KLP ("hat") trap with semiochemical lures suitable for trapping two *Diabrotica* spp. exotic for Europe.

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The trap

The KLP ("hat") trap baited with pheromone or floral lures is a highly efficient non-sticky trap for the western corn rootworm *Diabrotica v. virgifera* (Tóth et al., 2006, Tóth, 2011).
The objective of our research was to test the suitability of the KLP trap design for the related species, *D. speciosa* and *D. barberi*, baited with their respective lures.
Both *D. barberi* and *D. speciosa* are exotic to Europe and are on the EPPO A1 list. Sensitive detection tools are sought for if any of them is accidentally introduced into the EU.

The experimental insects

D. speciosa inhabits mostly temperate regions of South America. Its host plants include maize, wheat, groundnuts, soybeans, potatoes, but feeds also on many other vegetables and ornamental plants as well. *D. barberi* occurs in North America, its area partly overlaps with that of *D. v. virgifera*. *D. barberi* is more cold resistant than *D. v. virgifera*. Its introduction into Europe cannot be excluded. Climatic conditions in most maize-growing areas of Europe will be suitable for its survival. The damages are on maize and resemble damages caused by *D. v. virgifera*.

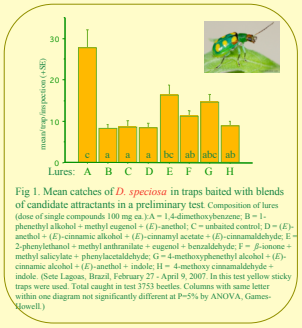

Fig 1. Mean catches of *D. speciosa* in traps baited with blends of candidate attractants in a preliminary test. Composition of lures (dose of single compounds 100 mg ea.): A = 1,4-dimethoxybenzene; B = 1-phenethyl alkohol + methyl eugenol + (*E*)-anethol; C = unbaited control; D = (*E*)-anethol + (*E*)-cinnamic alkohol + (*E*)-cinnamyl acetate + (*E*)-cinnamaldehyde; E = 2-phenylethanol + methyl anthranilate + eugenol + benzaldehyde; F = *β*-ionone + methyl salicylate + phenylacetaldehyde; G = 4-methoxyphenethyl alcohol + (*E*)-cinnamic alcohol + (*E*)-anethol + indole; H = 4-methoxy cinnamaldehyde + indole. (Sete Lagoas, Brazil, February 27 - April 9, 2007. In this test yellow sticky traps were used. Total caught in test 3753 beetles. Columns with same letter within one diagram not significantly different at P=5% by ANOVA, Games-Howell.)

Results on *D. speciosa*:

1,4-Dimethoxybenzene has been described before as an attractant for *D. speciosa* adult beetles (Ventura et al., 2000). In our screening tests performed in Brazil combinations of synthetic floral compounds were found to be attractive to *D. speciosa* (Fig 1).

However, the greatest effect was recorded for the previously known attractant 1,4-dimethoxybenzene. When the most active compounds in the preliminary tests, 2-phenylethanol, methyl anthranilate, eugenol or benzaldehyde were added to 1,4-dimethoxybenzene, no synergistic effect was observed (Fig 2). When 1,4-dimethoxybenzene was formulated in three types of polyethylene (PE) dispensers, PE bag dispensers were superior to two types of PE vial dispensers and caught hundreds of *D. speciosa* in KLP traps (Fig 3). Unbaited traps caught negligible amounts of beetles.

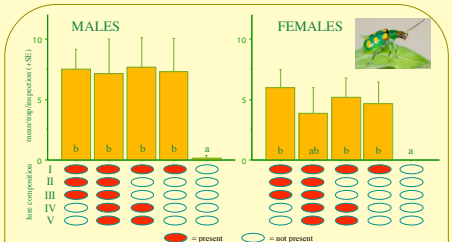

Fig 2. Mean catches of *D. speciosa* in traps baited with I and its blends with candidate co-attractants (Brazilia, 2008). Compounds tested (dose 100 mg ea.): I = 1,4-dimethoxybenzene; II = 2-phenylethanol; III = methyl anthranilate; IV = eugenol; V = benzaldehyde. (Sete Lagoas, Brazil, March 5 - April 25, 2008. Total caught in test 179 males and 118 females. Columns with same letter within one diagram not significantly different at P=5% by ANOVA, Games-Howell.)

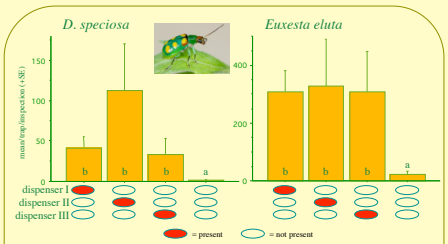

Fig 3. Mean catches of *D. speciosa* and *Euxesta eluta* in traps baited with 1,4-dimethoxybenzene formulated in three dispenser types. Dispenser types:I = polyethylene vial with lid; II = dental roll in polyethylene bag; III = dental roll in polyethylene vial with lid. (Sete Lagoas, Brazil, March 28 - May 2, 2010. Total caught in test 751 *D. speciosa*, and 3861 *E. eluta*. Columns with same letter within one diagram not significantly different at P=5% by Kruskal-Wallis, Mann-Whitney

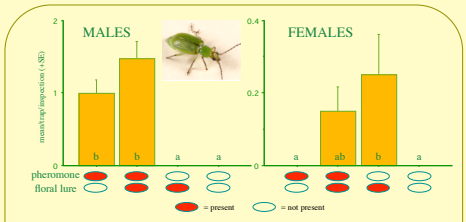

Fig 4. Mean catches of *D. barberi* in traps baited with the pheromone, the floral lure and with the two lures together. (Pine Grove Mills, PA, USA, July 22 - August 15, 2011. Total caught in test 99 males and 16 females. Columns with same letter within one diagram not significantly different at P=5% by Kruskal-Wallis, Mann-Whitney.)

Results on *D. barberi*:

As for *D. barberi*, the pheromone [as (2*R*,8*R*)-8-methyl-2-decyl propanoate] and a potent floral lure (as 4-methoxyphenethanol + indole) are already known (Guss et al., 1984; Ladd et al., 1985; Metcalf et al., 1995). For detection purposes it is of advantage if the trap catches both sexes. In our tests with KLP traps we found that both pheromonal and floral lures can be applied in the same trap to maximize both male and female numbers (Fig 4).

Non-target catches:

There was an interesting non-target effect. KLP traps baited with 1,4-dimethoxybenzene caught large numbers of the fly *Euxesta exoleta* (Diptera), which is known as a maize pest. To our knowledge this is the first report of an attractant for this insect.

Conclusions

In conclusion, for first detection programs in Europe, the application of KLP traps baited with 1,4-dimethoxybenzene in PE bag dispensers could be recommended for use in programs for *D. speciosa*, and KLP traps with dual (pheromonal and floral) lures for *D. barberi*. In the case of *D. barberi* one should note that the lures also show some attraction for *D. v. virgifera*, and the ratio of *D. barberi* vs. *D. v. virgifera* in the catch will be predominantly determined by the relative population densities at the given site

The end user should keep in mind that a KLP trap works best if insects caught in the catch container are killed by an insecticide. For this purpose anti-moth strips with dichlorvos can be used, or the inside of the trap can be sprayed (at weekly intervals) by a pyrethroid of household use (i.e. permethrin, empethrin, deltamethrin, etc.). According to experience, also transfluthrin or diazinone works well.

References cited:
Guss, P.L., Sonnet, P.E., Carney, R.L., Tumlinson, J.H., Wilkin, P.J. 1984. J. Chem. Ecol. 10:1123-1131.
Metcalf, R.L., Lampman, R.L., Deem-Dickson, L.J. 1995. J. Chem. Ecol. 21:1149-1162.
Tóth, M. 2011. IOBC EPS Informatsionny Byulleten 42:45-53.
Tóth, M., Csonka, É., Szarukán, I., Vörös, G., Furlan, L., Imrei, Z., Vuts, J. 2006. Intl. J. Hortic. Sci. 12:57-62.
Ventura, M.U., Martins, M.C., Pasini, A. 2000. Florida Ent. 83:403-410.

Acknowledgements
This research was partially supported by grant OTKA K81494 of Hungarian Academy of Science. Contributions of EMBRAPA to a study trip by MT to Brazil is gratefully acknowledged.