Applied chemical ecology of cetoniin scarabs (Coleoptera: Scarabaeidae)

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Foto: Nagy Z. L.

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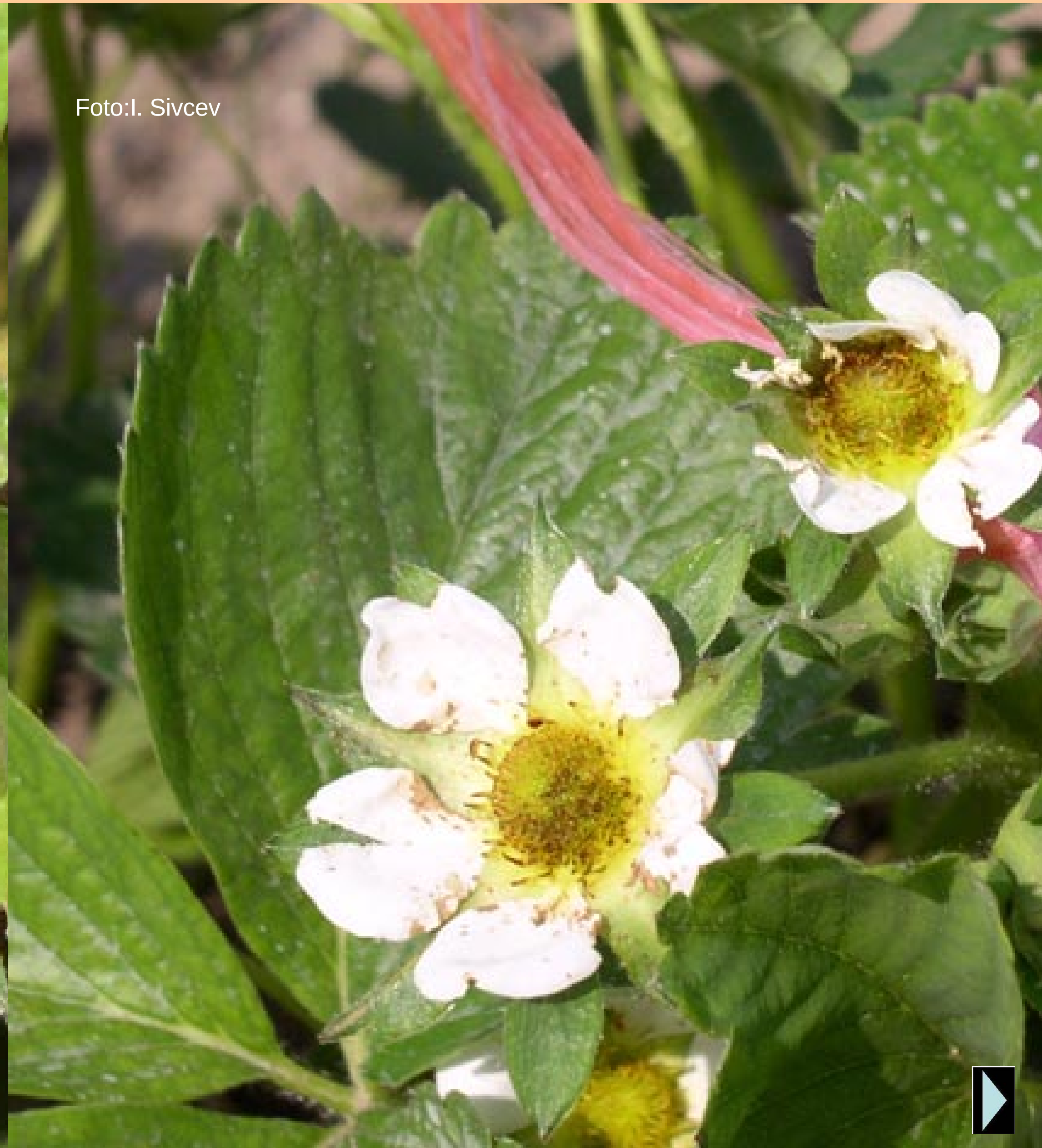
Cetoniin scarabs occasionally can swarm in very large numbers and their damage is not easy to avert. They damage flowers and ripening fruit.

Epicometis (Tropinota) hirta is one of the most abundant pest species of the subfamily in Europe and the Middle East.

Apart from different fruit trees, *E. hirta* can be a devastating pest of strawberries and other berries as well, damaging the flowers,



or even ripening fruits, causing yield loss and malformed fruits which cannot be marketed.

Foto:I. Sivcev

An attractant baited trap could be a useful tool in detection, monitoring, and even perhaps in mass trapping (for direct control) of the pest.

But, how to make one???

(without knowledge of a pheromone)

Lets look for floral attractants instead!!!

Fotó: Nagy Z. L.

To select candidate attractants, EAG screenings of synthetics could be helpful.

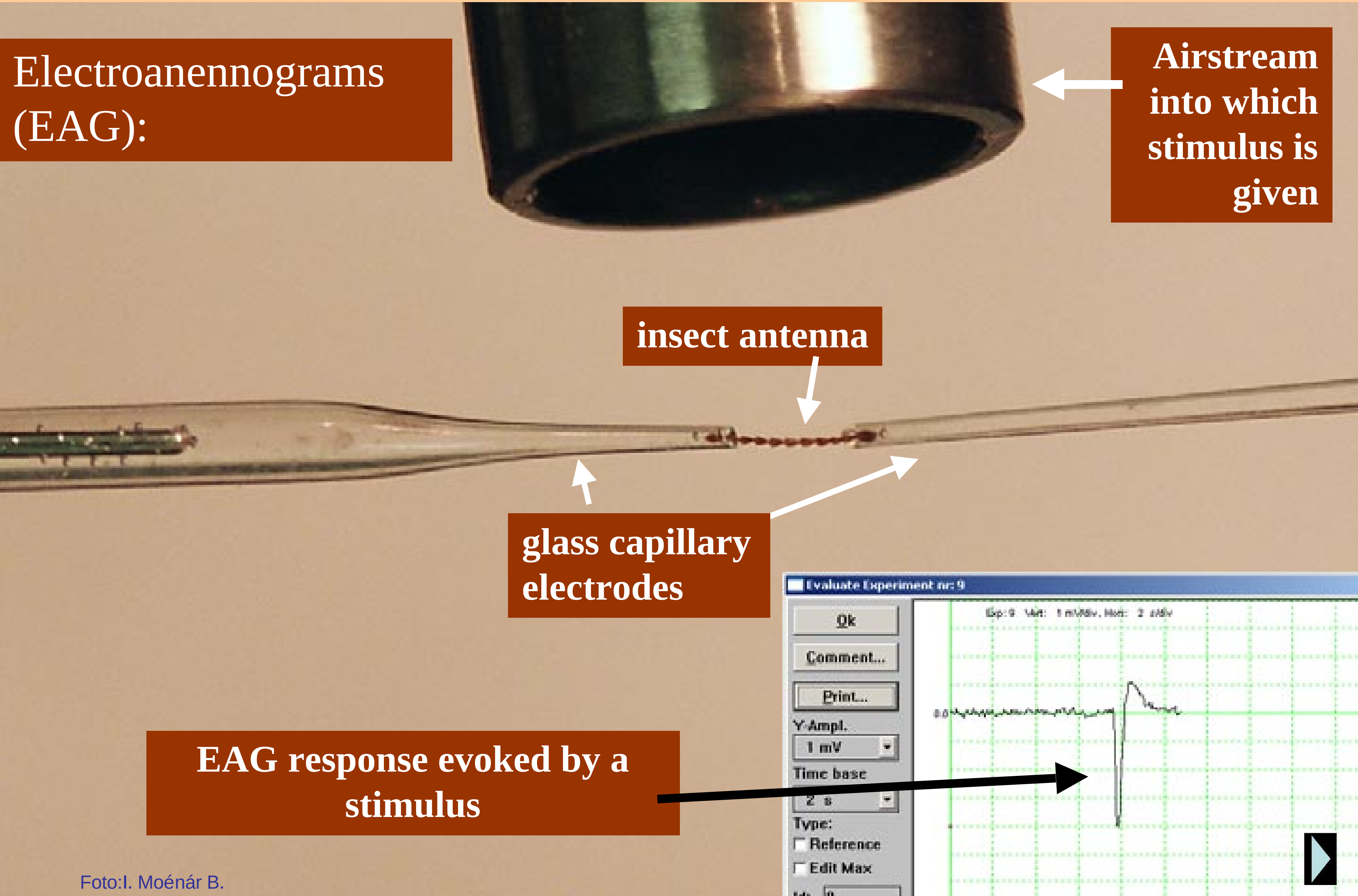
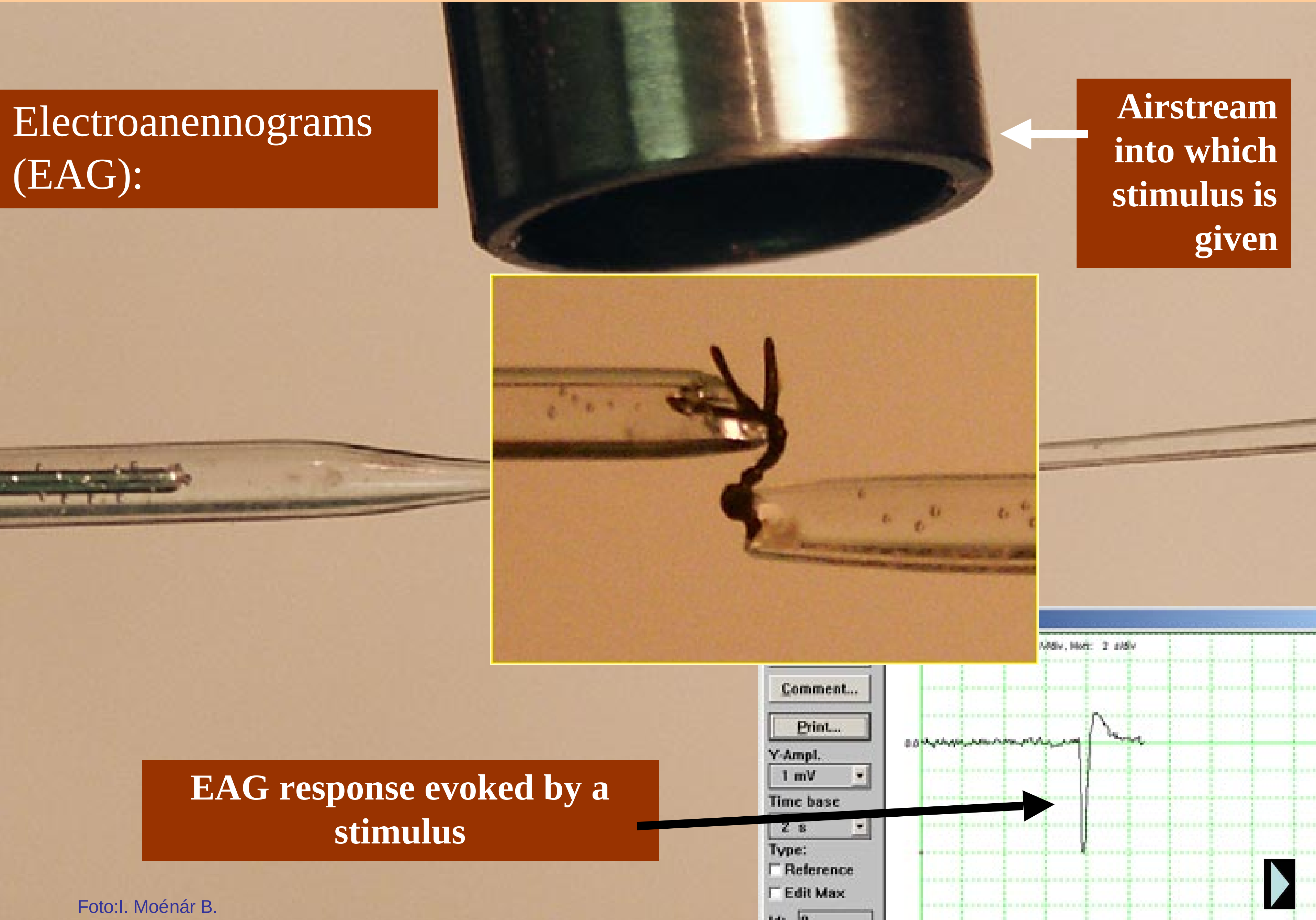


Foto:I. Moénár B.

With scarabs, special antennnal preparation is necessary.

Electroanennograms (EAG):

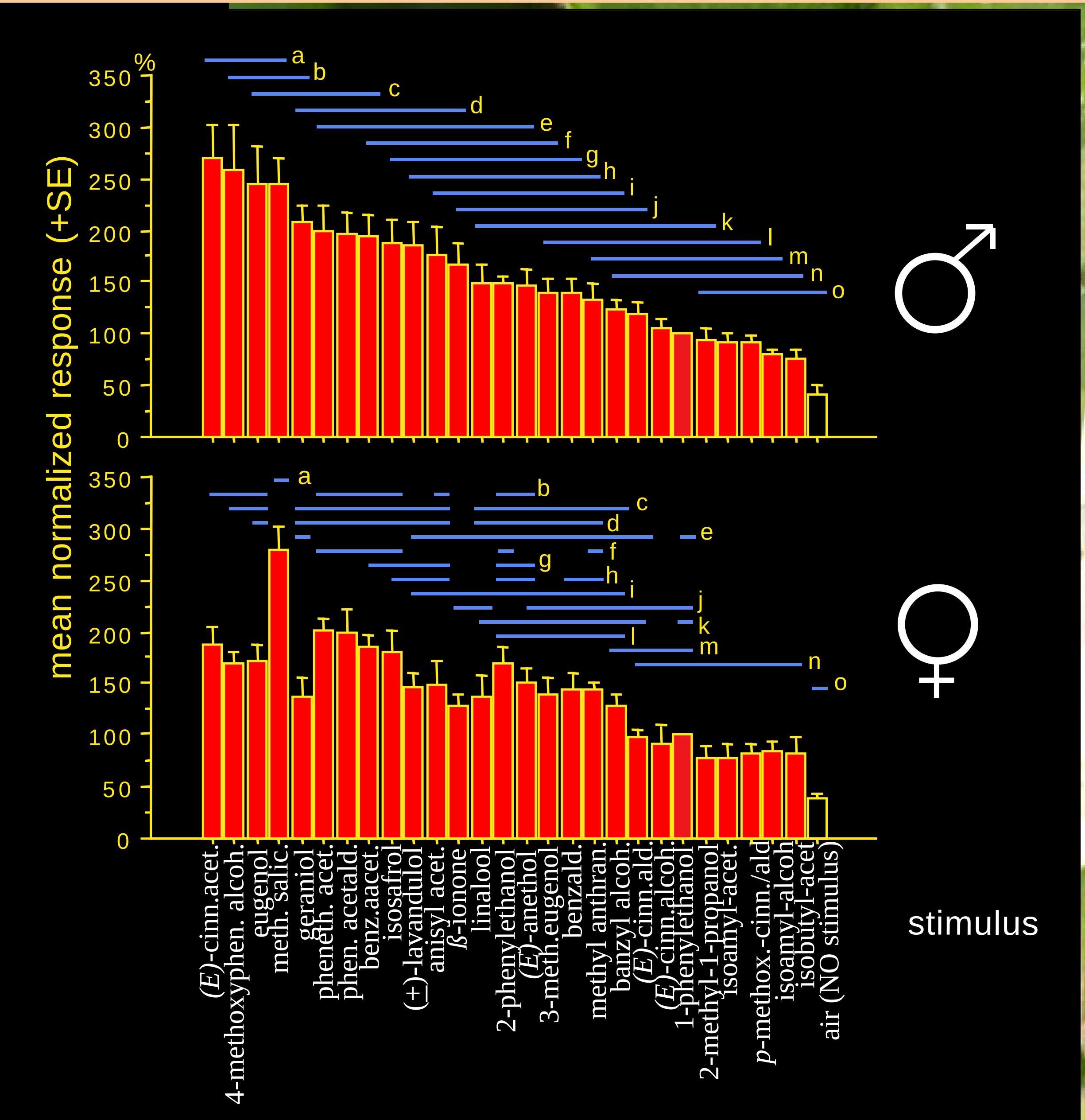


Airstream into which stimulus is given

EAG response evoked by a stimulus

Foto:I. Moénár B.

EAG response spectra to common floral compounds may allow to restrict compounds to be field tested to a manageable number.



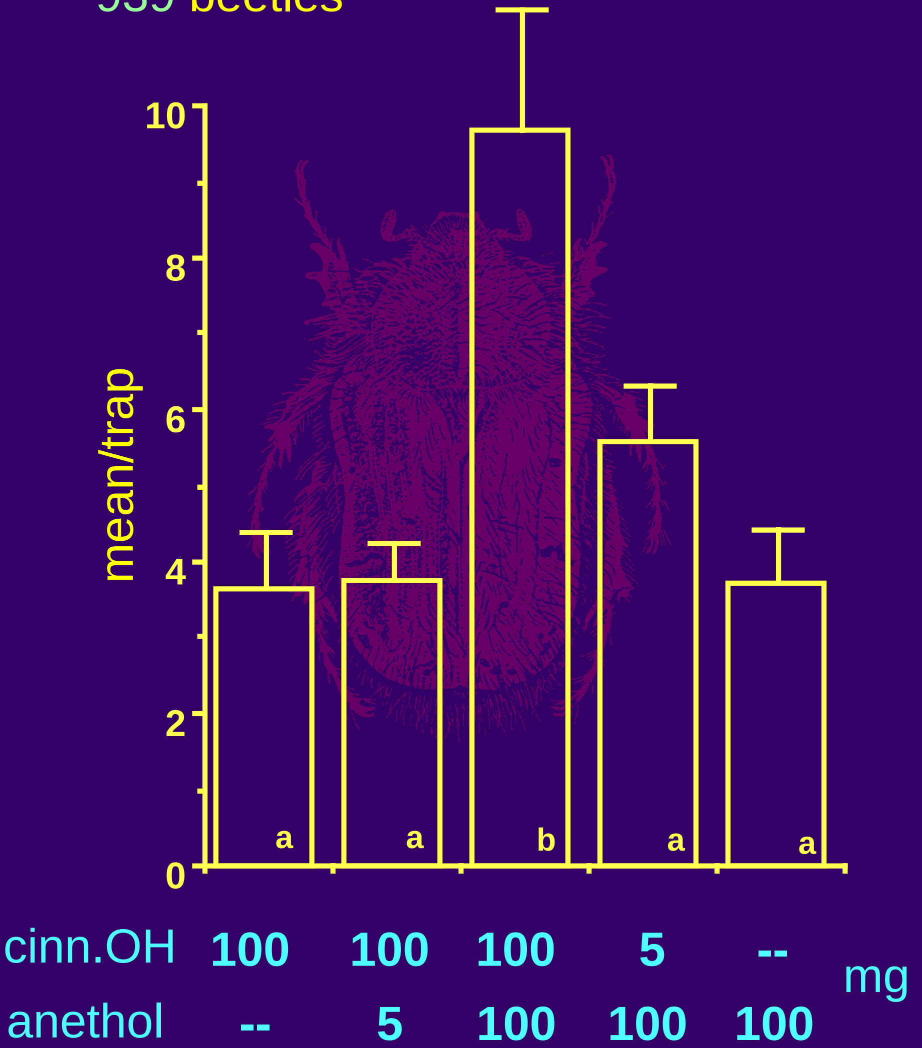
Having screened a number of compounds in field trapping tests, we established that *E. hirta* was attracted to a mixture of (*E*)-cinnamyl alcohol and (*E*)-anethol.

Foto: Voigt E.

Epicometis hirta

Agárd,
April 15 - May 6 1999

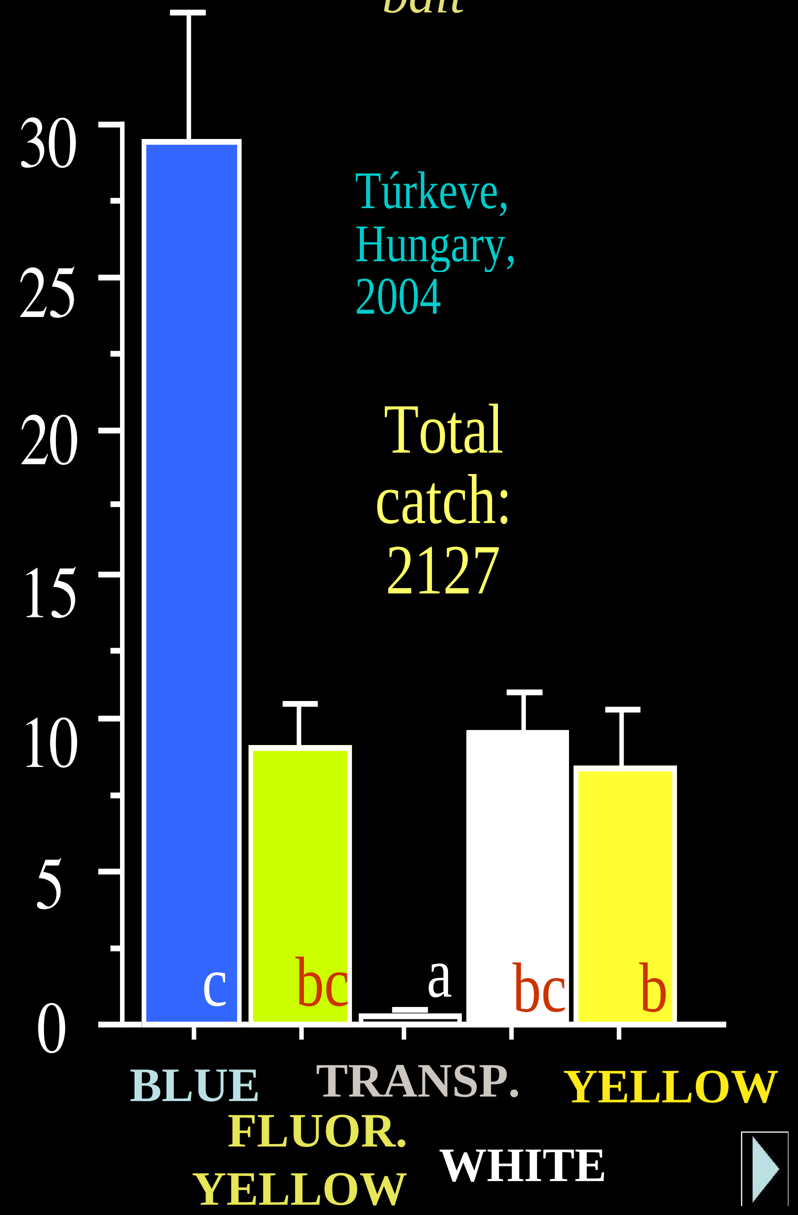
Total caught in test:
939 beetles



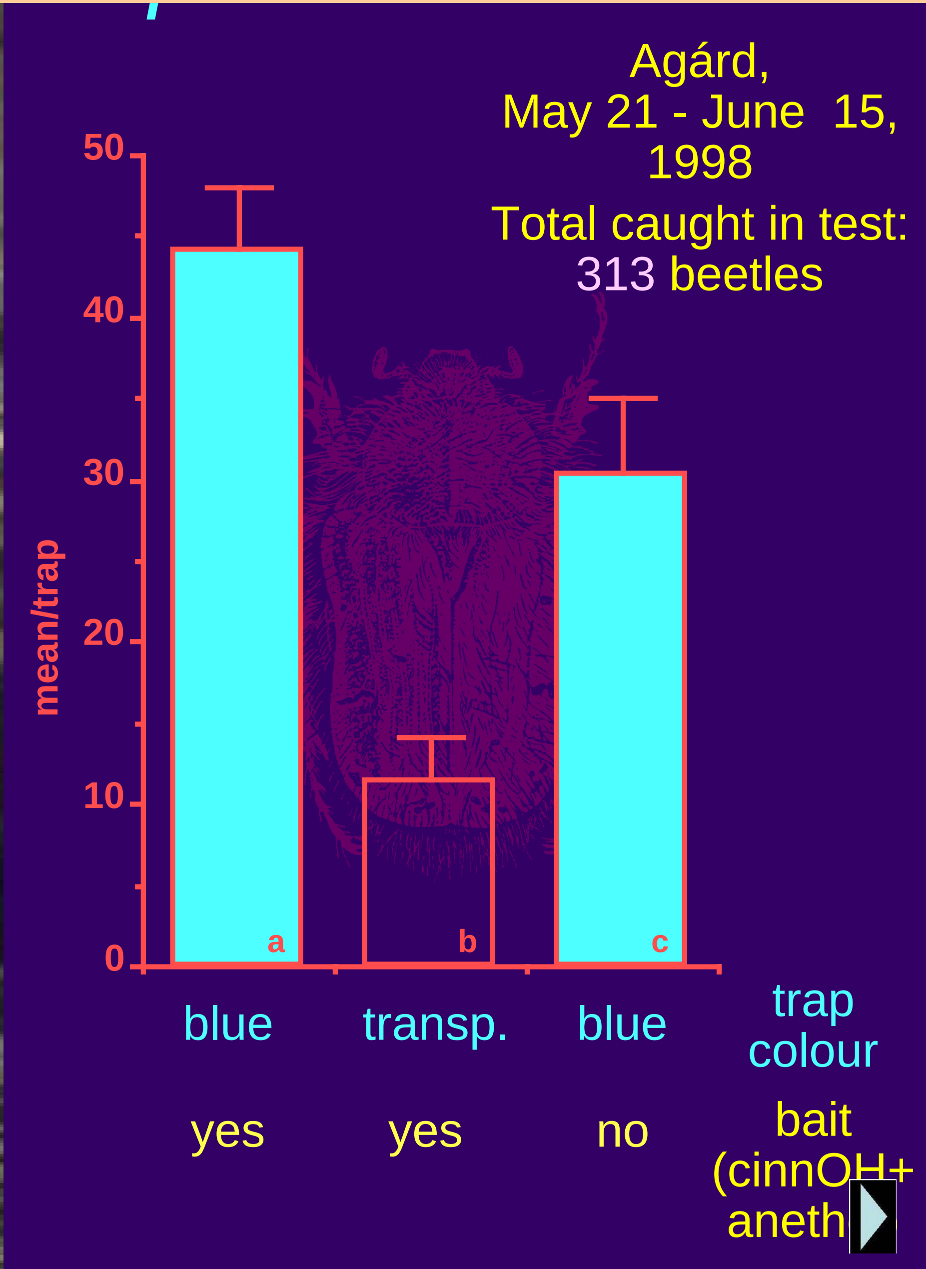
As a flower visitor, *E. hirta* also responded strongly to colour cues.

Epicometis hirta

no chemical bait



Consequently, we developed a trap for *E. hirta* containing both the floral bait and blue colour.



This trap is capable of catching thousands of beetles and its application decreased damages in backyard strawberry fields.

Foto: I. Sivcev

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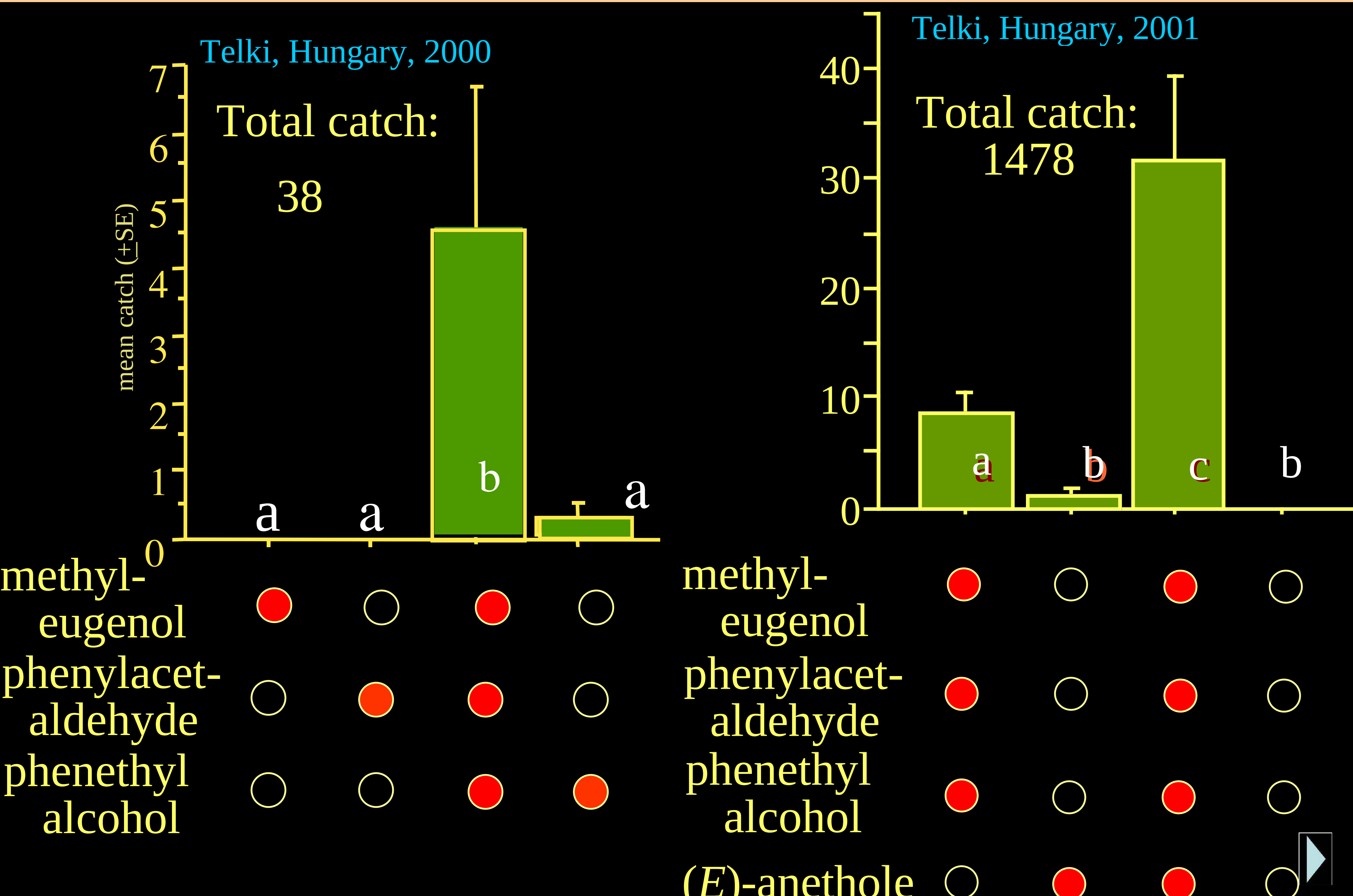
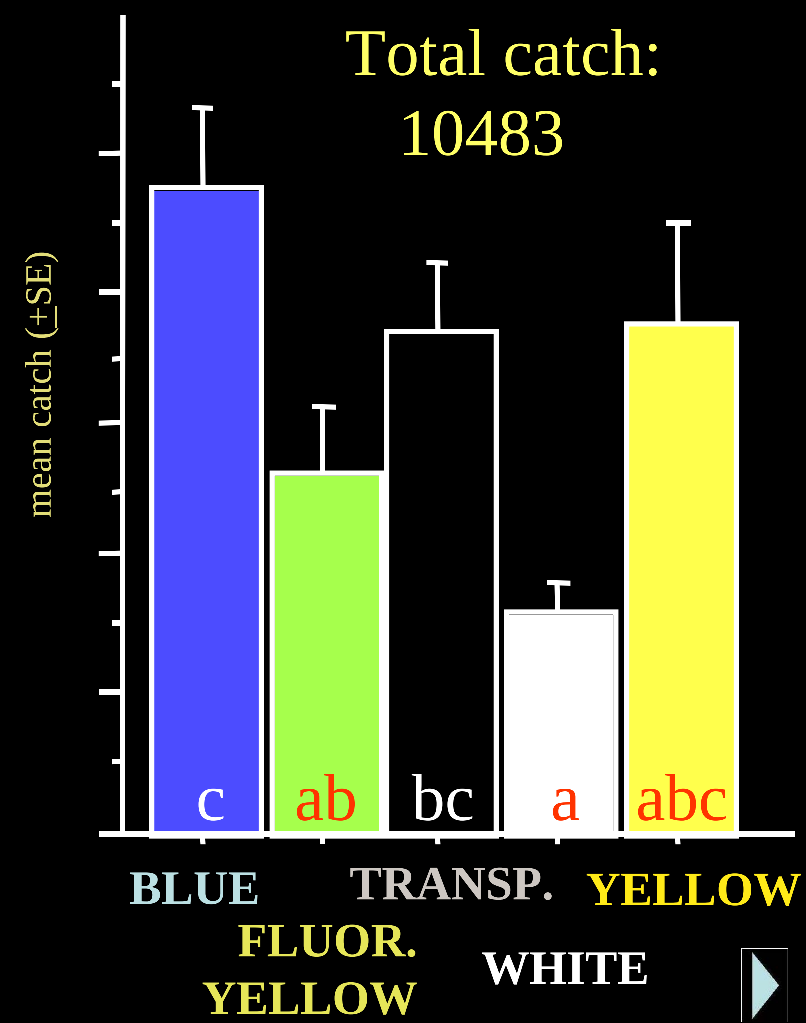
Large-scale mass trapping applications in industrial strawberry fields also gave promising results.

A close relative is *Cetonia a. aurata*. In recent years reports on damages of this pest increased in Hungary. Similar news were coming also from Croatia.

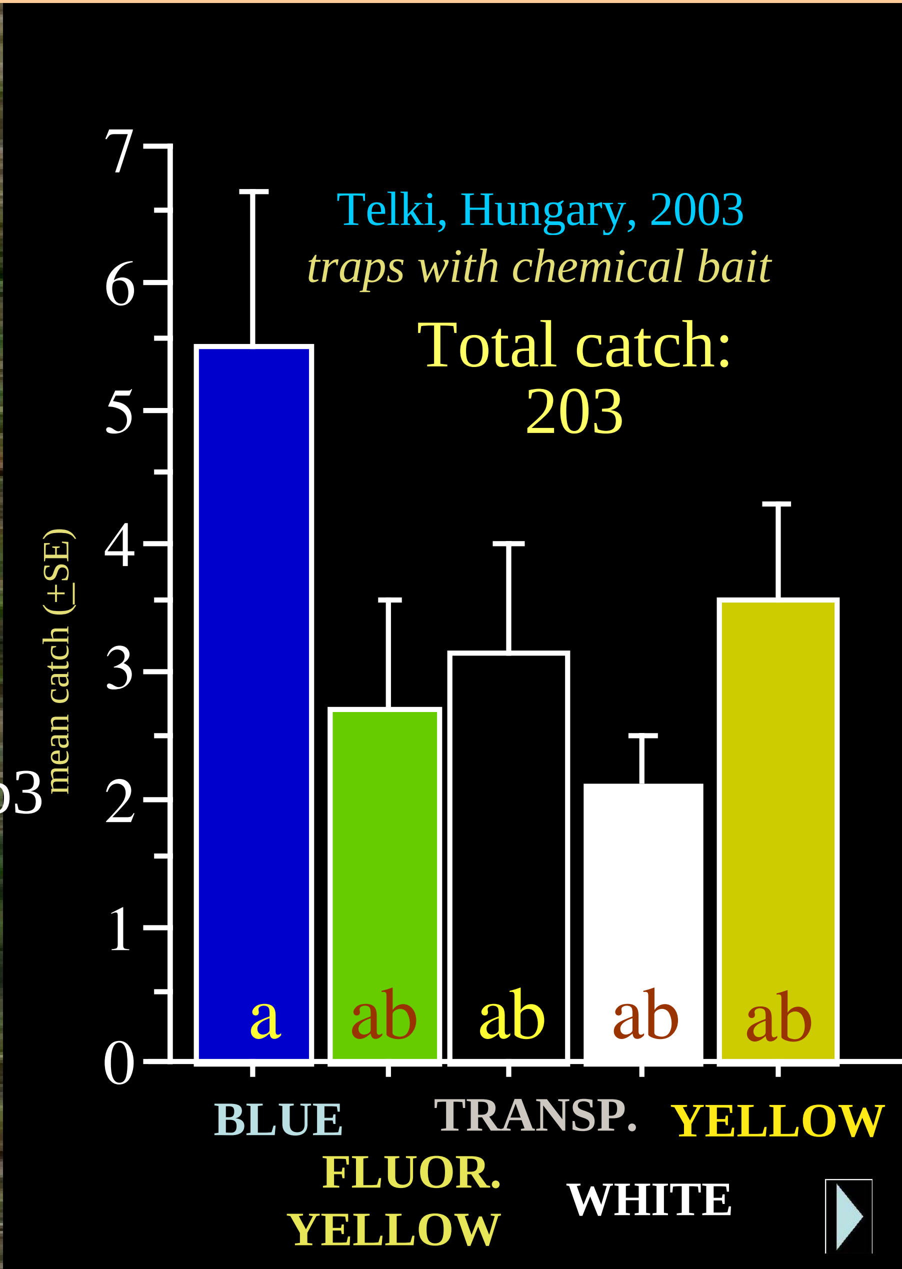
For attracting *Cetonia* a multicomponent chemical attractant was necessary.



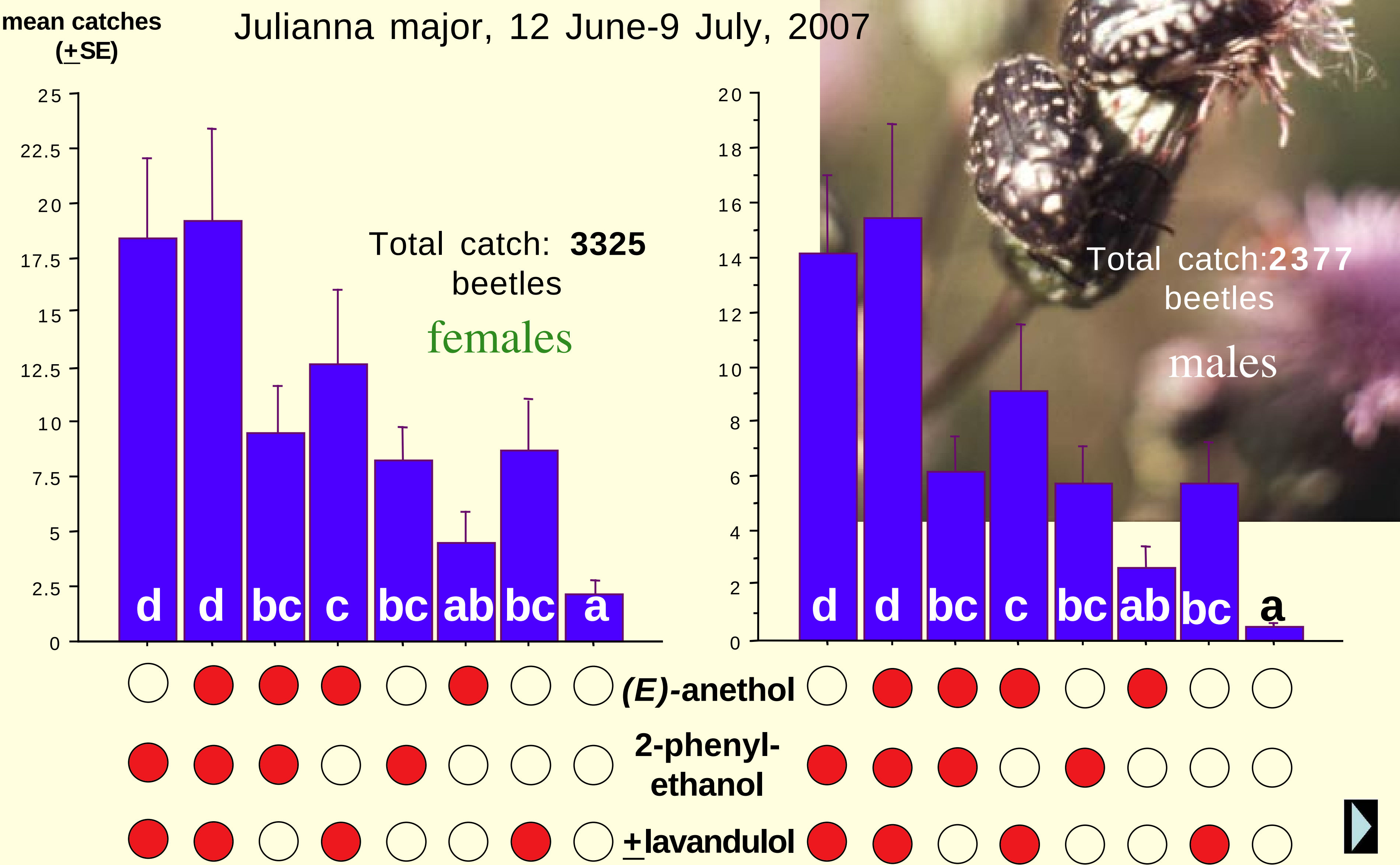
Cetonia did not response to colours *per se*, but in the presence of the chemical attractant showed a slight preference for blue.



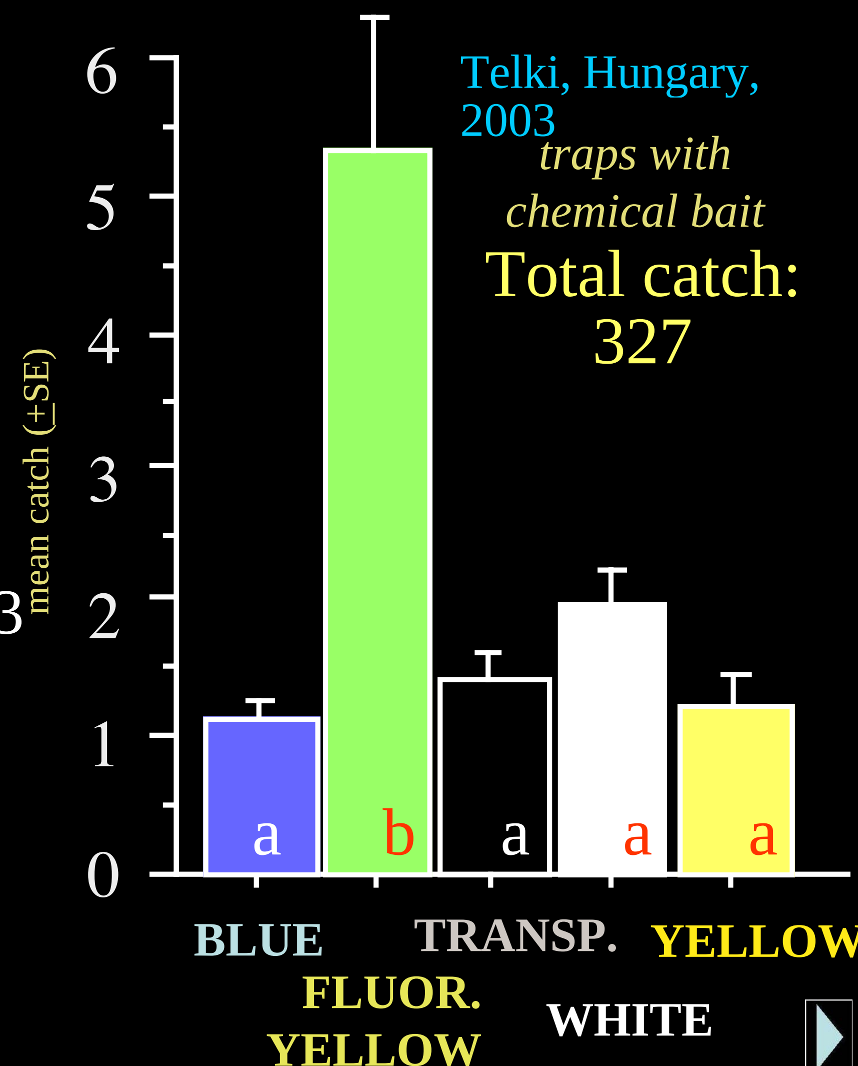
In its responses to both chemical and visual cues the related *Potosia cuprea* proved to be very similar to *Cetonia*.



In further extensive field tests a binary floral attractant was optimized for *Oxythyrea funesta*, a secondary cetoniin pest.



O. funesta drastically differed from all previous species in which it responded very strongly to fluorescent yellow.



Consequently we ended up with the following traps developed for the different cetoniin pests:

VARb3k blue trap

- with *E. hirta* bait = EP

OR

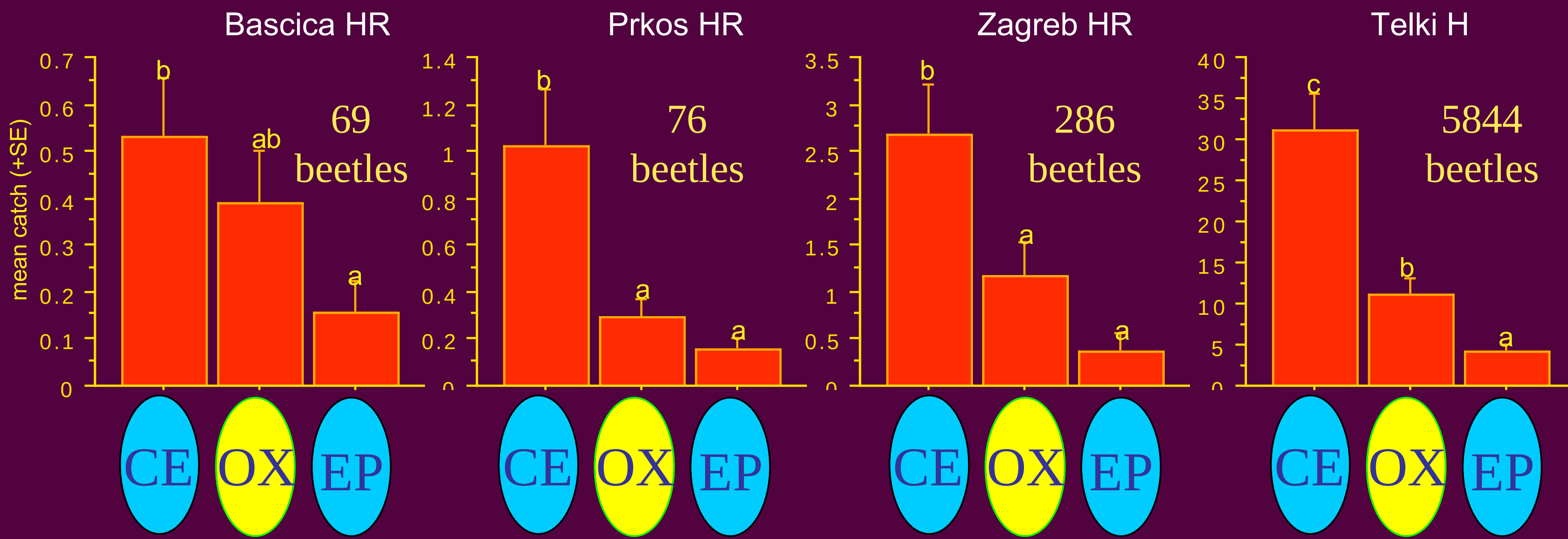
- with *Cetonia / Potosia* bait = CE

VARb3z fluorescent yellow trap

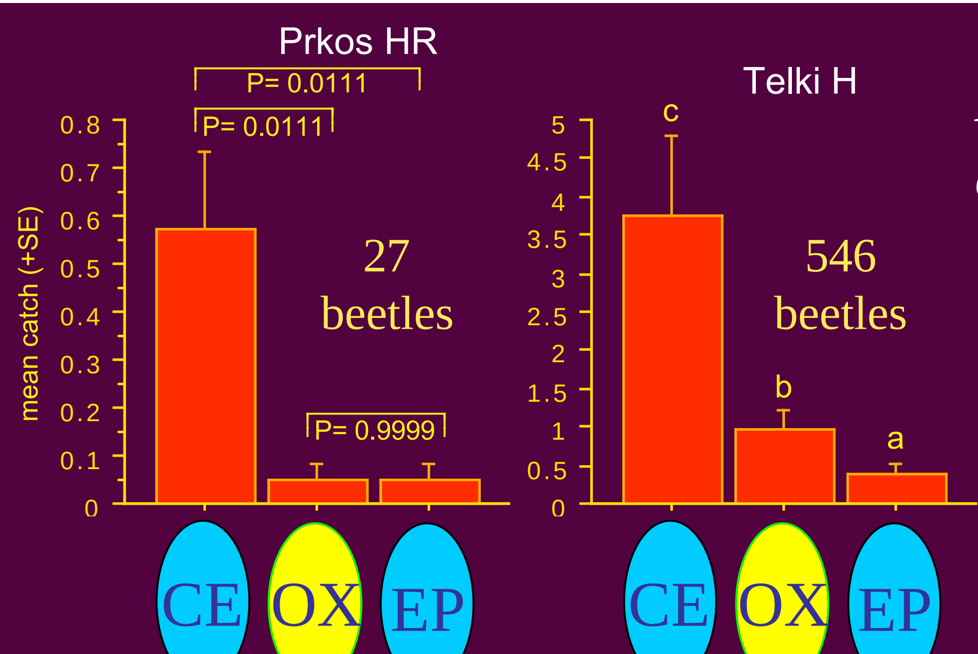
- with *O. funesta* bait = OX

These traps were parallelly tested for performance and specificity in several European countries.

Cetonia a. aurata



The target species usually were best attracted to their respective trap/bait combinations, as seen for *Cetonia* and *Potosia* here, which were captured at relatively few sites.



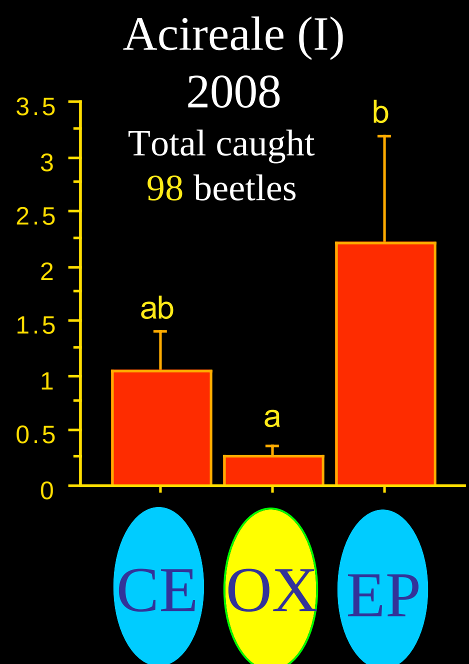
Potosia cuprea

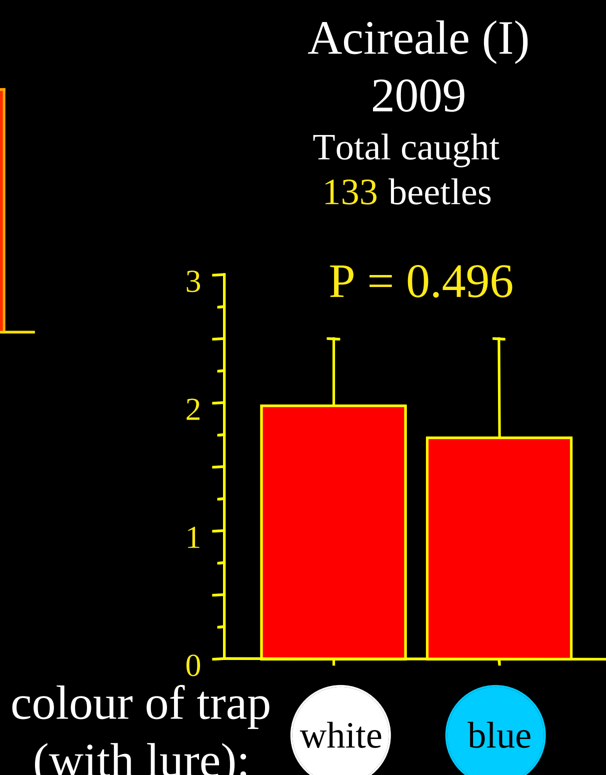
The traps in the majority of cases were fairly specific (although showed less specificity than conventional pheromone traps of moths usually do).

Selectivity of combination EP (target: *E. hirta*)

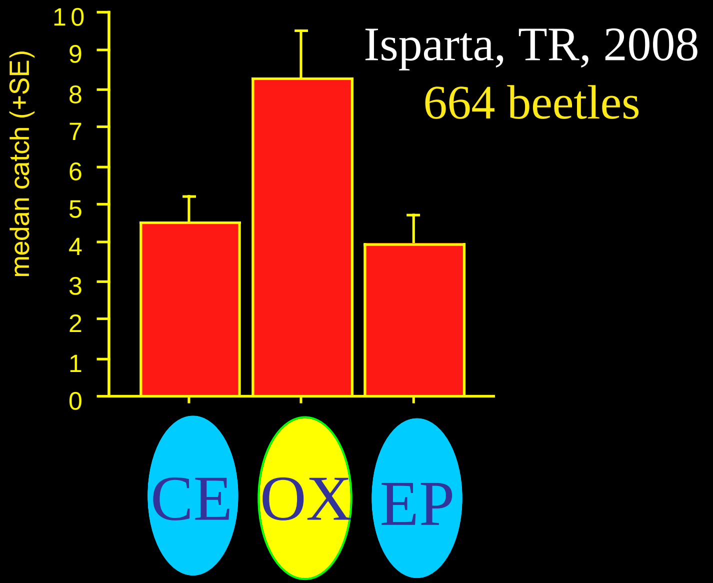
Among further species captured, at sites in Italy, the more southerly-occurring *Tropinota squalida* was recorded. It responded in a similar way to both visual and chemical cues as *E. hirta* did, to which it is morphologically also very close.

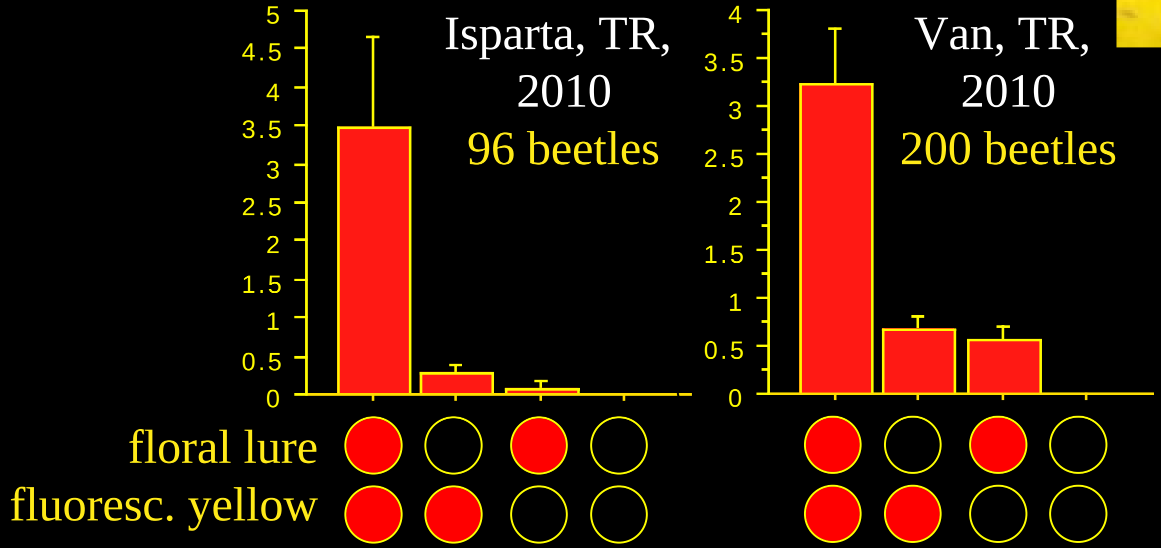
Tropinota squalida





Most recent results: catches of *Oxythyrea cinctella* in Turkey! The species is an important cetoniin pest in the Middle East.



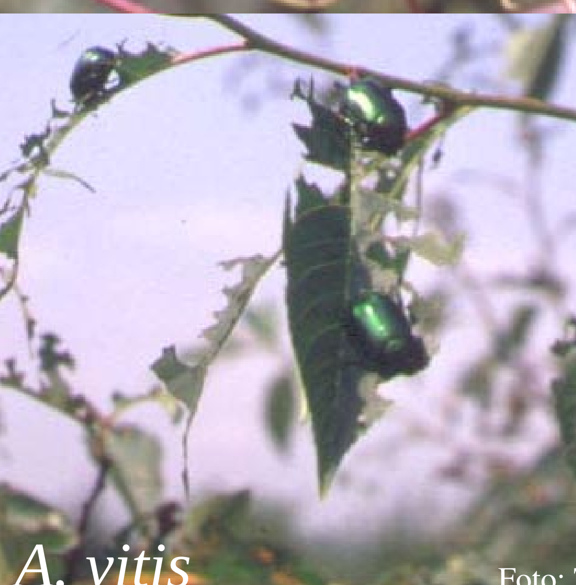


Both chemical AND visual stimuli are necessary for good activity.

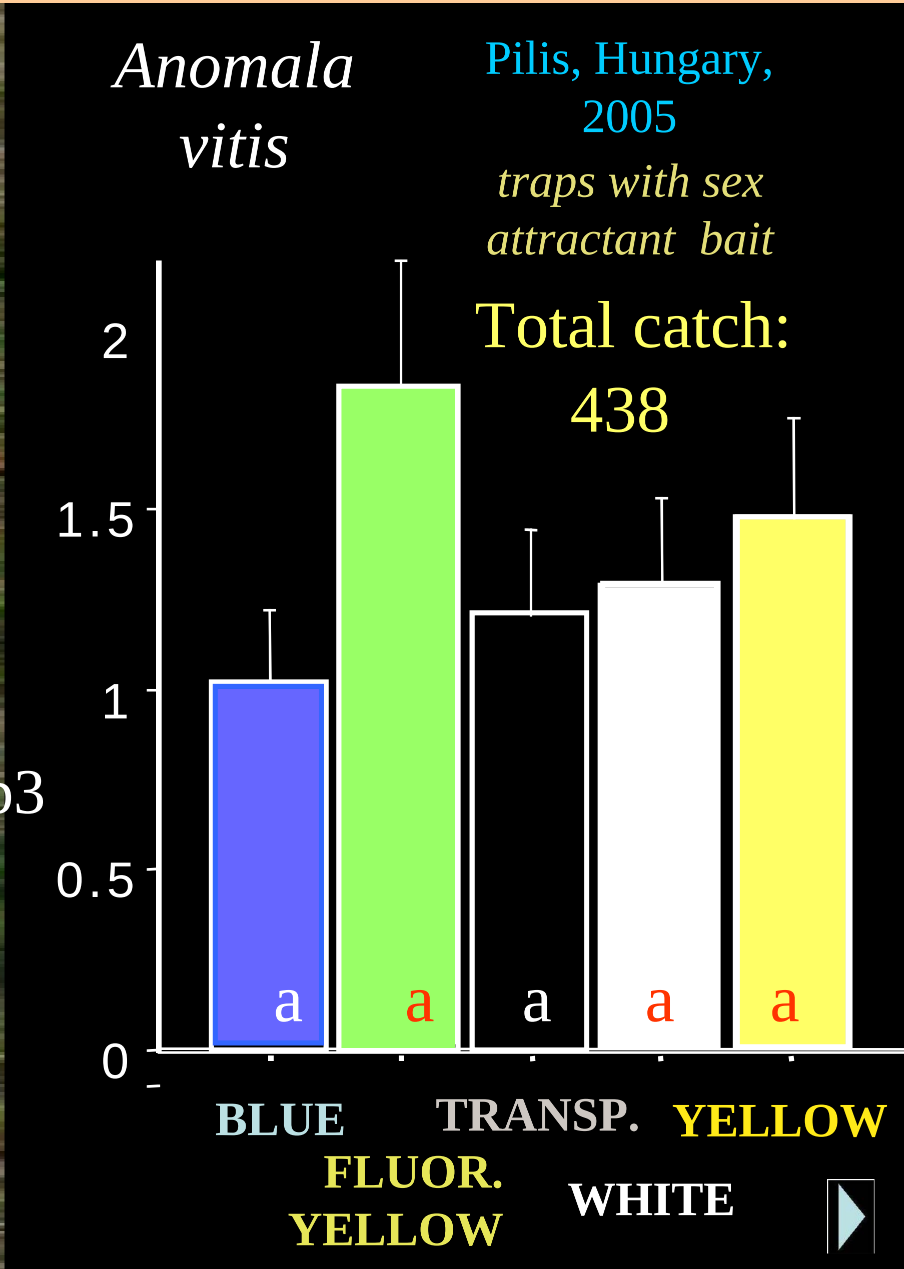
Rutelin scarabs damage green leaves and ripening fruit (never the flowers).

Males locate the females with the help of powerful sex attractants. Chemical compositions have been defined for the three most important European *Anomala* species as:

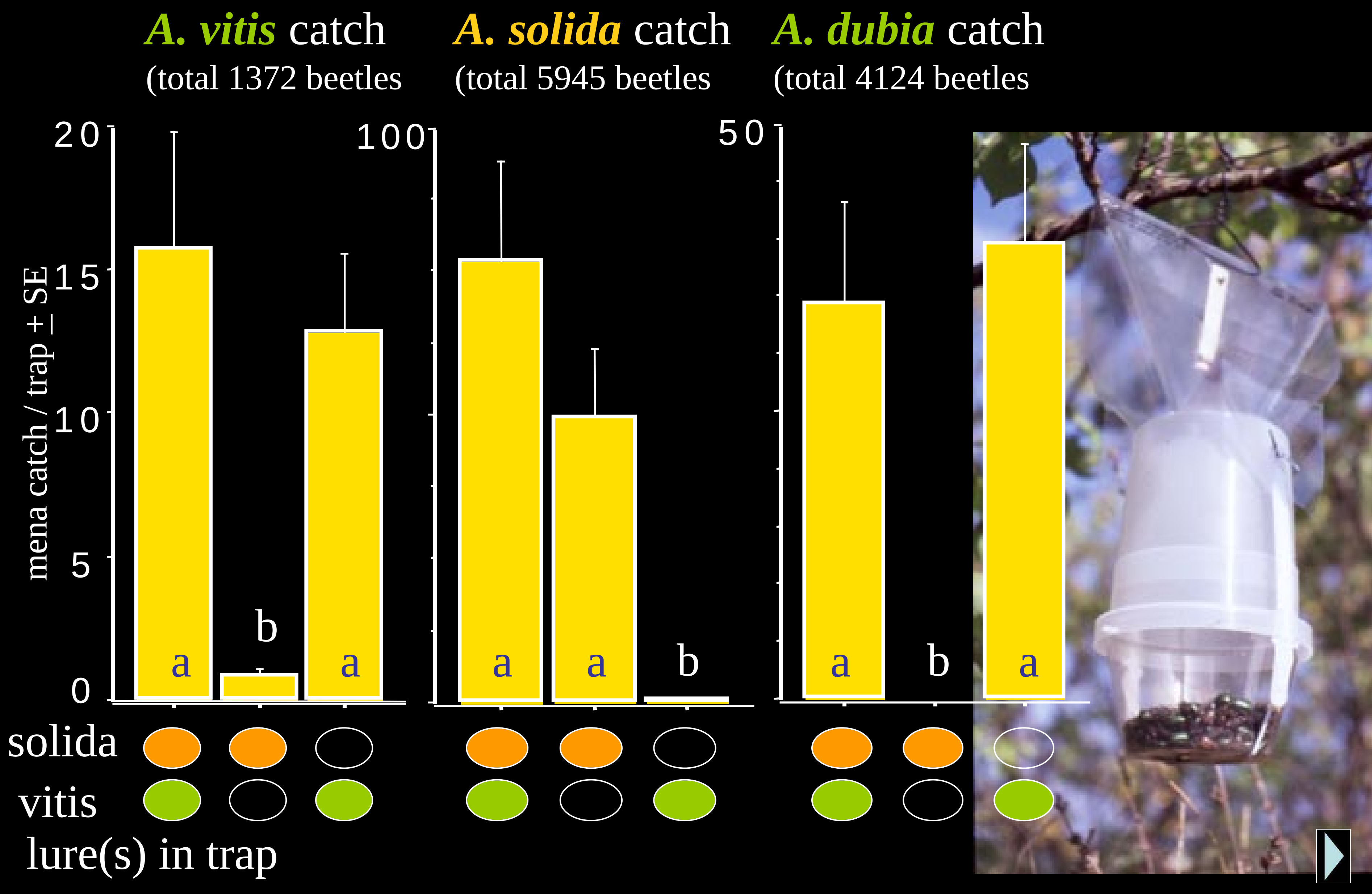
(E)-2-nonenol for *Anomala vitis* and *A. dubia*, and (*R*,*Z*)-5-(-)-(oct-1-enyl) oxa-cyclopentan-2-one (= *R*-buibuilactone) for *A. solida*.



Anomala spp. showed no colour sensitivity, so in this case the chemical cue (sex attractant) was the only stimulus necessary for a powerful trap.



(E)-2-nonenol and *R*-buibuilactone do not interfer so by placing the two lures into the same trap a device catching all three *Anomala* spp. results.



Many scarabs have bright metallic colour. A century ago it was discovered that scarabs with metallic colours reflect circularly polarized light *(Michelson A.A. 1911: On metallic colouring of birds and insects. Philos. Mag. 21:554-67.)*

Potosia aeruginosa
(Photo J. Razov)

It was automatically supposed that scarabs possessing left-circularly polarizing metallic shiny exocuticle in an optical environment being poor in polarized light (i.e. vegetation) could use this stimulus to find each other in the circularly unpolarizing foliage, without the risk of being recognized by predators (being unsensitive to polarized light).

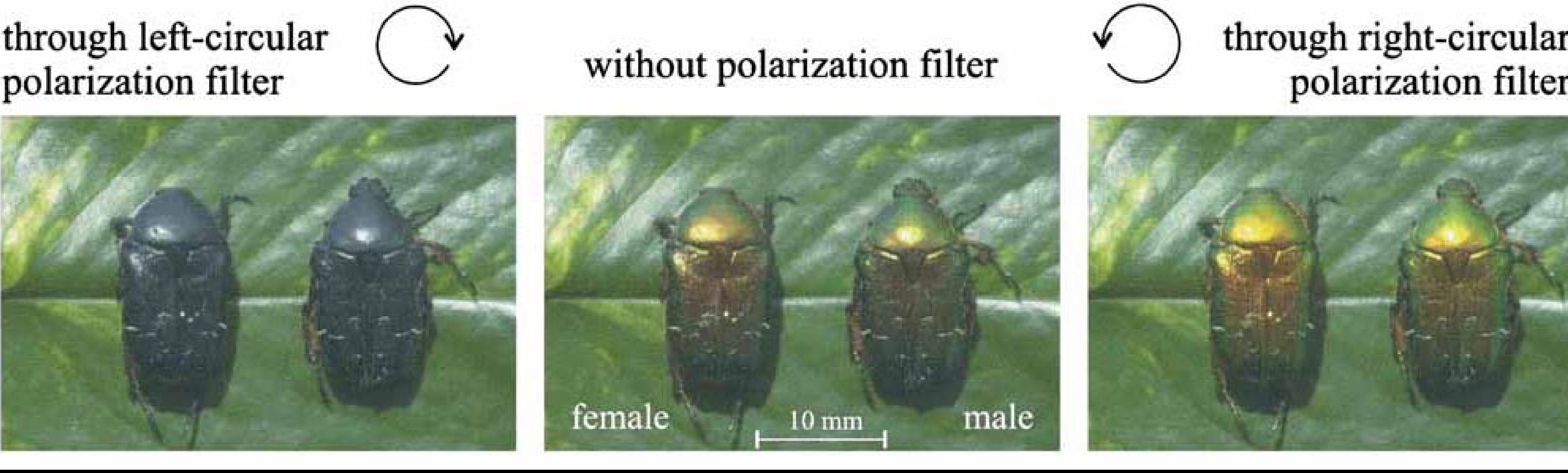
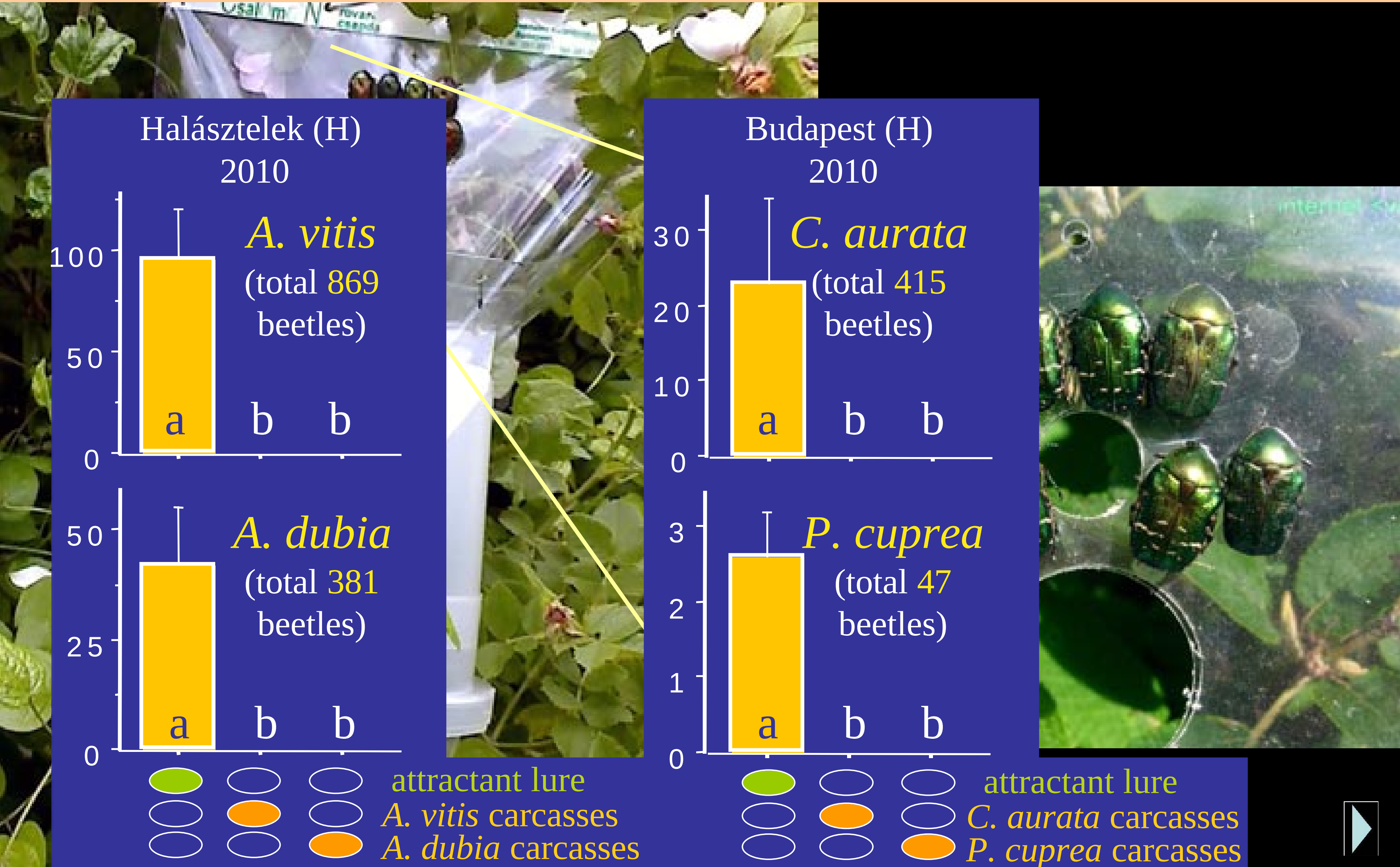
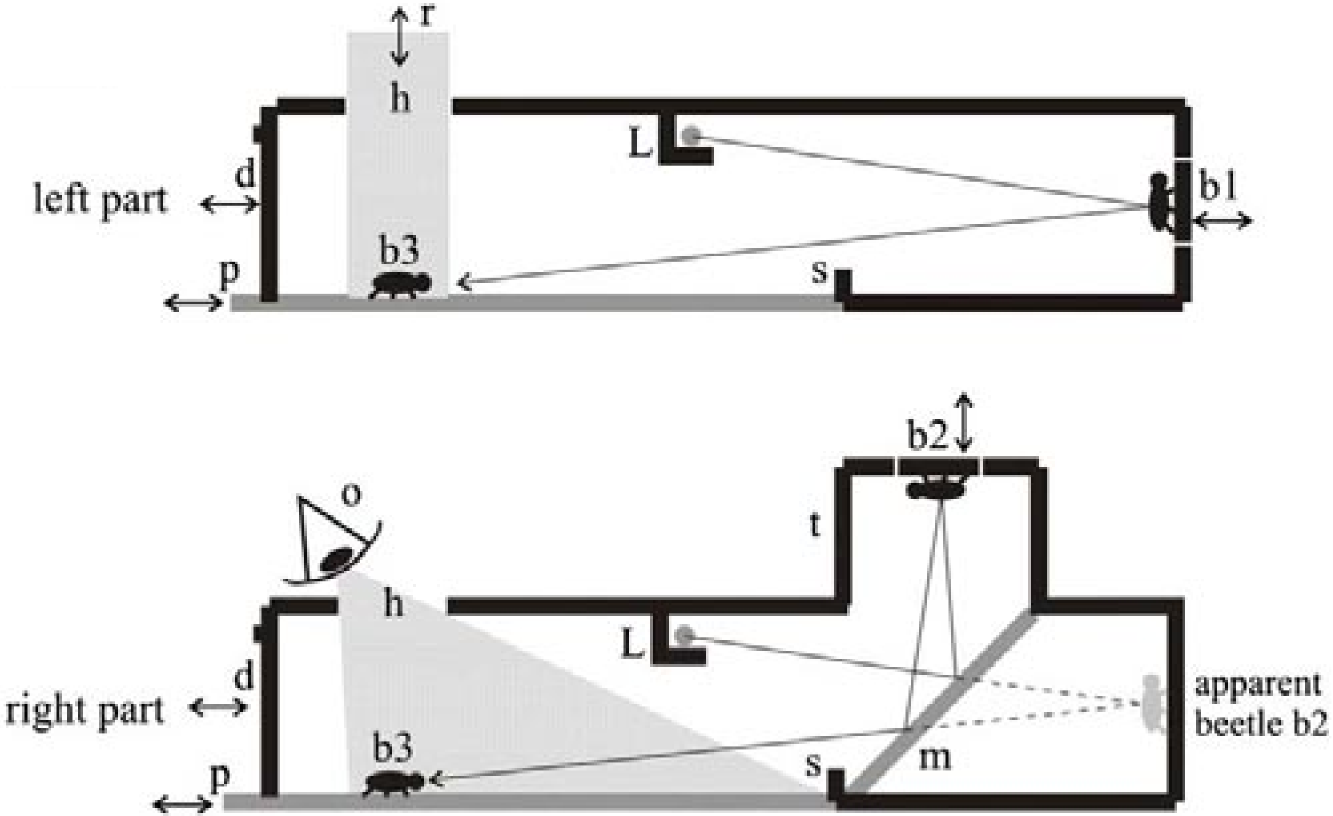


Photo from: Blahó M., Egri Á., Hegedüs R., Jósvai J., Tóth M., Kertész K., Biró L.P., Kriska Gy., Horváth G. (2012) Physiol & Behav. 105:1067-1075.

When setting solvent-washed carcasses of scarabs (which lacked possible chemical cues but yielded natural visual cues) into traps no behaviroral response was observed.

The presence of the respective species at the test site is demonstrated by catch in the pheromone or floral baited traps, while no catch occurred in traps with beetle carcasses.





Also, no behavioral response was found in biooptical laboratory experiments, neither to the true visual stimulus of beetles nor to mirrored images reflecting left- or right polarized light.

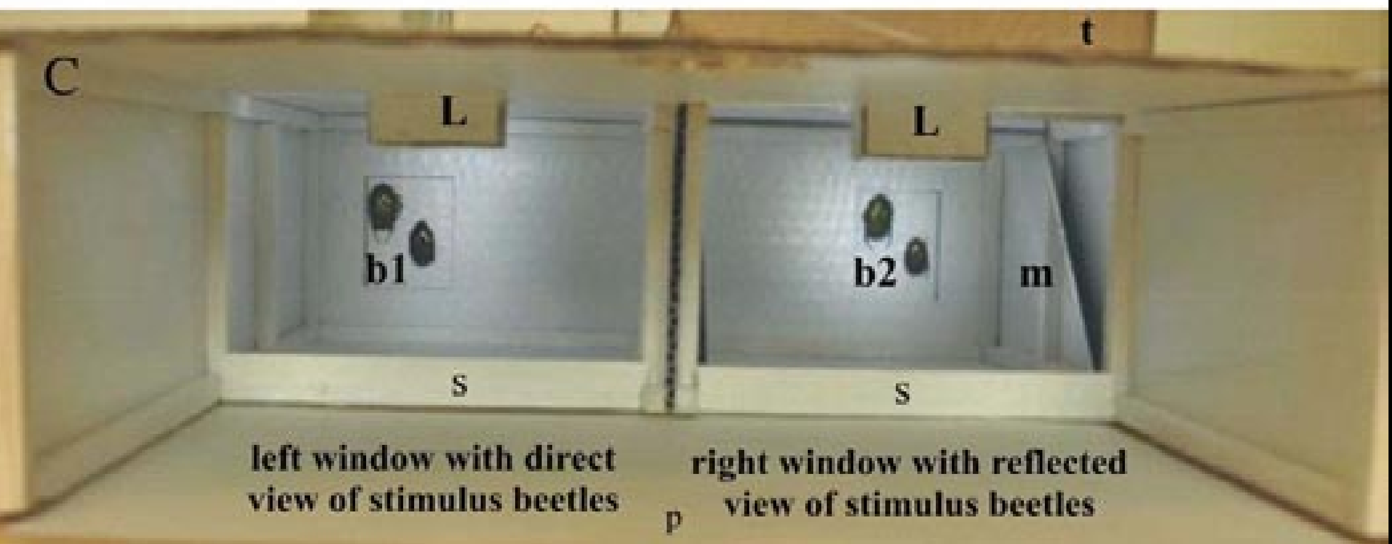


Diagram and photo from: Blahó M., Egri Á., Hegedüs R., Jósvai J., Tóth M., Kertész K., Biró L.P., Kriska Gy., Horváth G. (2012) Physiol & Behav. 105:1067-1075.

Consequently the hundred-year-old hypothesis of Michelson was contradicted. It appears that the reflectance of circularly polarized light in scarabs is a by-product of the physical structure of the exocuticle.

Summing it all up, three types of traps combining optimal floral (chemical) and colour (visual) cues are capable of trapping the 6 major cetoniin pests in Europe and the Middle East.

As for rutelins, a single trap design baited with dual sex attractant lure is suitable to catch the 3 most important *Anomala* scarabs in Europe.

First results suggest that the traps – beyond detection and monitoring – will be useful for directly suppressing damages through mass trapping.

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