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Infestation rate of San Jose scale, *Quadraspidiotus perniciosus* (Comstock) in the fruit orchards of Baramulla, Kashmir, India

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Abstract

San Jose scale is an important pest in almost all the apple growing states of India particularly in north and north western states, including Kashmir. It is a tiny insect which sucks the plant juice from twigs, branches, fruits and foliage. Studies on San Jose scale infestation pattern from five test sites selected at reasonably different altitude from one another with slightly different topography and weather parameters were made during 2015. Results indicated that there is a distinct variability in the rate of infestation of the pest in different months of the year and pest escalated its damage with the progression of summer. Results justified clearly that the damage of the pest in Baramulla district of Kashmir is heavy in the months of July and August. Among the crops observed peach (20.56%) was found highly vulnerable to the attack of San Jose scale followed by apple (16.28%), and pear (12.79%) was found to be least susceptible. Analysis of variance (ANOVA) did not show any significant difference in the rate of infestation across the sites, however infestation rate different significantly among the months ($F_{\text{Apple}} = 4.17, p = 0.04, F_{\text{Pear}} = 9.56, p = 0.003, F_{\text{Peach}} = 8.89, p = 0.004$); Peach gardens were often neglected and left unsprayed that may be the probable reason for its higher pest infestation.

Keywords: San Jose scale, fruits, susceptibility, variation

Introduction

Jammu and Kashmir holds a peak spot in Indian fruit industry. It produces most diverse type of fruits from edible soft cover to hard jacketed dry fruits. Among the various varieties produced apple, pear and peach are well received worldwide. All these fruits are unfortunately susceptible to a variety of pest attack limiting the production and productivity^[1]. Among various pests, San Jose scale acts as a key pest in almost all the districts of state. Contrary to other pests it directly affects the shape of fruits. It produce grey to brown spots on fruit hence retards its allurance (Fig.1). San Jose scale (*Quadraspidiotus perniciosus* (Comstock), Homoptera: Diaspididae) was first reported in America around 1870 from San Jose valley of California from where it gets its present name^[3]. Since then this pest has got introduced accidentally into many countries and is considered a major pest in most regions of the world where deciduous fruits are^[6]. It was first time reported in Kashmir in 1921 by N. Gopal, the then Director of Agriculture^[4]. Whatsoever had been the year or mode of its introduction, it has become established in the entire deciduous fruit growing belt of the state causing serious losses to the fruit and trees. San Jose scale sucks the sap and causes loss of vigour, poor growth and death of the plant. Severely infested trees show an ash-grey appearance and the infested fruits become unfit for consumption and marketing. Furthermore among all the insect pests of apple orchards, San Jose scale is a key pest in all apple growing areas of Jammu and Kashmir^[7, 9, 15]. San Jose scale was kept under check by the normal orchard practice of dormant spraying with diesel-oil emulsion and by the complex of natural enemies including dominant aphelinid parasitoid (*Encarsia perniciosi* Tower)^[8]. However, in recent past the incidence of the pest increased indicating a severe resurgence, attributed to shift of growers from dormant diesel spray to potent synthetic chemical pesticides. The shift in the management strategies led to disruption of natural enemy complex and probably development of resistance to pesticides^[14]. This shift in management strategy gave excellent result in reducing the San Jose scale incidence in the early years but, later in recent years has resulted in pest resurgence. Further for its management many trials are being conducted for testing the effect of various mineral oils viz., P.D. spray oil, Atso spray oil, orchex oil, Arbofine, H.P oil, Diesel oil and group of organophosphoric products^[2, 10].

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In Kashmir it is a serious pest of almost all the varieties of apple of which golden and red delicious in particular are being highly susceptible. Moreover traces of infection have also been reported on Pear, Apricot and Peach [4,9].

Quadraspidiotus perniciosus is a polyphagous pest and is known to infest over 700 plant species belonging to 34 plant families [13]. The most preferred hosts are found in the family *Rosaceae* which includes the genera, *Prunus*, *Pyrus*, *Cydonia*, *Malus* and *Ribes* [5].

The insect appears upon the bark as a greyish, rough coating, scarcely noticeable to the naked eyes. At first they are generally found clustered around the buds and at branching of the twigs. As the trees become more thoroughly infested, the bark may be completely covered, and sometimes there are layers of scales covering the bark. In such cases leaves and fruit are usually attacked. The young scales locate upon both sides of the leaves along the ribs where they cause a reddish discoloration. This discoloration also occurs on the fruit in severe infestation. Where the insect is found upon the fruit, it seems to prefer the calyx and the stem cavities. Upon slightly infested trees the fruit is not attacked but on trees which are badly infested the fruit is often so thoroughly covered as to present a very disgusting appearance. Thus there is every need to know about the current status in terms of its infestation rates in the Kashmir valley particularly Baramulla, which is one of the important runner in apple and other fruit production in Kashmir.

Materials and methods

The study was accomplished from May to August 2015, during which the infestation rate is comparatively high and pest occurs in peak compared to other months. San Jose scale maintains its characteristic identity and its colonies are easily identifiable.

Study area

In the present study comprised of 30 orchards of Apple, Peach, and Pear in Baramulla district at Pattan, Tangmarg, Sopore, Rafiabab, and Kunzer. These five locations were selected as these were having meteorological observatory besides having distinct topographical variations (Table 1).

Data Collection and observations

To measure the infestation rate each in orchard 100 trees were observed randomly at monthly intervals between May to August 2015. The rate of infestation by San Jose scale in each orchard was measured deploying the formula:

$$\text{Rate of Infestation} = \frac{\text{Number of trees infected}}{\text{Total number of trees present}} \times 100$$

The mean for each crop for each study area as well as for the district was estimated for each.

To eliminate/minimise the human error in recording the

observations a magnifying glass (10x or 20 x) was used. Observations were made from 10 cm long twig from top, middle and bottom of branch from four branches on each of five trees. Observations were also made from the leaves on either side from five random leaves each from top, bottom and middle of the canopy from selected four branches.

Statistical analysis

The data obtained was analyzed using technique of ANOVA to see the statistical significance among the variables followed by Tukey posthoc 't' test if the data was significant in R software version 6.2.1.

Results and Discussion

The survey was conducted on San Jose scale incidence status in district Baramulla at stem, branches and fruit maturity stage during 2015. Results revealed that the San Jose scale was prevalent in all the study locations on all three fruit crops (Figure 2). The pest incidence in apple crop ranged between 13.69% to 19.21%. Among the five study areas, the highest pest incidence on apple (19.21%) was found in Rafiabab followed by Tangmarg (17.50%), Sopore (16.82%), Kunzer (14.20%), and least was found in Pattan (13.69%) (Table 02)

Incidence of San Jose scale in Pear crop ranged between 10.88% to 15.40%. Highest pest incidence (15.40%) was found in Tangmarg followed by Kunzer (13.87%), Sopore (12.20%), Pattan (11.62%), and least was found in Rafiabab (10.88%) (Table 02).

Incidence of San Jose scale in Peach crop ranged between 17.98% to 23.95% with highest pest incidence (23.95%) in Kunzer followed by Tangmarg (21.67%), Rafiabab (20.10%), Sopore (19.10%), and least was found in Pattan (17.98%) (Table 02).

Among the three crops studied for the incidence of san jose scale in Baramulla district during 2015 highest incidence (20.56%) was recorded on peach and it was least on pear (12.79%) crop and on apple it was 16.28 per cent (Figure 2). Irrespective of the crops, out of five study locations, highest san jose scale incidence was in Tangmarg (18.19%) followed by Kunzer (17.34%), Rafiabab (16.73%), Sopore (16.04%) and was least (14.43%) in Pattan. The incidences of the pest vary from month to month and from area to area because of changes in the factors influencing their population dynamics and dispersal also supported by [12]. The study also shows the temperature above 20 °C favours the pest infestation which was earlier identified by [2].

One-way analysis of variance (ANOVA) did not show any significant difference in the rate of infestation across the sites, however infestation rate different significantly among the months ($F_{\text{Apple}} = 4.17, p = 0.04, F_{\text{Pear}} = 9.56, p = 0.003, F_{\text{Peach}} = 8.89, p = 0.004$; Figure 3). The Tukey pair-wise test revealed infestation rate differs significantly in June-August months [11] in all three crops.

Table 1: Agro-climatic features of District Baramulla (zone wise) of Kashmir

| Site | Topography | Average Temperature (May to August) °C | Humidity (May to August) % | Rainfall (May to August) (MM) |
|----------|----------------------|--|----------------------------|-------------------------------|
| Pattan | 23.8500 °N 72.1210°E | 22.7 | 72.07 | 50.75 |
| Tangmarg | 34.0609°N 74.4247°E | 18.65° | 65.57 | 78.75 |
| Sopore | 34.2868°N 74.4624°E | 22.2° | 71.97 | 51.00 |
| Rafiabab | 28.4121°N 79.3156°E | 22.5° | 71.85 | 58.00 |
| Kunzer | 34.0870°N 74.5009°E | 22.05° | 71.65 | 55.00 |

(Adopted from India Metrological Department)

Table 2: Average Infestation rate of San Jose scale for Apple, Pear and Peach crop during 2015 in Baramulla, Kashmir

| Months | Kunzer | Tangmarg | Pattan | Rafiabad | Sopore | Mean |
|--------------|--------|----------|--------|----------|--------|-------|
| Apple | | | | | | |
| June | 12.60 | 16.12 | 10.64 | 17.53 | 12.27 | 13.83 |
| July | 14.34 | 17.20 | 14.64 | 18.87 | 18.18 | 16.65 |
| August | 15.65 | 19.20 | 15.78 | 21.23 | 20.00 | 18.37 |
| Mean | 14.20 | 17.51 | 13.69 | 19.21 | 16.82 | 16.28 |
| SD | 1.25 | 1.28 | 2.20 | 1.53 | 3.30 | |
| CV % | 8.80 | 7.29 | 16.10 | 7.96 | 19.62 | |
| Pear | | | | | | |
| June | 11.76 | 13.15 | 8.10 | 9.18 | 8.33 | 10.10 |
| July | 13.09 | 15.57 | 11.47 | 10.27 | 13.10 | 12.70 |
| August | 16.76 | 17.47 | 15.30 | 13.18 | 15.16 | 15.57 |
| Mean | 13.87 | 15.40 | 11.62 | 10.88 | 12.20 | 12.79 |
| SD | 2.11 | 1.77 | 2.94 | 1.69 | 2.86 | |
| CV % | 15.24 | 11.48 | 25.31 | 15.52 | 23.45 | |
| Peach | | | | | | |
| June | 20.51 | 16.25 | 12.96 | 18.98 | 15.66 | 16.87 |
| July | 24.02 | 21.25 | 19.51 | 19.18 | 19.65 | 20.72 |
| August | 27.33 | 27.50 | 21.48 | 22.15 | 22.00 | 24.09 |
| Mean | 23.95 | 21.67 | 17.98 | 20.10 | 19.10 | 20.56 |
| SD | 2.78 | 4.60 | 3.64 | 1.45 | 2.62 | |
| CV % | 11.63 | 21.24 | 20.25 | 7.21 | 13.70 | |



Fig 1: San-Jose scale on apple, Peach and Pear Fruit.

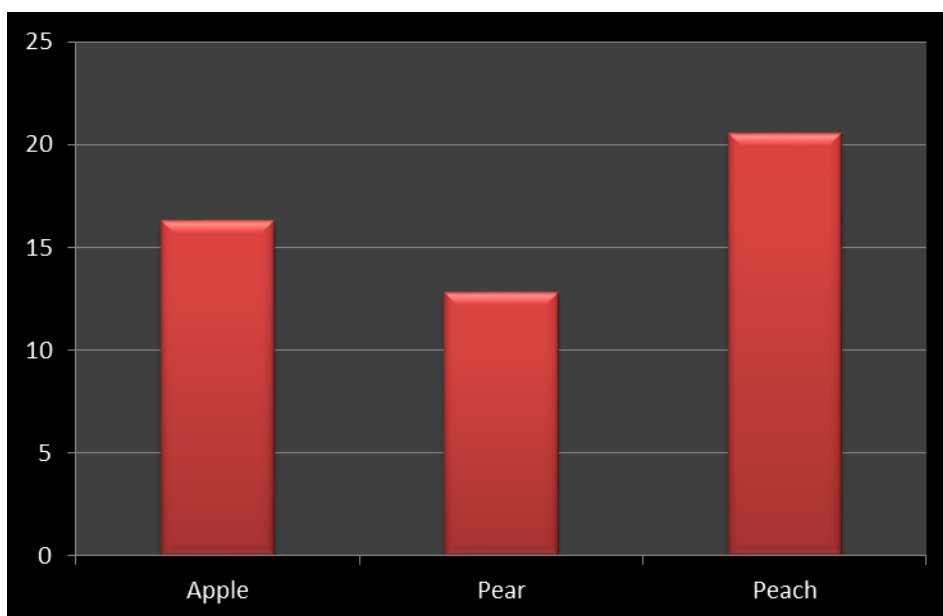
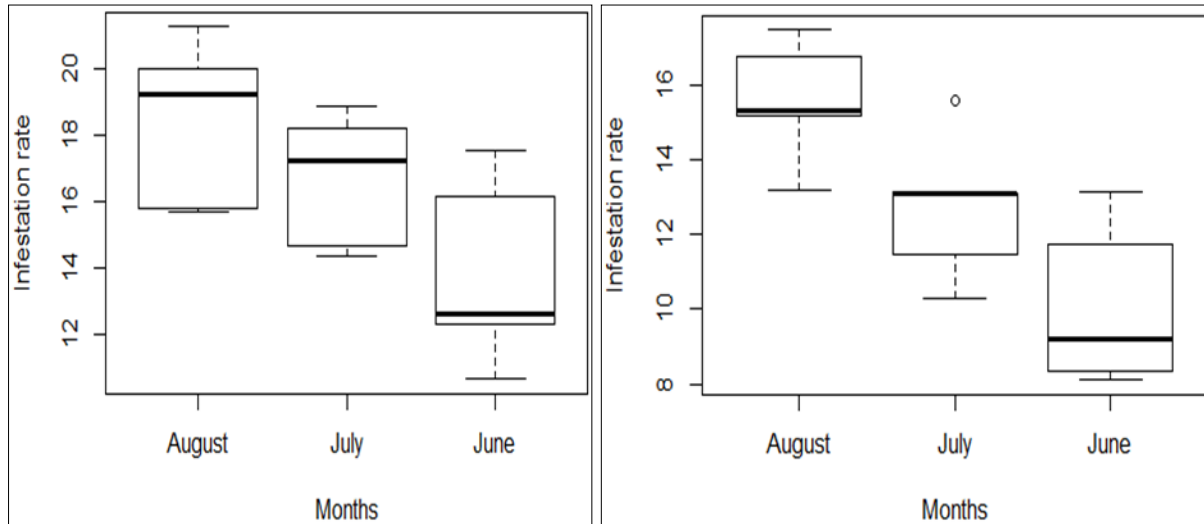
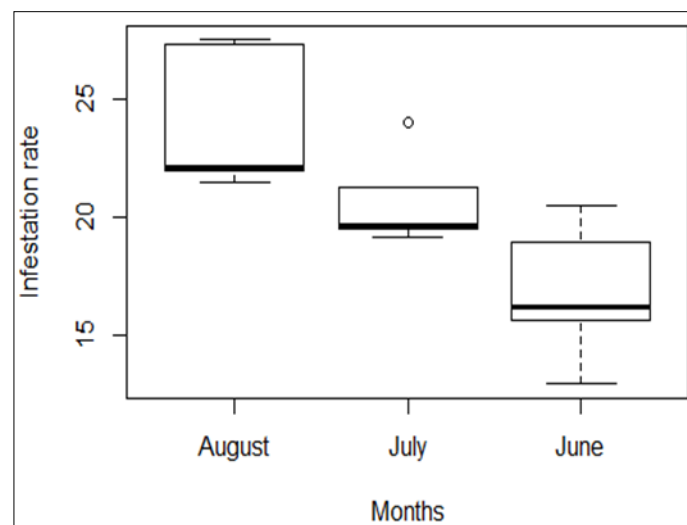


Fig 2: Comparative Infestation of San-Jose scale on various fruits



(a) Apple

(b) Pear



(c) Peach

Conclusion

Studies clearly demonstrated a distinct variability in the rate of infestation of the San Jose scale in different months of the year and different crops. It is also clearly evident from the studies that the pest went on increase linearly from June through August. Pest population and intensity escalated its damage with the progression of summer (July and August). Among the three crops observed, Peach was found highly vulnerable to the attack followed by Apple, and Pear was found least susceptible. Peach gardens are often neglected and left unsprayed that sounds the probable reason for its higher victimization. The economic value and market demand of apple and pear puts them ahead in care by the growers. They are comparatively well managed and sprayed hence were found very restraint.

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