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Detection and Monitoring of *Epicometis hirta* Poda and *Tropinota squalida* Scop. with the Same Trap

M. TÓTH[1]*, J. VUTS[1], F. DIFRANCO[2], R. TABILIO[3], B. BARIC[4], J. RAZOV[5], T. TOSHOVA[6], M. SUBCHEV[6] and I. SREDKOV[7]

[1]Plant Protection Institute, HAS, P.O. Box 102, H-1525 Budapest, Hungary
[2]CRA – Centro di Ricerca per l'Agrumucoltura e le Colture Meridionali, Corso Savoia 190., I-95024 Acireale (Catania), Italy
[3]Instituto Sperimentale per la Frutticoltura di Roma, Via di Fioranello 52., I-00040 Ciampino Aeroporto (RM), Italy
[4]Department of Agricultural Zoology, Faculty of Agriculture, University of Zagreb, Svetosimunska 25., HR-10000 Zagreb, Croatia
[5]Department of Mediterranean Agriculture and Aquaculture, University of Zadar, Mihovila Pavlinovica bb., HR-23000 Zadar, Croatia
[6]Zoology Institute, BAS, blvd. Tzar Osvoboditel 1., BG-1000, Sofia, Bulgaria
[7]Institute of Agriculture, BG-2500, Kyustendil, Bulgaria

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There was no significant difference in the mean catch of *Tropinota squalida* Scop. (Coleoptera: Scarabaeidae, Cetoniinae) in white or blue traps with the floral bait consisting of (*E*)-cinnamyl alcohol plus (*E*)-anethol (which is the previously optimized floral bait for the closely related scarab *Epicometis hirta* Poda). Therefore we concluded that both scarabs can be trapped efficiently with the same trap, which could be advantageous from the practical point of view. In seasonal monitoring trials conducted at 8 sites in Europe using blue traps with the floral bait, adult beetles of both *T. squalida* and *E. hirta* were successfully detected and their flight pattern was clearly established. At the site in Sicily (Italy) only *T. squalida* was present, while in Bulgaria, Croatia and Hungary only *E. hirta* was captured. At a site near Rome (Italy) both scarabs were caught.

Keywords: *Epicometis hirta, Tropinota squalida,* blue colour, (*E*)-cinnamyl alcohol, (*E*)-anethol, trapping.

Adults of the scarab beetle *Epicometis hirta* Poda (Coleoptera: Scarabaeidae, Cetoniinae) cause significant damage by feeding on the reproductive parts of the flowers or ripening fruit of cultivated plants all over Europe, especially in the temperate parts (Endrödi, 1956; Hurpin, 1962; Homonnay and Homonnayné-Csehi, 1990). Damages have frequently been reported on flowers of apple, cherry, sour cherry, and many other spring-blossoming fruit trees. They are important pests of ripening strawberry and also of other berries (Sivcev et al., 2006). They damage frequently also cereals, first of all ears of rye (Homonnay and Homonnayné-Csehi, 1990). They chew the petals, staminae and stigmae thus rendering the flower infertile. They can damage not only flowers in full blossom, but also in the bud stage (Hurpin, 1962). The grub (larva) lives in the soil, feeds on rotting plant material, it causes no damage (Endrödi, 1956).

The closely related and morphologically very similar *Tropinota squalida* Scop. is more widespread in the Mediterranean (Hurpin, 1962). The species has similar pest per-

* Corresponding author; e-mail: h2371tot@ella.hu

formance and importance as *E. hirta.* In Sardinia and Sicily, for example, the adult beetles feed on buds, sprouts and clusters of grapevine, and, as a consequence, can cause great damage to the crop (Mineo, 1964; Ortu et al., 2001). In Egypt alone *T. squalida* was reported to attack more than two dozen orchard trees and ornamental plants (Ali, 1988). Regular damage in orange and apple orchards have been reported (Abdalla, 1991; El Dein et al., 1993; Haydar et al., 1993).

E. hirta, similarly to many other day-active insects feeding on flowers, exploits both chemical and visual stimuli in feeding site location. Adults are strongly attracted to objects of light blue colour (Kozár, 1972). When directly comparing blue, yellow, fluorescent yellow, and white traps it was reported that all colours attract the beetles (as compared to transparent traps), but traps in blue showed highest catches in all experiments (Tóth et al., 2005).

As for chemical attractive stimuli for *E. hirta,* a binary floral attractant consisting of (*E*)-cinnamyl alcohol and (*E*)-anethol has been optimised (Tóth et al., 1998, 2003, 2004). These compounds are common flower scent constituents (Knudsen et al., 1993).

When studying the relative importance of the chemical and the visual stimuli, it was found that catches of *E. hirta* were highest when traps were of blue colour and contained the binary chemical attractant also (Schmera et al., 2004). Such traps are in use today in Central and Eastern Europe for monitoring and mass trapping of *E. hirta* (Mircheva et al. 2004; Tóth et al., 2005; Sivcev et al., 2006).

In *T. squalida,* adult beetles were reported to respond to objects in white colour (El Dein et al., 1993; Ortu et al., 2001), but attraction to other colours has also been reported (Ali, 1993; Haydar et al., 1993). On the chemical side, in preliminary tests significant attraction to traps baited with the single compounds (*E*)-cinnamyl alcohol or (*E*)-anethol has also been reported (Ortu et al., 2001, 2003).

It appears from the literature data cited above that host finding is controlled by similar visual and chemical cues in both scarabs. The objective of the present research was to investigate whether both *E. hirta* and *T. squalida* can be detected and monitored with the same trap, notably the blue funnel trap baited with the floral mixture of (*E*)-cinnamyl alcohol and (*E*)-anethol. Therefore first we compared efficiency of white vs. blue traps containing floral baits on *T. squalida,* and then we performed seasonal monitoring trials in several countries of Europe to check the performance of the trap for the capture of both scarabs in “real-life” detection and monitoring situations.

Materials and Methods

Experimental sites

Tests were run at several sites in Europe *(Table 1).* The distance between traps was at least 10–15 m. Traps were set up in sunny places, attached to poles or suspended from the vegetation at a 30–40 cm height above ground. Traps were inspected at some days’ intervals (preferably twice weekly), when captured insects were recorded and removed. For other experimental details pls refer to *Table 1*.

Table 1

Details of field tests. BG = Bulgaria, HR = Croatia, HU = Hungary, I = Italy

Experiment	Locality	Biotop	Period	No. of traps
No. 1	Acireale, Sicily (I)	mixed orchard	March 4–July1, 2008	8
No. 2	Rome (I)	mixed orchard	April 1–August 4, 2008	4
No. 3	Bascica (HR)	edge of a mixed orchard	March 26–August 19, 2008	4
No. 4	Prkos (HR)	edge of a mixed orchard	March 26–August 19, 2008	4
No. 5	Zagreb (HR)	edge of a mixed orchard	April 9–August 20, 2008	4
No. 6	Kjustendil (BG)	mixed orchard	March 31–August 9, 2008	4
No. 7	Sofia (BG)	mixed orchard	April 1–July 29, 2008	4
No. 8	Telki (HU)	bushy edge of an oak forest	April 3–August 29, 2008	4
No. 9	Acireale, Sicily (I)	mixed orchard	March 10–April 8, 2009	10
No. 10	Rome (I)	mixed orchard	March 18–May 5, 2009	10

Traps

In the tests, CSALOMON® VARb3k modified funnel traps with blue funnels (produced by Plant Prot. Inst., HAS, Budapest, Hungary) were used, which proved to be excellent for the capture of *E. hirta* (Schmera et al., 2004; Mircheva et al., 2004). Photos of VARb3k traps can be viewed at *www.julia-nki.hu/traps*. Reflectance spectrum of the blue colour used has been reported before (Schmera et al., 2004).

For killing captured insects, a small piece (1 × 1 cm) of a household anti-moth insecticide strip (Chemotox® SaraLee, Temana Intl. Ltd, Slouth, UK; active ingredient 15% dichlorvos) was placed into the catch container of the trap.

Baits

For preparing the bait dispensers, a 1 cm piece of dental roll (Celluron®, Paul Hartmann AG, Heidenheim, Germany) was placed into a tight polythene bag made of 0.02 mm linear polyethylene foil. The dimensions of the polyethylene bags were ca. 1.5 × 1.5 cm. The dispenser was attached to a plastic strip (8 × 1 cm) for easy handling when assembling the traps. For making up the baits a solution of (*E*)-cinnamyl alcohol and (*E*)-anethol (ratio 1:1, 200 mg total load) was administered onto the dental roll, and the opening of the polythene bag was heat-sealed. Earlier experience showed that the bait did not loose its activity during several weeks of field exposure; hence we decided to replace the lures at 3-week-intervals.

Dispensers were wrapped singly in pieces of alufoil and were stored at –30 °C until use.

Chemicals

Both (*E*)-cinnamyl alcohol and (*E*)-anethol were obtained from Sigma-Aldrich Kft. (Budapest, Hungary). Both compounds were > 95% pure as stated by the supplier.

Results and Discussion

There was no significant difference in the mean catch of *T. squalida* recorded in white or blue traps with floral bait *(Fig. 1),* suggesting that both colours can be used as visual cues in traps for the species. This confirms results from earlier reports, where traps without chemical bait were studied. Ortu et al. (2001) reported a mean catch of 42.4 vs. 34.3 *T. squalida* in white or blue traps, resp., however, in that study no statistical analysis was performed. In Egypt, blue traps attracted most beetles as compared to white, yellow or green (Ali, 1993).

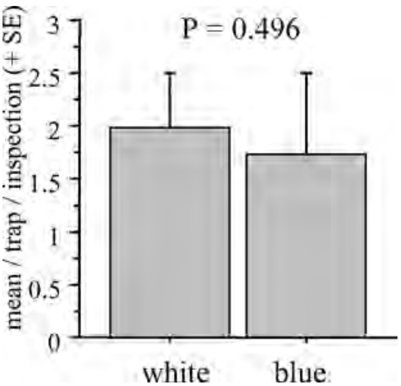

Fig. 1. Catches of *T. squalida* in white or blue traps both baited with the floral bait of (*E*)-cinnamyl alcohol and (*E*)-anethol. (Exp. No. l; total caught in test: 133 beetles. P value derives from Student *t*-test)

In *E. hirta,* where response to colours was studied in more detail, there was no difference in colour preference no matter whether traps with or without chemical cue (floral bait) were compared (Tóth et al., 2005). Literature data and results of this study suggest the same phenomenon also in *T. squalida*. In contrast, in the closely related cetoniin scarabs *Cetonia aurata aurata* L. and *Potosia cuprea* Fabr., no response to colour cues *per se* was observed (Tóth et al., 2005), however, when traps baited with the floral bait optimized for these two scarabs were compared, a significant preference for blue traps was recorded (Tóth et al., 2005).

In trials of seasonal monitoring in the present study, *T. squalida* was captured at sites in Sicily and Rome (Italy), in both 2008 (Exps 1, 2) and 2009 (Exp. 9, 10) *(Fig 2).* Already in the second half of March sizeable catches were recorded in Sicily, and the flight was over by late April. In Rome, catches started still in March, but the main bulk of the flight was observed in April (in 2008 no reliable flight curve was recorded due to the very low number of specimens caught) *(Fig. 2).* This slight delay in swarming is undoubtedly due to the relatively cooler climate at Rome as compared to Sicily.

The seasonal flight of *E. hirta* was recorded in this study at all of the sites except in Sicily *(Fig. 3)*. Very few specimens were caught at Rome. At the other sites *E. hirta* appeared at the end of March or early April. Unfortunately at the two sites on the Adriatic

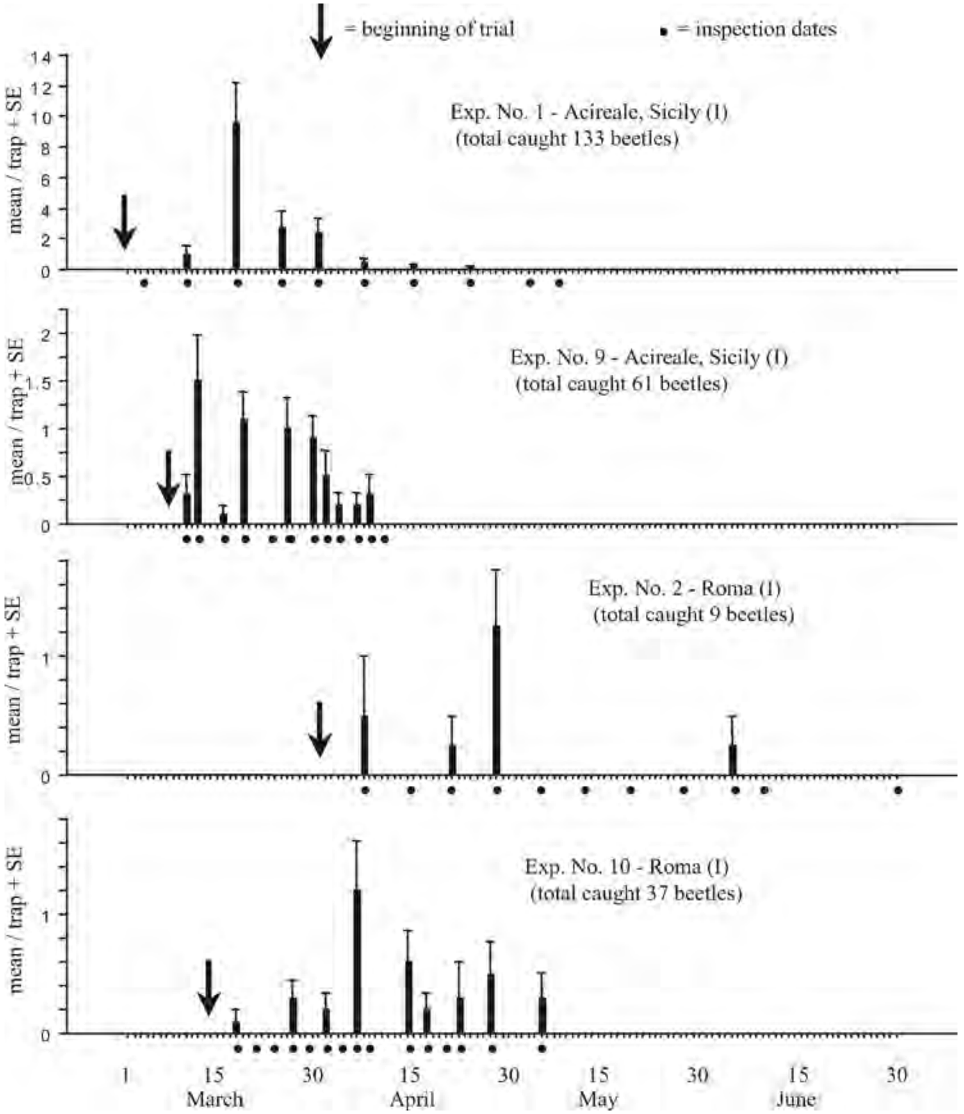

Fig. 2. Seasonal distribution of catches of *T. squalida* in blue traps baited with the floral bait of (*E*)-cinnamyl alcohol and (*E*)-anethol in trials aimed at monitoring at two sites in Europe. (I = Italy)

coast of Croatia and at one site in Bulgaria (Exps 3, 4, 6), evidently the flight started earlier than the setting out of the traps, as large numbers were recorded already at the very first inspection date. The peak flight of *E. hirta* was recorded in April at most of the sites. The only exception was Sofia (Bulgaria, Exp. 7), where *E. hirta* flew in May. This probably can

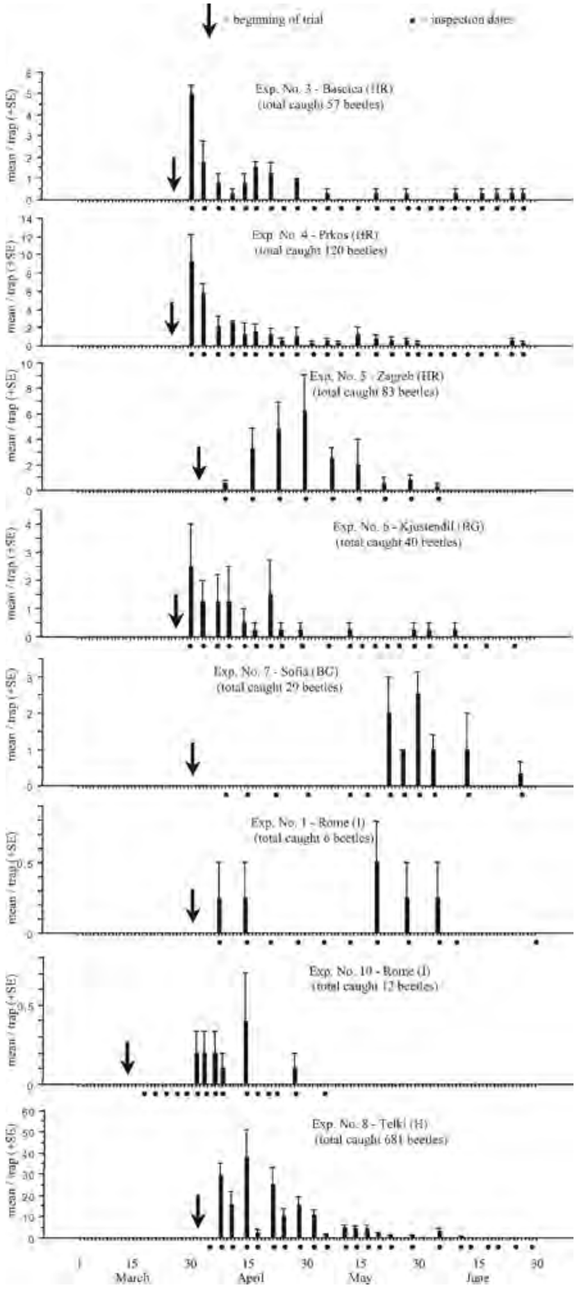

Fig. 3. Seasonal distribution of catches of *E. hirta* in blue traps baited with the floral bait of (*E*)-cinnamyl alcohol and (*E*)-anethol in trials aimed at monitoring in several countries of Europe. (BG = Bulgaria, HR = Croatia, HU = Hungary, I = Italy)

be explained by the lower average temperatures in spring due to the higher altitude of this site. A similar flight curve for *E. hirta* has already been reported from earlier years from Bulgaria (Mircheva et al., 2004).

Results of this present study strongly suggest that blue traps baited with the floral bait can be used for trapping of both *T. squalida* and *E. hirta* at the same time. This is clearly of importance in areas where both scarabs co-occur. In fact, at one of our sites (Rome, Exps 2, 10) both species were captured, albeit in some years in low numbers only *(Figs 2–3).*

The control of these scarab pests is difficult, since most insecticides cannot be applied during flowering without affecting honeybees or other beneficials, and sprayings at fruit ripening and harvest have increased health hazards. Mass removal of adult beetles by high capacity traps supplied with highly effective attractants could be an excellent alternative control method, as it could reduce damage to below an economically acceptable threshold and, at the same time, would be non-toxic, posing no health or environmental risk to other organisms, and so could be used throughout the blossoming period and harvest.

Successful mass trapping of *E. hirta* using blue traps with the floral bait has been reported from Central and Eastern Europe in some plant cultures like strawberries and apples (Tóth et al., 2005; Sivcev et al., 2006). Mass trapping with water pan traps of white or blue colour (and no chemical bait) has been reported for *T. squalida* in Egypt (Ali, 1993; Haydar et al., 1993). Since in *E. hirta* it has been demonstrated that traps containing both visual and chemical attractive stimuli perform dramatically better than traps containing only one type of stimulus (Schmera et al., 2004), it can be expected that also in *T. squalida* mass trapping can be more efficiently achieved by traps being blue and containing also the floral bait.

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