INTRODUCTION OF *COTESIA RUBECULA*, A PARASITOID OF WHITE BUTTERFLY

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Introduction of the white butterfly parasitoid *Cotesia rubecula* (Marshall) (Hymenoptera: Braconidae) was proposed because the existing larval parasitoid *Cotesia glomerata* (L.) is not well synchronised with its host and often provides insufficient control in vegetable brassicas (Beck and Cameron 1992). *C. rubecula* kills larvae at a smaller stage than *C. glomerata* and therefore reduces feeding damage by the pest. Richards (1940) reported that *C. rubecula*, a native of Europe, was the most common parasitoid of white butterfly *Pieris rapae* (L.) (Lepidoptera: Pieridae) in the UK. It has also established in Asia, Ontario, Missouri and has become the dominant parasitoid in British Columbia and in southern parts of Australia (Cameron 1993). This paper briefly documents the specificity assessment of *C. rubecula* and its introduction into New Zealand.

In the UK, *C. rubecula* was almost entirely specific to *P. rapae* and very exceptionally it attacked *P. brassicae* (Richards 1940) or *P. napi* (Shenefelt 1972). In North America and Australia, *C. rubecula* was recorded as an obligate parasitoid of *P. rapae* (Nealis 1990). In Europe, Shenefelt (1972) and Mustata (1992) listed *C. rubecula* as a rare parasitoid of diamondback moth *Plutella xylostella* (L.) (Lepidoptera: Yponomeutidae) but the host identifications were not authenticated. Diamondback moth has never been recorded as a host in Australia (Austin and Dangerfield 1992; M.A. Keller unpublished).

Host location studies also provide measures of the specificity of *C. rubecula*. Richards (1940) noted that *C. rubecula* was first attracted to areas of cabbage and noted zero parasitism of *P. rapae* in other locations. Agelopoulos and Keller (1994) investigated the effects of kairomone release on the flight approach of *C. rubecula* and demonstrated that volatiles play an important role in guiding *C. rubecula* to Lepidoptera on brassicas.

Ecological and behavioural measures of the specificity of *C. rubecula* were provided by observations on the relatives of *P. rapae* in Australia. The pierid *Anaphaeis java* (Sparman) occurs close to mixed crops where *C. rubecula* is common but it is apparently not parasitised by *C. rubecula* (Austin and Dangerfield 1992; M.A. Keller unpublished). This host specificity was confirmed in laboratory experiments we carried out in Adelaide with the *C. rubecula* culture proposed for release in New Zealand. In wind tunnel experiments *C. rubecula* was clearly attracted to *P. rapae* but not to *A. java*. Similarly, *C. rubecula* could not be reared from *Bassaritis itea* (F.) (Nymphalidae) (yellow admiral) a relative of *P. rapae* that is present in both Australia and New Zealand. Flight tunnel tests also showed that *C. rubecula* was not attracted to and would not oviposit in *B. itea*.

Confirmatory oviposition tests were carried out in New Zealand by exposing parasitoids to relatives of *P. rapae* in the Papilionoidea - *B. itea*, *Danaus plexippus*, *Zizina labradus*; and to species that might be encountered in vegetable crops - the Noctuidae *Agrotis ipsilon*, *Helicoverpa armigera*, *Thysanoplusia orichalcea*, *Graphania mutans*, *Uresiphita polygonalis* (Pyralidae), *Epiphyas postvittana* (Tortricidae), *Phrissogonus laticostatus* (Geometridae), and *P. xylostella*. Individual

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mated female parasitoids were exposed in 10 x 2.5 cm tubes to single larvae of alternate species, each for a period of 5 minutes. This time was sufficient for females to locate the larvae, unless active avoidance occurred. Ten to 24 larvae of each species were tested and all larvae were within the 3-10 mm range suitable for oviposition. To confirm that females were capable of oviposition, every second or third alternate host was *P. rapae*. Larvae were either tested with no plant matter, or on their usual host plant, or after confinement on cabbage. Oviposition was obtained only with *P. rapae*, but occasional oviposition-like probing was observed with *G. mutans* and *P. xylostella* on cabbage. The 10 larvae (from a total of 144) that were subjected to probing were reared or dissected but no parasitoid cocoons formed, nor were parasitoid eggs or larvae present. It was concluded that this behaviour was used by parasitoids to search damaged cabbage leaves for host stimuli. In longer exposures of 16 hours, parasitoid development was similarly obtained in *P. rapae* only. Choice experiments with *P. rapae* and *G. mutans* or *P. xylostella* showed that parasitoids would walk over other species to selectively oviposit in adjacent *P. rapae*.

It was concluded that the Australian source of *C. rubecula* was specific to the genus *Pieris*. Following the submission of an Import Impact Assessment, permission to release was obtained and the parasitoid was first released on 22 December 1993 (Table 1).

The releases (Table 1) were based on four shipments totalling 298 *C. rubecula* supplied by the University of Adelaide in South Australia. Females from the source culture were mated with field collected males in Australia to maintain the genetic variability in the shipments. In New Zealand, all importations were reared individually for at least two generations to ensure each shipment contributed parasitoids for release. A disease free culture of *P. rapae* was established on cabbage to provide small larvae for parasitism. The resulting cocoons of *C. rubecula* were harvested for release, placed in 20 x 5 cm cardboard tubes (100-200/tube) with a small exit hole at one end, and supplied with agar-honey-sugar as food for the emerging adults. These release containers were placed in small shelters at canopy height in brassica field sites where larvae of *P. rapae* were present. Sites were located at research stations or organic gardens where a succession of unsprayed brassica crops were planted.

At frequently sampled sites in the Auckland region, parasitised larvae were recovered within 2-4 weeks. Parasitism was assessed by collecting and rearing a minimum of 40 larvae from 20 or more plants. High rates of parasitism at experimental release sites in Kumeu (70-80%) and Pukekohe (61-97%) were associated with lower survival of larvae to the fifth and most damaging instar. This relationship is currently being quantified. *C. rubecula* was reared from larvae collected in November 1994 in Auckland and Canterbury, confirming overwinter survival at a range of latitudes that contrasted with the total mortality recorded by Biever (1992) at latitudes lower than 44°35' in Oregon. The widespread recoveries and high parasitism rates (Table 1) show that there are now substantial populations of *C. rubecula* that are likely to persist in New Zealand.

TABLE 1: Releases and recoveries of *Cotesia rubecula* to May 1994, and overwintering success.

Region	Release sites	1st release	Number released	Recovery sites	Over-wintered (sites)	Peak parasitism (%)
Northland	2	22/2/94	156	2	0	25
Auckland	9	22/12/93	6,253	7	4	97
Levin	3	3/3/94	1,214	3	0	89
Canterbury	2	10/3/94	1,030	2	1	71
Gore	1	8/3/94	903	1	0	54
Total	17		9,456	15	5	

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REFERENCES

- Agelopoulos, N.G. and Keller, M.A., 1994. Plant-natural enemy association in the tritrophic system, *Cotesia rubecula*-*Pieris rapae*-Brassicaceae (Cruciferae): I. Sources of infochemicals. *J. Chem. Ecol.* 20: 1725-1732.
- Austin, A.D. and Dangerfield, P.C., 1992. Synopsis of Australian Microgastrinae (Hymenoptera: Braconidae), with a key to genera and description of new taxa. *Invert. Taxonomy* 6: 1-76.
- Beck, N.G. and Cameron, P.J., 1992. Developing a reduced spray programme for brassicas in New Zealand. Pp 341-350 *In*: Takekar N.S. (Ed.); Diamondback moth and other crucifer pests, AVRDC publ., Tainan.
- Biever, K.D., 1992. Distribution and occurrence of *Cotesia rubecula* (Hymenoptera: Braconidae), a parasite of *Atogeia rapae* in Washington and Oregon. *J. Econ. Entomol.* 85: 732-742.
- Cameron, P.J., 1993. Import impact assessment for release of *Cotesia rubecula* from quarantine for control of white butterfly. Report for MAF Regulatory Authority, Crop & Food Research, Auckland, 20 pp.
- Mustata, G., 1992. Role of the parasitoid complex in limiting the population of diamondback moth in Moldavia, Romania. Pp 203-212 *In*: Diamondback Moth and Other Crucifer Pests, Talekar N.S. (Ed.); AVRDC publ., Tainan.
- Nealis, V.G., 1990. Factors affecting the rate of attack by *Cotesia rubecula* (Hymenoptera: Braconidae). *Ecol. Ent.* 15: 163-168.
- Richards, O.W., 1940. The biology of the small white butterfly (*Pieris rapae*), with special reference to the factors controlling its abundance. *J. Anim. Ecol.* 9: 243-288.
- Shenefelt, R.D., 1972. Braconidae 4, Microgastrinae, *Apanteles*. Pp 429-668 *In*: Hymenopterum catalogus, J. van der Vecht and R.D. Shenefelt (Eds), Part 7, Dr W. Junk, Gravenhage.