Results of a two-year study on bioethology and control of chestnut orchard key-pest *Curculio elephas* (Gyll.) (Coleoptera, Curculionidae) in Central Italy

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Abstract

Detailed studies were conducted over a two-year period (1998-1999) on bioethology and control of *Curculio elephas* (chestnut weevil). It was confirmed development and timing of the biological cycle of the species in central Italy, as it was outlined in previous studies (Cinti et al. 1993, Speranza 1999). In some biotopes, this phytophagous insect represents the key-pest of chestnut orchards. Two active ingredients (Lamda-Cyhalothrin and Rotenone) recommended for chemical control of adult populations *of C. elephas* were also tested.

Material and Methods

The study was conducted in a chestnut orchard near Vallerano (Viterbo, Italy, 413 m a.s.l.). In the orchard, cv. "Castagna" (Maschio o Velletrana) is predominant, while to a little extent cv. "Marrone" is also present (Bignami, 1990). Population density in the orchard is 1000 plants m^{-2} (10 m x 10 m). The chestnut weevil is strongly present in the area.

Trials were carried out in 1998 and 1999 in experimental plots sub-divided into two units of about half hectare each, at around 20 m of distance each other, the one treated and the other not treated (control).

In 1998, a treatment with the active ingredient (a.i.) Lamda-Cyhalothrin was applied on September 3 when, by the shaking method, 1.5 females (with ovarian eggs) per plant were recorded (Table 1). The commercial product used was Karate Xpress (Solplant) at the rate of 250 g diluted in 100 l of water. At harvest, carried out at the end of September, 8340 nuts per treated plot and 1050 nuts per untreated plot were randomly sampled from the ground. On nut samples, at monthly intervals until the end of December, infestation was determined in laboratory by counting nuts presenting the typical exit hole of larvae.

In 1999, chestnuts were treated with the a.i. Rotenone (*Derris elliptica*). The same methodology as in the previous year was used. The treatment was carried out on 1 September 1999 at the rate of 250 g diluted in 100 l of water. The commercial product used was *Derris elliptica* of Serbios Company. At harvest, carried out in October, 3500 and 1800 nuts were collected from treated plot and untreated plot, respectively. Infestation was determined with the same methodology as in the previous year, by monthly counting until January 2000.

Dates	male	female
2°August	0	0
3°August	0,475	0,7
4°August	3,7	1,375
1°September	3,55	1,35
2°September	1,125	0,85
3°September	0,35	0,1
4°September	0,075	0,05

Table 1. Chestnut weevils recorded per plant just before treatment of plots with Lamda-Cyhalothrin

Results and discussion

- 1998 (a.i. Lamda-Cyhalothrin)

The average infestation recorded at harvest on untreated and treated plots was 19.00 and 5.70 %, respectively (Table 2). During the following periods of nuts storage, percentage of infested nuts from the untreated plot rose up to 29.89 % at last recording (December 1998). On the contrary, percentage of infested nuts from the treated plot did not increase over the same period. The difference in percentage of infested nuts between treated and untreated plot resulted to be highly significant ($P < 0.01$).

	Infestation %	
Dates	Not treated	Treated (Lamda-Cyhalothrin)
Sep-98	19,00	5,70
27/10/98	22,15	5,92
18/11/98	28,38	6,11
22/12/98	29,89	6,31

Table 2. Percentage of nut infestation picked from treated with Lamda-Cyhalothrin vs. untreated plots

- 1999 (a.i. Rotenone)

The average infestation recorded at harvest on untreated and treated plots was 21.75 and 12.34 %, respectively (Table 3). During the following periods of nuts storage, percentage of infested nuts from the untreated plot rose up to 41.18 %, while percentage of infested nuts from the treated plot did not increase as compared to that recorded at harvest. In 1999, higher nut infestation occurred as compared to 1998; nevertheless, chemical control gave still good results. The difference in percentage of infested nuts between treated and untreated plot resulted to be highly significant ($P < 0.01$).

Infestation %		
Dates	Not treated	Treated (Rotenone)
5/10/1999	21,75	12,34
2/11/1999	31,72	13,3
6/12/1999	40,52	14,26
11/1/2000	41,18	14,43

Table 3. Percentage of nut infestation picked from treated with Rotenone vs. untreated plots

Results of the two-year period of trials lead to suggest that a hidden infestation is present in nuts at harvest and at trading; the infestation will become evident during storage, over the following two-three months. This is due to the presence in nuts of pre-imaginal stages of weevil in various developmental phases. In turn, this can be due to timing of exit of adults from the soil, and so to timing of egg lay (Menu et al., 1995).
Results also showed that weevil is widespread over Cimini mountains (Viterbo, Central Italy), but only in some areas it is particularly damaging (more than 50% of infested nuts).
Confirming the insect biology also led to define proper time of treatments against adults. Trials of control of insect adult populations gave good results using either Lamda-Cyhalothrin (synthetic a.i.) or Rotenone (biological a.i.). However, the use of lower environmental impact, biological a.i. should be preferred, given the complexity of the chestnut ecosystem and the particular bioethology of this insect. Attention, however, should be paid to the problem of a.i. registration for treatments in chestnut orchards.
Promising results were obtained by the use of a microbiological insecticide (a.i.: *Beauveria bassiana* (Balsamo) Vuill., Deuteromycotyna: Hyphomycetes) against larvae overwintering in the soil (Paparatti and Speranza, 1999). Trials to check the effect of an entomopathogen nematode are also in progress.
These new control methodologies could be integrated with agronomic practices (use of plastic films under the plant canopy to avoid burial of larvae, mechanical harvest), to allow high quality, environmentally sound productions of the ecosystem chestnut (Vitagliano et al., 1993).

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