensify scouting & mapping, prune and remove infested wood, quarantine of materials, plan for dormant oil application.
Dormant/delayed – dormant period (Year-1)	First Prophylactic Spray	Apply Horticultural Oil (Oil +Insecticide if infestation high) in early and delayed timing.
Spring/early Season	Monitor 7 Target Crawlers	Setup pheromone traps, sticky tape, sample crawlers, time insecticide/IGR Spray if needed.
Summer/ Multiple generations	Suppress & Protect	Monitor later generations, avoid heavy broad – spectrum insecticide disruption, and support biological control.
Subsequent dormant seasons	Evaluate & Adjust	Assess residual infestation, refine thresholds, adapt spray timing, and consider integrating pheromone or biological tools.

CONCLUSION

A study of the San Jose scale insect infestation in cherry orchards in the Nomal Valley, discovered significant changings in infestation levels across several locations and plant parts. Branches constantly infected the most severe damage,

with the highest infestations observed in the Batot and Majini Mohallah, mainly on branches. This shows significant pest pressure in these areas, necessitating focused pest management methods. While infestations were less severe on the trunk and branches, they still impacted overall plant health. This study highlights the importance of managing targeted Pest Management strategies for prioritized areas, categorizing the control of San Jose scale insects on branches, as this is where the infestation is most severe.

AUTHOR'S CONTRIBUTION

Azhar Hussain & Farukh Faiz: Supervision, and methodology. Zakir Hussain & Iqbal Hussain: Methodology; data curation, initial draft, formal analysis and revision. Tajuddin: Data curation, formal data analysis, Abdul Karim: Manuscript review and editing, and data curation. Atiqa Bano: Data curation and formal analysis.

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AVAILABILITY OF DATA AND MATERIAL

All data generated or analyzed during this study are available from the corresponding author upon reasonable request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study does not involve human or animal participants and therefore, does not require any constitutional consent. As there have been no similar studies conducted in this region, if any institution or researcher raises concerns regarding animal and human rights, ethical, or public issues, the author of this article will assume sole responsibility.

CONSENT FOR PUBLICATION

All authors have reviewed the manuscript and approved it for publication.

CONFLICT OF INTERESTS

Authors of this study shows no conflict of interest at any point for this manuscript.

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