COMMERCIAL INUNDATIVE RELEASES OF 
TRICHOGRAMMATOIDEA CRYPTOPHLEBIAE 
[HYM. : TRICHOGRAMMATIDAE] AGAINST 
CRYPTOPHLEBIA LEUCOTRETA 
[LEP. : TORTRICIDAE] IN CITRUS

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Inundative releases of the egg parasitoid Trichogrammatoidea cryptophlebiae Nagaraja were made against Cryptophlebia leucotreta (Meyrick) on 5 commercial citrus farms in the western Cape Province, South Africa, over 2 successive seasons. A target release volume of 80 000 parasitoids ha\(^{-1}\) week\(^{-1}\) was established for releases over 29 and 33 weeks during the 2 seasons. Total seasonal volumes reached an equivalent of 2.3 and 3.8 million parasitoids ha\(^{-1}\) respectively. Compared with check treatments on each farm, larval population size was reduced in the release areas by 54 % in the 1\(^{st}\) and by almost 60 % in the 2\(^{nd}\) season. Percentage crop loss was reduced by 49.4 ± 12.4 and 61.1 ± 8.3 % respectively. Treatment effects were clearly related to increases in rate of parasitism measured in both artificially-placed and in native C. leucotreta egg populations. Treatment efficacy is similar to that obtained with applications of chitin synthesis inhibitors but parasitoid production costs are 30 % of insecticide costs. Manual distribution of parasitoids is labour intensive, however, and further studies should investigate whether inoculative releases at higher rates per week over a shorter period, are effective.

KEY-WORDS: biological control, egg parasitoids, orchard pests, false codling moth.

Considerable emphasis has been placed on the biological control of the false codling moth, Cryptophlebia leucotreta (Meyrick) (Anonymous, 1984). Since Catling & Aschenborn (1974) recognized the potential of augmentative/inundative releases of an egg parasitoid, Trichogrammatoidea cryptophlebiae Nagaraja, this indigenous trichogrammatid has been the focal point of attempts at suppression on citrus in southern Africa.

In the winter rainfall areas of the western Cape Province, South Africa, the citrus season begins with flowering in September-October. The early ripening navel cultivars, which are most susceptible to C. leucotreta, are generally harvested the following May-June. Oviposition by C. leucotreta occurs on fruitlets immediately after petal drop and continues

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until harvest, usually reaching a peak during the December-February period. Up to 4 generations may be completed during the navel orange fruiting season. On citrus, the egg is laid directly on the fruit surface and the emerging larva burrows into the fruit. The resultant lesion and subsequent feeding lead to premature fruit ripening and abscission. Fruit lesions also allow secondary fungal invasion and fruit loss, irrespective of the degree of early larval mortality. Late larval instars generally escape from fallen fruit to complete the pupal stage in leaf litter or the soil surface.

Most control attempts have, therefore, been directed at the egg stage of *C. leucotreta*. Following the recommendation of Catling & Aschenborn (1974), experimental trials of inundative releases of *T. cryptophlebiae* aimed to augment their numbers in orchards throughout as much of the citrus fruiting season as possible. These early tests led to crop savings which were regarded as economically cost-effective (Schwartz, 1980, 1981). Subsequently, commercial applications were able to reduce damage to an acceptable level after an unprecedented outbreak of the pest in the western Cape Province (Schwartz et al., 1982). These successes led to almost 20% of the local industry adopting mass-rearing and release programmes. However, heavy crop losses persisted in some areas while, in others, the release programmes had no clear impact in comparison with similar farms which relied on the activity of native *T. cryptophlebiae* populations. Further experimental attempts at inundative releases later indicated that the different degrees of success observed in otherwise apparently similar situations could be explained, in part, by aspects of the searching characteristics of the female parasitoid (Newton, 1988b). The agricultural efficiency of egg parasitism also appeared to be critically determined by pest pressure and its influence on the distribution of host eggs on fruit (Newton, 1988a).

It was proposed that strategies for controlling the pest using this indigenous egg parasitoid should examine 2 issues. The outcome of attempts to follow one of those strategies, combined applications of chitin synthesis inhibiting insecticides and releases of *T. cryptophlebiae*, is reported by Newton (1989). In the present study, we have examined a 2nd approach: whether high volumes of *T. cryptophlebiae* releases could overcome any adverse characteristics of its searching behaviour and functional response, and lead to reliable suppression of damage by *C. leucotreta*.

**METHODS**

**EXPERIMENTAL SITES**

Treatments were applied to navel sweet orange, *Citrus sinensis* (L.), orchards on 5 commercial farms, designated A to E, in the Citrusdal area of the western Cape Province, South Africa (32°34' S 18°59' E). On each farm, 2 orchards of similar age, and scion and rootstock cultivar were selected. A standard integrated pest management programme (Bedford et al., 1985) was applied to all orchards, and a programme of releases of *T. cryptophlebiae* was assigned randomly to one of each pair. All sampling in both treatments, and the parasitoid releases themselves, were confined to a central plot of 100-trees (10 x 10 rows) within orchards. The parasitoid release and non-release (check) treatments were alternated between the 2 orchards on a farm over 2 successive fruiting seasons: November 1986 - June 1987; and November 1987 - June 1988.

**PARASITOID RELEASES**

Weekly releases of *T. cryptophlebiae* commenced on 15 December 1986 (designated week 0) and continued for 29 weeks, until 29 June 1987, in the 1st season; and were made over