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**Research Note**

# Exploitation of *Chilocorus infernalis* Mulsant (Coleoptera: Coccinellidae) for suppression of the San Jose scale, *Diaspidiotus perniciosus* (Comstock) (Hemiptera: Diaspididae) in apple orchards

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**ABSTRACT**: *Chilocorus infernalis* Mulsant (Coleoptera: Coccinellidae) was evaluated against San Jose scale in apple orchards at five locations in farmers' fields in Kashmir during 2008. The predator was released @ 20, 25, 30, 35 / plant three times at 10 days intervals starting from 1st week of June. The population of San Jose scale was recorded before release and a month after release from three apple trees at each location selected at random. All the four rates of release were effective for the control of the scale. Release of *C. infernalis* @ 35 / plant significantly reduced the infestation of the San Jose scale in all locations of Kashmir.

**KEY WORDS**: *Chilocorus infernalis*, apple orchard, suppression, predation, releases, San Jose scale

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## INTRODUCTION

The San Jose scale, *Diaspidiotus perniciosus* (Comstock) (Hemiptera: Diaspididae), is a notorious pest virtually occurring throughout the deciduous fruit growing areas of the world. In India, the pest is believed to have entered Kashmir during the first decade of 20th century along with some flowering plants but its seriousness was felt only in 1922 (Pruthi and Rao, 1951). At present it is considered to be a serious pest of apple, plum, pear and peach in Jammu and Kashmir. In India, efforts have been made for achieving success of biological suppression of fruit pests (Singh, 1980). The work on biological suppression of horticultural pests has been reviewed earlier (Singh, 1989). A number of coccinelid beetles, *Chilocorus infernalis* Mulsant, *C. rubidus* Hope, *Pharoscymnus flexibilis* (Mulsant), etc. (Kapar, 1956; Khan *et al*., 2009), have been recorded feeding on this pest but these beetles were not found to give the desired control. Earlier attempts have been made to utilize *C. infernalis* and *P. flexibilis* in Himachal Pradesh and both species got established and provided reasonable control of San Jose scale, adults survived in the winter and were observed 10km away from the release site in the next season (Rawat, *et al*., 1988). In Kashmir, this bioagent has been reared in laboratory in small quantity only for the study of preying potential against San Jose scale. The present study was undertaken to assess the effectiveness *C. infernalis* for the management of San Jose scale, *D. perniciosus* in apple orchards of Kashmir.

The experiments were conducted in farmers' field at five locations in Syedpora, Dara and Ishber (district Srinagar), Wagoora and Pattan (district Baramulla) during 2008. Adults of *C. infernalis* were taken from the Mass Production of Bioagents Laboratory, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar campus, Srinagar, for the experimentation. *C. infernalis* was released @ 20, 25, 30 and 35 / plant with an untreated control. The doses of *C. infernalis* were released simultaneously three times at 10 days intervals starting from 5th June. Population of San Jose scale was recorded before release and a month after release from the branches of three apple selected at random. Ladybird beetles were released as adults and transported to release sites in plastic ice cream containers (2l), each containing crumpled paper toweling to prevent injury. The containers and toweling were placed within the canopy of scale infested trees and the beetles allowed to disperse without constraint.

**Table 1. Efficacy of field release of** C. *infernalis* **on the population of San Jose scale,** *D. perniciosus* **at different locations of Kashmir**

| Number of *C. infernalis* released / plant | San Jose scale population/cm$^2$ on apple plant at different locations of Kashmir | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Before release | | | | | After release (30 Days after first release) | | | | | % reduction over pre treatment count | | | | |
| | Syedpora | Dara | Ishber | Wagoora | Pattan | Syedpora | Dara | Ishber | Wagoora | Pattan | Syedpora | Dara | Ishber | Wagoora | Pattan |
| 20 | 15.33 (23.05) | 16.66 (24.09) | 16.33 (23.84) | 17.33 (24.60) | 16.33 (23.84) | 10.33 (18.75) | 11.66 (19.97) | 12.66 (20.84) | 12.33 (20.56) | 11.66 (19.9) | 34.00 (35.66) | 33.90 (35.60) | 31.50 (34.14) | 24.00 (29.33) | 30.00 (33.21) |
| 25 | 14.66 (22.52) | 15.66 (23.32) | 14.66 (22.52) | 15.66 (23.32) | 17.66 (24.85) | 9.33 (17.79) | 10.66 (19.06) | 11.33 (19.67) | 11.33 (19.67) | 11.33 (19.67) | 40.40 (39.46) | 39.60 (38.99) | 37.00 (37.46) | 31.90 (34.39) | 32.00 (34.45) |
| 30 | 14.33 (22.24) | 15.33 (23.05) | 14.33 (22.24) | 14.33 (22.24) | 15.33 (23.05) | 8.66 (17.12) | 10.00 (18.43) | 10.66 (19.06) | 10.66 (19.66) | 10.66 (19.66) | 44.60 (41.90) | 43.30 (41.15) | 40.70 (39.64) | 36.10 (36.92) | 36.10 (36.92) |
| 35 | 13.33 (21.41) | 14.33 (22.24) | 13.33 (21.41) | 12.33 (20.56) | 16.66 (24.09) | 8.00 (16.43) | 9.33 (17.79) | 9.33 (17.79) | 10.00 (18.43) | 9.66 (18.12) | 48.90 (44.37) | 47.20 (43.39) | 44.40 (41.78) | 43.90 (41.49) | 42.40 (40.63) |
| Untreated Control | 15.33 (23.05) | 16.66 (24.09) | 16.33 (23.84) | 17.33 (24.60) | 15.33 (23.05) | 15.66 (23.32) | 17.66 (24.85) | 16.66 (24.09) | 18.00 (25.10) | 16.66 (24.09) | – | – | – | – | – |
| C.D. ($P$=0.05) | 0.54 | 0.68 | 0.98 | 0.89 | 0.87 | 1.69 | 1.57 | 1.34 | 1.08 | 1.16 | 2.46 | 3.43 | 2.06 | 1.69 | 1.88 |

Each figure is a mean of three replicates; data in parentheses are arcsine and square root transformed values

The data obtained before and after release were taken into consideration to find out per cent reduction in the population which was calculated by applying a correction factor given by Henderson and Tilton (1955).

$$\text{Percent reduction} = 100\left(1 - \frac{\text{Ta x Cb}}{\text{Tb x Ca}}\right)$$

Where,

$T_a$ = Number of insects after treatment

$T_b$ = Number of insects before treatment

$C_a$ = Number of insects before in untreated control after treatment and

$C_b$ = Number of insects in untreated control before treatment

The data were then analyzed statistically in randomized block design using R-software (R Development Core Team, 2008) after appropriate transformations.

The populations of San Jose scale before release ranged from 13.33 to 15.33 / $cm^2$ on the branches of apple trees at Dara, 13.33 to 16.33 / $cm^2$ at Ishber, 12.33 to 17.33 / $cm^2$ at Wagoora and 15.33 to 17.66 / $cm^2$ at Pattan. The populations at different locations of apple orchards of Kashmir were not significantly different from untreated control (Table 1). After release, the population of San Jose scale decreased and the lowest population (8.00 / $cm^2$) was observed when predators were released @ 35 / plant at Syedpora compared to untreated control and other treatments. At Dara, the minimum population of San Jose scale was observed when predators were released @ 35 / plant, which was at par with release of *C. infernalis* @ 30 / plant (10.0 / $cm^2$) and 25 / plant (10.66 / $cm^2$). The highest population (17.66 / $cm^2$) of San Jose scale was recorded after a month in untreated control, which was significantly higher than all other treatments. At Ishber, the minimum population (9.33 / $cm^2$) was observed when *C. infernalis* was released @ 35 / plant and it was not significantly different from the release of 30 *C .infernalis* / plant, while releases of *C. infernalis* @ 20 / plant and 25 / plant were on par with each other and all the treatments were significantly different from untreated control.

At Wagoora, the minimum population of San Jose scale was observed (10.0 / $cm^2$) when *C. infernalis* was released @ 35 / plant, which was on par with releases @ 30 / plant and 25 / plant. All the doses showed significantly lower population as compared to untreated control. At Pattan, the minimum population was observed (9.66 / $cm^2$) when release were made @ 35 *C. infernalis* / plant, significantly lower than other releases. The other releases decreased the population of San Jose scale and were significantly different from control but the differences among release rates were insignificant (Table 1). Reduction in San Jose scale infestation was observed after release *C. infernalis* @ 20, 25, 30 and 35 / plant after a month at Syedpora, Dara, Ishber, Wagoora and Pattan as presented in Table 1.

The maximum reduction in infestation was recorded (48.90%) when the coccinellids were released @ 35 / plants, which was significantly higher than that obtained with release of @ 20 / plant and 25 / plants and on par with release of 30 / plants (44.60%) at Syedpora. At Dara, the minimum reduction was observed (33.90%) with the release of *C. infernalis* @ 20/plant and the maximum was observed (47.20%) when the predators were released @ 35 / plants. At Ishber, the release of *C. infernalis* @ 20 / plant reduced the infestation by 31.50% and when the release rates was @ 35 / plants, the rate of reduction was also enhanced up to 44.4%. The maximum reduction of 43.90% was observed when coccinellids were released @ 35 / plant, which was significantly higher to other released except to @ 30 / plant and it was significantly higher than other doses at Wagoora. The maximum reduction in infestation of San Jose scale was observed (42.40%) with the release of 35 / plant and it was 30.00% more compared to releases made @ 20 / plant. (Table 1).

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