ATTRACTION OF *PLECIA NEARCTICA* (DIPTERA: BIBIONIDAE) TO FLORAL LURES CONTAINING PHENYLACETALDEHYDE

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The bibionid fly *Plecia nearctica* Hardy, commonly called the 'lovebug', is a widely recognized insect found alongside roadways in all southern states bordering the Gulf of Mexico as well as Georgia, and North and South Carolina (Denmark et al. 2010). In Florida, descriptions of this insect in large numbers coincide with peak seasonal flight periods in Apr-May and Aug-Sep, with a smaller third flight in Dec in southern Florida (Cherry & Raid 2000). While testing for attractiveness of floral-based lures to lepidopteran turf pests in 2011, we noticed a large number of *P. nearctica* adults in traps containing phenylacetaldehyde (PAA), an aromatic compound found in many foods and flowers. Previously described attractants for adult *P. nearctica* include automobile exhausts irradiated with UV-light (Callahan & Denmark 1973; Callahan et al. 1985), localized heat sources (Whitesell 1974) and the aromatic oil anethole (Cherry 1998). However, information on the attractiveness of floral (food)-based lures has not been previously reported for this species.

To investigate this further, we tested traps containing different floral baits that are known attractants to noctuid and pyralid moths in central and southern Florida. Green delta-shaped sticky traps (Pherocon IIID, Trécé Inc., Adair, Oklahoma) suspended from 1 m PCV poles (Fig. 1A) were placed

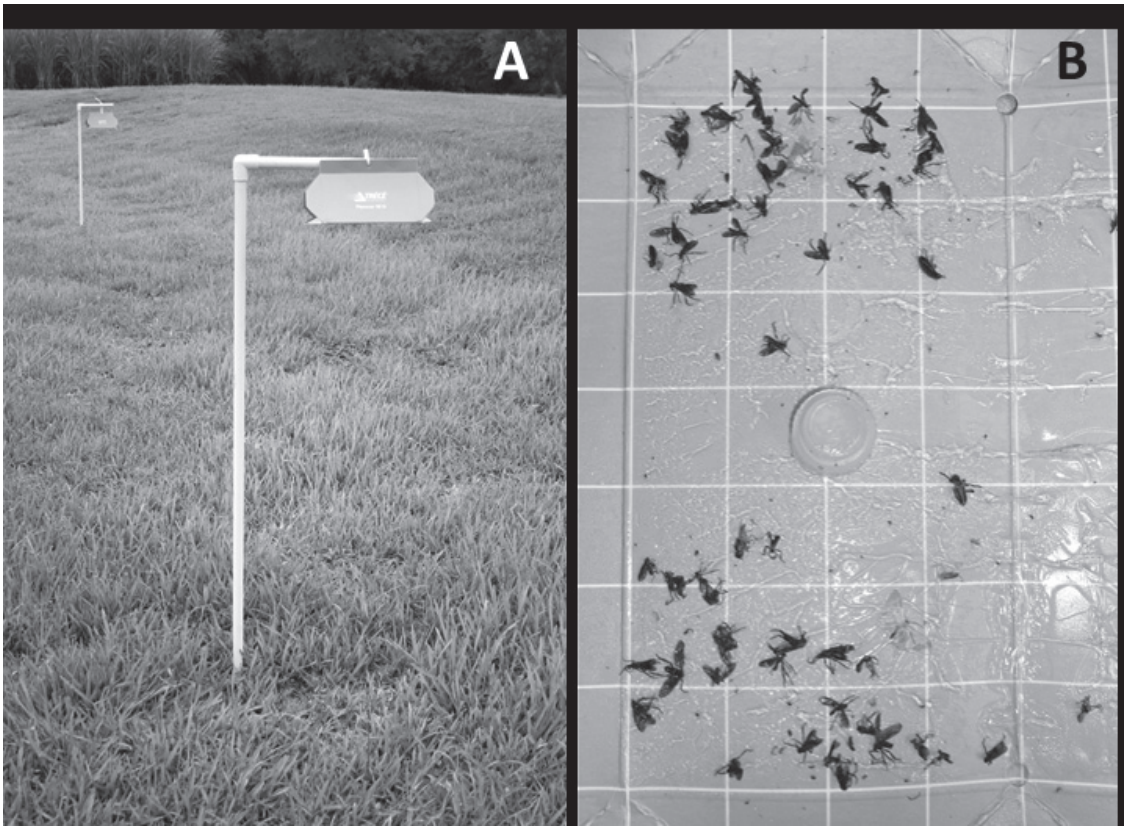

Fig. 1. A: Deployment of delta-shaped sticky traps at 1 m height. B: Captures of lovebugs (*Plecia neartica* Hardy) on sticky surface baited with phenylacetaldehyde dispensed from a hollow polyethylene stopper (middle of trap).

in open grassy areas on the research grounds of the Mid Florida REC in Apopka and farther south at the Everglades Research and Education Center in Belle Glade. Traps were baited with the following treatments, with each chemical dispensed separately in hollow polyethylene stoppers (Kimble, Vineland, New Jersey) (0.5 ml): phenylacetaldehyde (PAA), PAA + β-myrcene, PAA + methyl salicylate, acetic acid + 3 methyl-1-butanol (isoamyl alcohol) (AA + 3MeB) and unbaited controls. All chemicals were purchased from Aldrich Chemical Co. (Milwaukee, Wisconsin, USA). Treatments were arranged as a randomized block design with 5 replicates. Traps were placed at 10 m spacing with each replicated block separated by at least 50 m. Tests were conducted in Sep 2011 when adult lovebugs were observed flying at the two locations. Traps were collected after one wk at each location and insects counted and sex ratio determined as described previously (Cherry 1998). Differences in numbers of lovebugs captured among treatments was determined by one-way ANOVA and Tukey's HSD mean separation at $P < 0.05$ following log $(n+1)$ transformation (SPSS v.17). A 2 by 2 contingency table using χ^2 analysis with Yates correction was used to determine if the sex ratio was different between adult lovebugs caught in PAA-baited traps and those collected concurrently with a sweep net on surrounding vegetation between 11 am and 2 pm (Apopka only).

The number of *Plecia nearctica* caught in traps was strongly influenced by treatment at both locations; $F_{4,20} = 69.0$, $P < 0.0001$ (Apopka) and ($F_{4,20} = 20.0$, $P < 0.0001$) (Belle Glade), with significantly higher catches in PAA-baited traps (Table 1; Fig 1B). The addition of the volatile compounds methyl salicylate and β-myrcene did not increase captures. The acetic acid + 3 methyl-1-butanol treatment was not attractive in our tests. There was no statistical difference between the sex ratios of *P. nearctica* caught in PAA-baited traps (68% male, $n = 584$) and those collected by sweep netting (58% male, $n = 73$), ($\chi^2 = 2.8$, df = 1, $P = 0.09$). Female *P. nearctica* caught in sweep nets averaged 11.3 ± 1.0 mg and males 6.1 ± 0.4 mg.

Table 1. Adult *Plecia nearctica* (mean ± SEM) collected after one week on green delta traps baited with floral lures.

Lure[1]	Apopka[2]	Belle Glade
AA + 3MeB	0.8 ± 0.4 b	1.2 ± 0.5 b
PAA	52.4 ± 8.0 a	17.2 ± 4.2 a
PAA + β-myrcene	39.4 ± 10.1 a	26.2 ± 7.5 a
PAA + methyl salicylate	26.6 ± 4.5 a	20.6 ± 9.7 a
Unbaited	0.4 ± 0.2 b	0.6 ± 0.4 b

[1]Abbreviations are as follows: AA = acetic acid, 3MeB = 3 methyl-1-butanol (isoamyl alcohol), PAA = phenylacetaldehyde.
[2]Means in a column followed by the same letter are not significantly different (α = 0.05, Tukey's HSD test).

This is the first report of specific floral compounds being attractive to lovebugs. The mechanism of attraction is unknown; although since both sexes of *P. nearctica* feed on pollen and nectar (Hetrick 1970; Leppla et al. 1974; Evans et al. 2002), it most likely relates to food-based olfactory receptors located on antennal sensillae as has been shown for other Diptera (Kendra et al. 2009). Harold A. Denmark (personal communication) observed hundreds of *P. nearctica* attracted to blooms of the oakleaf hydrangea *Hydrangea quercifolia* which, when analyzed by USDA, Agricultural Research Service chemists in Gainesville, Florida, were found to contain PAA. There are previous reports of PAA being attractive to other insects, including several noctuid moths and sphecoid and scoliodid wasps (Meagher & Mitchell 1999; Meagher 2001). Meagher & Landolt (2008) also showed that the following floral odorants, cis-jasmone, benzyl acetate, limonene, linalool, β-myrcene, methyl salicylate, and methyl-2-methoxy benzoate, increased captures of some moths when added to traps containing PAA. However in this study, we did not observe additive effects of β-myrcene or methyl salicylate. Several aldehydes have been reported previously as attractive for *P. nearctica*. Callahan et al. (1985) tested irradiated automobile exhaust fumes and their components against adult lovebugs in controlled conditions and reported that heptaldehyde, acetaldehyde and formaldehyde were attractive to 68-95% of specimens tested. The authors suggested that these substances produced as byproducts of photochemical reactions of exhaust fumes might duplicate oviposition attractants arising from decaying organic matter.

The identification of attractants for *P. nearctica* is significant since a sex pheromone has not been reported and this day-flying insect apparently does not respond to traditional blacklight or tungsten light traps (Callahan et al. 1985). PAA can be infused into rubber septa or other materials to facilitate its slow release. The use of attractive floral odors such as PAA warrants consideration for use in sampling strategies for *P. nearctica*. We note that our collections were made in late Sep, possibly after the peak flight of *P. nearctica* (Cherry & Raid 2000), suggesting that greater numbers of lovebugs could be captured at other times. Since *P. nearctica* is a clumsy flyer, it was often observed on the PVC poles or outer surfaces of traps. Therefore the testing of alternative trap types such as sticky yellow panel traps (Cherry 1998), is also warranted.

Summary

We observed that the floral odorant, phenylacetaldehyde (PAA), was attractive to both sexes of adult *P. nearctica* in central and southern Florida. The addition of β-myrcene and methyl salicylate

to PAA did not improve the numbers of *P. nearctica* caught in delta traps. This report provides additional information for sampling strategies.

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