

RESEARCH NOTES

Introduction, Colonisation and New Records of some Biocontrol Agents of San Jose Scale, *Quadraspidotus perniciosus* Comstock (Hemiptera: Coccidae) in Kullu Valley, H.P., India

J.N. THAKUR¹, A.D. PAWAR² and U.S. RAWAT³

Central Biological Control Field Laboratory, Seobag
Kullu (Himachal Pradesh)

San Jose Scale, *Quadraspidotus perniciosus* Comstock is a serious pest of temperate fruits and is world-wide in distribution. The pest has been recorded on more than 200 different species of plants (Atwal, 1976). In the Himachal Pradesh, the pest was first reported at Kullu in 1921 and at Kotgarh (Shimla) in 1924 (Pruthi and Rao, 1951). At present, it is found all over India where temperate fruits are grown (Tuhan *et al.*, 1979). Himachal Pradesh is known as the fruit State of India, but the serious attack of San Jose Scale particularly on apple, plum and pear resulting in appreciable loss each year is a major concern to the growers. Till recently, insecticidal spray remained as the main tool for pest control, but soon the hidden ill-effects of insecticides and high cost involved in operation came to the notice of researchers and farmers. Therefore, necessity was felt to adopt Integrated Pest Management practices with the least use of insecticides. Control of pests through bioagents is one of the important components of IPM. A detailed list of some bioagents along with places of their origin throughout the world has been reviewed by Tuhan *et al.* (1979). Some of these bioagents were imported by CIBC, Indian Station, Bangalore in late fifties and were released in J & K, Himachal Pradesh and U.P. Later on, Jolly (1961-62) reported the establishment of *Aphytis diaspidis* How. and *Encarsia perniciosi* Tower in H.P. causing 86.5-89%

parasitism. But, our previous surveys (Thakur and Pawar, 1989) could recover only *Aphytis* sp. *proclia* group Walker, Therefore in the present communication, efforts were made to introduce and colonise the exotic natural enemies and detect the native bioagents of San Jose Scale in the valley which could contain the population build up of the pest below economic injury level.

The parasitoids, *Azotus perpecciosus* Girault, *Encarsia perniciosi* Tower and *Teleterebratus perversus* Compere and Zinna and predatory beetle, *Sticholotis marginalis* Kapur were collected from the field in Srinagar (J&K) and brought to the laboratory in 1986. These bioagents were reared on San Jose Scale- infested pumpkins and subsequently released in the field at different localities including Bhuthi, Bajaura, Jari, Bhuntar, Katrain, Nagar and Seobag etc. Orchardists of the respective locality were advised not to use insecticidal sprays where the bioagents have been released. Successive releases were made from April to October each year at the rate of 2000-5000 parasitoids and 50-100 beetles per infested tree depending upon the intensity of the pest and size of tree. In the following years, recovery tests were conducted and available bioagents were collected. Also, scale- infested twigs from each locality were brought to the laboratory for further examination. Cut ends of twigs were waxed to prevent further loss of cell sap.

Present Address : 1. CIPMC, 73, B/B Gandhi nagar, Jammu
2. Dte. of P.P.Q. & S., N.H.IV. Faridabad
3. CIPMC, Solan, H.P.

Table 1. Natural enemies of San Jose Scale recorded during field study in Kulu

Family and species
APHELINID PARASITOIDS
<i>Azotus kashmirensis</i> Narayanan
<i>Azotus perspicuosus</i> Girault
<i>Aphytis</i> sp. <i>proclia</i> group Walker
<i>Encarsia perniciosi</i> Tower
ENCYRTID PARASITOID
<i>Teletrebratus perversus</i> Compere & Zinna
COCCINELLID PREDATORS
<i>Chilocorus bijugus</i> Mulsant
<i>Coccinella septumpunctata</i> Linn.
<i>Oenopia sauzeti</i> Mulsant
<i>Pharoscygnus flexibilis</i> Mulsant
<i>Sticholotus marginalis</i> Kapur

Sets of these twigs were put in glass jars and covered with muslin cloth fastened with rubber bands. Emergence of bioagents from the infested twigs was observed under controlled conditions of temperature ($25 \pm 2^\circ\text{C}$) and relative humidity ($70 \pm 10\%$). Also the immature stages collected from fields were reared till adult emergence. Adults were killed in an atmosphere of ethyl-acetate and preserved in 70% alcohol or pinned for dry preservation. Bioagents obtained were sent for identification to C.A.B. International Institute of Entomology, London for identification.

Recovery tests revealed that all the bioagents brought from Srinagar (J&K) have established themselves well in the new environment after their introduction. Among them, *Aphytis* sp. *proclia* group and *Azotus kashmirensis* Narayanan were also recovered in the field. Among the parasitoids, *Aphytis* sp. *proclia* group and *E. perniciosi* were most common. Similarly, these two species were found most prevalent and sufficient in number contributing jointly to 90-95% parasitism in J & K (Thakur and Pawar, 1989). The combined parasitism by all parasitoids ranged between 58.73 - 71.5% in 1988 and 81.3 - 92.7% in 1989 at different localities. This showed that parasitism is increasing every year and is the impact of introduced parasitoids. In the similar way, Neuffer (1968) reported that in-

roduction of *E. perniciosi* in North America increased the parasitism from 2.3% in 1959 to 60 to 32.8% in 1966-67 and at several places it was 70-90%.

The different types of bioagents recorded during the present study are listed in Table-1. Of these, *A. kashmirensis* and *Oenopia sauzeti* are reported for the first time. Among the predators *C. bijugus*, *P. flexibilis* and *S. marginalis* were very common in the field and keeping good check on the population build up of the scale. Of these, *C. bijugus* was found to be a very good predator having an average feeding capacity of 80 scales per beetle per day (Rawat *et al.*, 1988). At many localities complete destruction of scale was observed only with this predator. Similar to our findings, Munskevshaya (1969) reported that species of *Chilocorus* were most effective and *C. renipustulata* alone destroyed 90% scale population. Identical results were reported by Rawat *et al.* (1988) in Himachal Pradesh.

From the above studies, it is clear that the menace of San Jose Scale could be checked effectively through its bioagents if the same are conserved, augmented and protected from indiscriminate insecticidal sprays. Present need is to educate the farmers so that they are able to recognise their friends (bioagents) and enemies (pests) in their fields. Still our knowledge may be meagre and needs more investigations to have a complete list of bioagents.

ACKNOWLEDGEMENTS

The authors are thankful to the Plant Protection Adviser, Govt. of India, Directorate of P.P.Q & S., N.H.IV., Faridabad for providing necessary laboratory facilities. Also we express our sincere gratitude to Drs. A.C. Booth, A. Palaszek and J.S. Noyes of C.A.B. International Institute of Entomology, London for identification of insect specimens. We also acknowledge the good co-operation of various orchardists during our study.

KEY WORDS: San Jose Scale, parasitoids, predators, investigations, integrated pest management

REFERENCES

- ATWAL, A.S. (ed). 1976. Agricultural Pests of India and South East Asia. PP. 183, Kalyani Publishers, H.O. Rajinder Nagar, Ludhiana.
- JOLLY, C.L. 1961-62. Biological control of San Jose Scale in Himachal Pradesh, Retrospect and Prospect. *Himachal Horticulture*, 2 & 3, 163- 168.
- MUNSKEVSHAYA, Z.S. 1969. Species of *Chilocorus*. *Zashchita Ras.*, 14, 36-38.
- NEUFFER, G. 1968. Die wirksamkeit der Aphelinidae *Prospectella perniciosi* Tower in Sudwest deutschen, Befall sgebeit der San Jose Scale, *Quadraspidiotus perniciosus* Comst. *Schdlingsh.*, 41, 97-101.
- PRUTHI, H.S. and RAO, V.P. 1951. San Jose Scale in India. Directorate of P.P.Q. & S. *Tech. Bull.*, No.3, 1-48.
- RAWAT, U.S., THAKUR, J.N. and PAWAR, A.D. 1988. Role of natural enemies in the Integrated Pest Management Control of San Jose Scale and wooly apple aphid in Himachal Pradesh. *Proceedings of National symposium on IPC-Progress and prospectives*, PP. 182-187.
- TUHAN, N.C., PAWAR, A.D. and PARRY, M. 1979. Biological control of San Jose Scale, *Quadraspidiotus perniciosus* Comstock (Hemiptera Diaspididae). *Plant Prot Bull.*, 31, 73-79.
- THAKUR, J.N. and PAWAR, A.D. 1989. Investigations on the occurrence of natural enemies of San Jose Scale *Quadraspidiotus perniciosus* Comstock (Hemiptera Coccidae) in J & K and Himachal Pradesh. *Entomon*, 14, 143- 146.