J. Biol. Control, 20(2): 219-223, 2006

Research Note

Appropriate packaging for transportation of *Telenomus remus* Nixon (Hymenoptera: Scelionidae) egg cards

C. R. BALLAL, K. R. LYLLA*, S. JOSHI and L. LAKSHMI
Project Directorate of Biological Control (ICAR)
P. B. No. 2491, H. A. Farm Post, Bellary Road, Hebbal
Bangalore 560 024, Karnataka, India
E-mail: ballalchandish@rediffmail.com

ABSTRACT: A novel method was devised for the transportation of parasitized egg cards of the scelionid parasitoid, *Telenomus remu* Nixon. Several consignments of parasitized eggs of *T. remus* were transported and based on the feedback obtained from the receiving station, it was evident that the eggs within the newly designed transportation containers were not damaged in transit. One container can hold 20,000 parasitized eggs and it costs Rs. 20. From this study, it is also evident that it is ideal to transport 0 to 4 day old un-stored eggs. If stored parasitized eggs (0-2 day old) have to be transported, the pre-transportation storage period should not exceed 4 days. This would prevent adult emergence in transit and also ensure that the receiving station has sufficient time to plan field releases prior to adult emergence.

KEY WORDS: *Spodoptera litura*, storage, *Telenomus remus*, transportation

Live beneficial insects have to be transported from one insectary to another or to places where they have to be field released. It is critical to understand the survival capabilities of the insect to be transported and to identify the developmental stage of the insect that is capable of surviving for the anticipated duration of the trip plus a few days in case of delay. For successful transportation of beneficial insects, adequate packing and transportation methods should also be followed (Boldt and Drea, 1980). Purcell *et al.* (1994) reported on emergence losses of 18-58 per cent when braconid parasitoids of fruitfly were transported, which was significantly reduced after packing and transportation procedures were standardized. In India, information is available on the methods to be adopted for packing and transportation of Trichogrammatids (Singh *et al.*, 1994; Jalali *et al.*, 2003), weed insects *Neochetina eichhorniae* and *N. bruchi* (Jayanth, 1988). There is a need to standardize methods of packing and transportation for other potential bio-agents. *Telenomus remus* Nixon is a potential exotic egg parasitoid of *Spodoptera litura* (Fabricius). Since *S. litura* has emerged as a serious pest on crops like tobacco, soybean, cole crops, *Bt* cotton, etc., there is a need to transport this parasitoid from the production units to different regions for field releases.

It is difficult to transport adult parasitoids because of their food requirements. Hence, egg

*Kerala Agricultural University, Vellanikkara 680 656, Thrissur District, Kerala

parasitoids are normally transported as immatures within the host eggs. Loose eggs can be transported by placing them in small tubes plugged with a piece of cotton, with the cotton inserted far enough into the tube to touch the eggs lightly. *Corcyra cephalonica eggs* are stuck to cards, exposed to Trichogrammatid adults and the parasitized cards are folded, ends stapled and transported in plastic boxes. In the laboratory, *T. remus* is reared on *S. litura* egg masses, which are pasted on cards (measuring 7x 1.3 cm), leaving gaps of 0.75 cm on both ends of the cards. These egg cards cannot be folded while packing them as this can damage the parasitised egg masses. The method suggested by Boldt and Drea (1980) is to affix the eggs, which are laid in groups to a substrate and then packing them by pinning or gluing the substrate to the bottom of the transportation container. The main objective of this study was to devise an appropriate packaging technology for the transportation of parasitized eggs of *T. remus* and to also to identify the right age for transportation. Parasitised egg cards are generally held at low temperatures in order to prolong the period over which they remain viable so that they could be utilized at the required time. In the present study, attempts were also made to identify the optimum pre-transportation storage period.

In the present study, a container was designed and tested for packing and transportation of parasitized egg cards of *Telenomus remus*. The container was designed by utilizing plastic boxes measuring 12 x 8 x 3.5 cm and a fine wire mesh (measuring 5 x 3 cm) was fixed to the lid for aeration. In order to provide support to the cards during transportation, they were fixed on to thermocol strips (measuring 7.5 x 2.5 x 1.5 cm) with slits, which were fixed firmly within the container on two sides (Fig. 1). The two ends of each parasitized egg card were fixed to the slits on either side. Figure1 shows that there are five slits on the strips in which five cards can be fixed. If more cards are to transported, in each slit two cards can be fixed with the empty side of each card facing and touching each other and the side with the eggs glued on it facing away from each other. This whole set-up was aimed to prevent the egg cards from getting damaged within the transportation container during transit.

Parasitized egg cards of *T. remus* were transported in the newly designed transportation containers through courier service to Trichur in Kerala. Parasitized eggs of different ages (0-2, 3-4, and 5-6 days after exposure) were transported to identify the appropriate age for transportation. Production units generally store parasitized egg cards at 15 ± 1°C (60 ± 2% RH) in order to stagger the developmental period. In the present study 0-2 day old parasitized *T. remus* cards, stored at the above temperature for different durations, *i. e.* 2, 4, 6 and 8 days, were transported to find out the optimum pre-transportation storage duration. Each treatment was replicated thrice. For all the treatments, parallel control batches were maintained in the laboratory. The receiving station was provided information (through email) on the date of exposure, expected date of emergence, date of transportation and courier number. The consignments were sent during the months of March - April, when the humidity was extremely low (40 – 50%) at the receiving station. Hence, the receiving station was advised to place the egg cards in tubes, which in turn had to be placed on moist sponge to maintain the humidity at 60-70 per cent to avoid drying of the eggs. For each consignment, feedback data were obtained from the receiving station on parameters like the condition of the consignment, date of receipt, date of emergence and per cent adult emergence.

From the feedback data, it could be derived that the parasitized egg masses pasted on the cards were intact within the containers on reaching the destination. It is evident from earlier studies that the lesser time the insects are in the package; the better will be their survival rate. Except for two of the consignments, which reached after 5 days from the date of transportation, all the other consignments reached in 1 to 2 days. The parasitoids generally emerge 9 to 12 days from the date of exposure. In the present experiment, in all cases, emergence occurred only after the egg cards reached the destination. In the unstored batches, 80 to 90 per cent adult emergence occurred in 9 to 10 days from the date of exposure, which was comparable to the control batch.

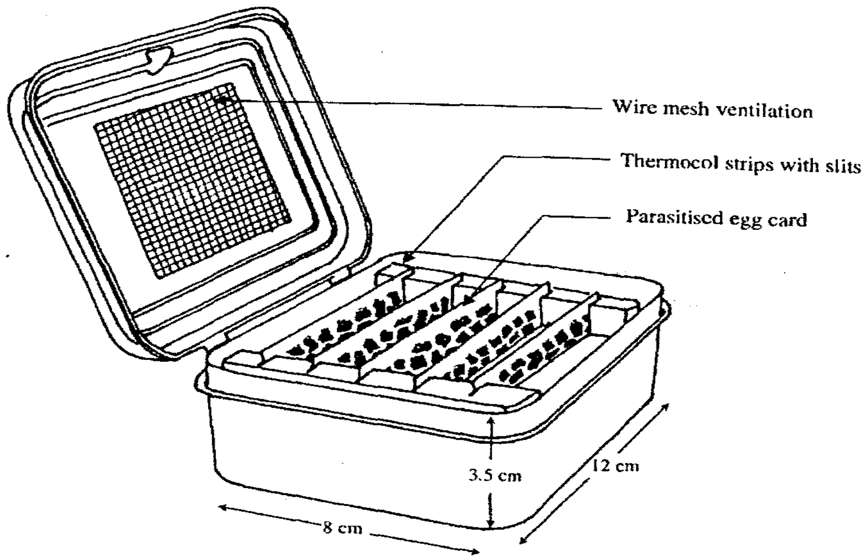

Fig. 1. Shipment container for transport of parasitized egg cards of *Telenomus remus*

For successful utilization of biocontrol agents, adults should not emerge from the parasitized egg cards either in transit or immediately after reaching the destination so that the receiver of the consignment gets sufficient time for planning field releases. Adult emergence occurred 6, 4 and 2 days after receipt in the case of 0-2, 3-4 and 5-6 day old eggs, respectively (Fig 2). Hence, it is evident that if unstored eggs are to be transported, it is ideal to choose 0 to 4 day old eggs so that the receiving station has 4 to 6 days time to plan field releases. This can also prevent adult emergence in transit, especially in cases where the consignment does not reach the destination within two days.

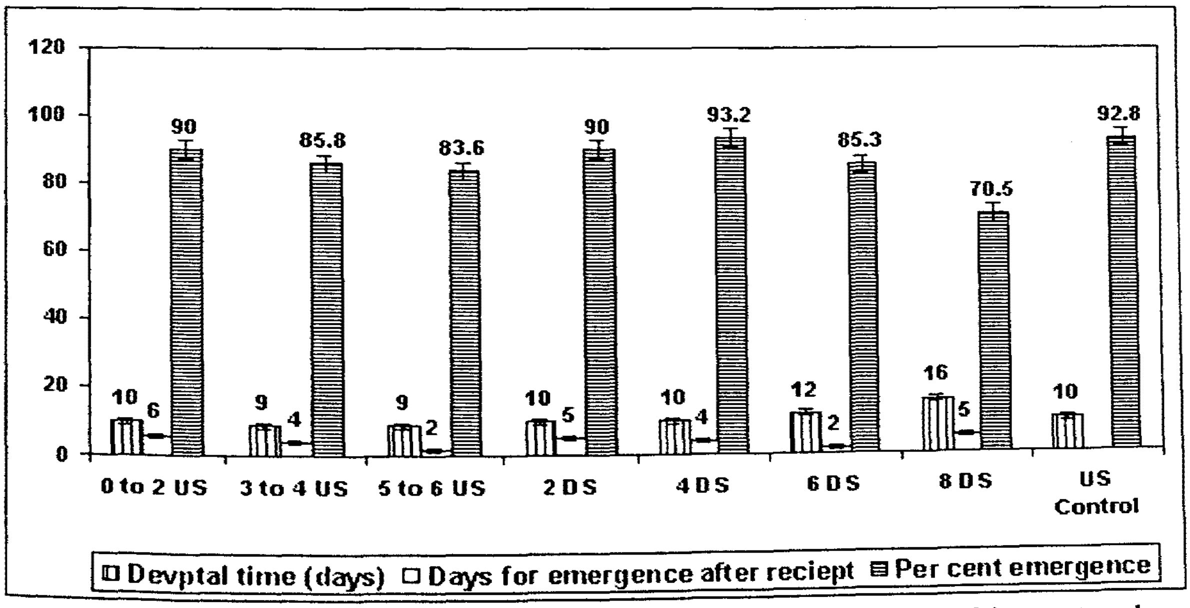

Fig. 2. The total developmental time, the days for emergence after receipt of shipment and per cent parasitism of unstored (US) and stored parasitized egg cards of *T. remus* (DS: Days in storage)

Earlier studies have reported on the optimum storage temperature and duration for *T. remus* egg cards with respect to their emergence after removal from storage (Gautam, 1986; Kumar *et al.*, 1984). However, no information is available on the post shipment quality of stored *T. remus* egg cards. In the present study, when the stored parasitized egg cards were transported, adults emerged in 10 days from date of exposure in both 2 and 4-day-storage batches and in 12 days in 6-day-storage batches (Fig 2). However, developmental period increased to 16 days in 8-day-storage batches. Per cent adult emergence was 85 to 93 per cent in the 2 to 6 day storage batches, which was comparable to the control batches. Though storing for 8 days could prolong developmental period, adult emergence was reduced (mean 70.5%). In the case of 2, 4, 6 and 8-day-storage batches, emergence occurred in 5, 4, 2 and 5 days, respectively, from date of receipt. Thus it is evident that if stored *T. remus* parasitized eggs have to be transported, the storage period should not exceed 4 days. This would ensure that the receiver gets 4 to 5 days to plan field releases.

The post shipment quality of *Trichogramma chilonis* Ishii supplied by different commercial producers was evaluated in India (Romeis *et al.*, 1998; Ballal *et al.*, 2005) and it was observed that in several of the consignments, adult emergence occurred either in transit or within a day after receipt of the consignment. It was also observed by Ballal *et al.* (2005) that two of the cardboard cartons used by private insectaries to pack and transport Tricho cards were crushed and damaged in transit. The newly designed transportation container is made of thick plastic and hence is durable and the mesh fixed to the lid provides adequate ventilation.

The *T. remus* transportation container was fabricated utilizing easily available materials. The whole unit comprising the plastic container with its mesh window and thermocol support costs Rs. 20 each. In one container, 10 *T. remus* cards holding 20,000 parasitised eggs can be sent. Thus, 5 such boxes (totally costing Rs. 100) would be required for sending *T. remus* cards for one hectare area (@ 100,000 eggs/ ha). O' Neil *et al.* (1998) assessed the quality of natural enemies shipped by different commercial companies and they reported notable differences in survivorship and emergence rates, which depended not only on the supplying company, but also on the packing media and the time of the year when the supplies were made. It is felt that in-depth studies are required on the transport of bio-agents during different seasons. There is a need for researchers to accumulate data on the condition of consignments of all the potential bio-agents (when they reach the consumers) and relate it with the packaging and transportation procedures followed by each supplier. The objective basis to judge the performance of a company should not only be based on the performance of the bio-agents, but also on the standards of packaging and transportation procedures followed.

ACKNOWLEDGEMENT

The authors are grateful to the Project Director, Project Directorate of Biological Control, for providing the basic research facilities.

REFERENCES

Ballal, C. R., Srinivasan, R. and Chandrashekhar, B. 2005. Evaluation of quality of *Trichogramma chilonis* Ishii from different production units in India. *Journal of Biological Control*, **19**: 1-8.

Boldt, P. E. and Drea, J. J. 1980. Packaging and shipping beneficial insects for biological control. *Plant Protection Bulletin, FAO*, **28**: 64-71.

Gautam, R. D. 1986. Effect of cold storage on the adult parasitoid *Telenomus remus* Nixon (Hymenoptera: Scelionidae) and the parasitised eggs of *Spodoptera litura* (Fabr.) (Lepidoptera: Noctuidae). *Journal of Entomological Research*, **10**: 125-131.

Jalali, S. K., Rabindra, R. J., Rao, N. S. and Dasan, C. B. 2003. *Mass production of Trichogrammatids and Chrysopids. Technical Bulletin No. 33*. Project Directorate of Biological Control, Bangalore. 16 pp.

Jayanth, K. P. 1988. A simple packing method for large – scale shipment of water hyacinth weevil (*Neochetina eichhorniae* and *N. bruchi*). *Journal of Biological Control*, **2**(2): 139-140.

Kumar, D. A., Divakar, B. J. and Pawar, A. D. 1984. Observation on the storage of life stages of *Telenomus remus* Nixon (Hymenoptera: Scelionidae) under low temperature. *Plant Protection Bulletin, India*, **36**: 13-14.

O'Neil, R. J., Giles, K. L., Obrycki J. J., Mahr, D. L., Legaspi, J. C. and Katovich, K. 1998. Evaluation of the quality of four commercially available natural enemies. *Biological Control*, **11**: 1-8.

Purcell, M. F., Daniels, K. M., Whitehand, L. C. and Messing, R. H. 1994. Improvement of quality control methods for augmentative releases of fruitfly parasitoids, *Diachasmimorpha longicaudata* and *Psyttalia fletcheri* (Hymenoptera: Braconidae). *Biocontrol Science and Technology*, **4**: 155-166.

Romeis, J., Shanower, T. G. and Jyothirmayi, K. N. S. 1998. Constraints on the use of *Trichogramma* egg parasitoids in biological control programmes in India. *Biocontrol Science and Technology*, **8**: 289-299.

Singh, S. P., Jalali, S. K., Bhumannavar, B. S., Bakthavatsalam, N. and Pushpalatha, N. A. 1994. Production and use of Trichogrammatid egg parasitoids. *Technical Bulletin* No. 11.Project Directorate of Biological Control, Bangalore. 16 pp.