

Cucurbita Blossom Aroma and Diabrotica Rootworm Beetle Attraction

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Recent research has shown that many diabroticite species found on cucurbits, including the striped cucumber beetle (SCB) Acalymma vittata, the spotted cucumber beetle (SCR) D. undecimpunctata howardi, the western corn rootworm (WCR) D. virgifera virgifera, and the northern corn rootworm (NCR) D. barberi, are attracted to olfactory cues. The preponderance of described attractants are phenylpropanoids or closely related compounds e.g., eugenol, estragole, and p-methoxycinnamaldehyde (1,2). We examined the attraction of Diabrotica beetles to the odors of Cucurbita blossoms independent of visual and contact cues, such as color, size, shape, and cucurbitacin content. Thirty grams of blossoms from cv. Dickinson Field (C. moschata) and cv. Blue Hubbard (C. maxima) were placed inside paper cartons, the top covered with cheesecloth (preventing contact with the blossoms), and the outside of the trap coated with sticky material. As shown in Table 1, the attraction of WCR and SCB beetles to the isolated Blue Hubbard blossoms, demonstrates that blossom odor alone plays an important role in distribution of these rootworm beetles. The apparent lack of response from SCR adults is probably due to extremely low number of beetles present in the field.

Beetle counts (conducted on July 16, 1987) on blossoms of C. maxima and C. moschata from field plants provided corroborative results. Mean numbers of WCR, SCR, and SCB collected per blossoms (n=31) of C. maxima were 24.5, 0.6, and 2.7, respectively. In contrast mean beetle counts were 4.3, 0.1, and 3.7 on blossoms (n=23) of C. moschata.

Over 40 individual volatile chemicals have been isolated from Cucurbita maxima blossoms and circa 25 of these have been unequivocally identified (3,4). We evaluated the major odor components as attractants for adult Diabrotica spp. using cylindrical sticky traps baited with dental cotton wicks (5) containing from 0.01 mg to 200 mg of volatile compound. A summary of tests conducted during the summers of 1985-1987 are shown in Table 2. The effective attractants show a linear log-dosage response and the attractive compounds have been rated according to their limit of response (LR), i.e. the least amount of compound producing significant attraction over a 24 hour period vis-a-vis unbaited control traps. The results are based on the means of four replicate traps and were significantly different from the control traps at P=0.01 by Duncan's multiple range test.

The majority of the C. maxima blossom volatiles are unattractive when tested singularly. The green volatiles, especially trans-2-hexenol and cis-3-hexenol, are marginally attractive, as are the aromatic compounds, 1,2,4-trimethoxybenzene, phenylethanol, and phenylacetaldehyde for SCR (4). trans-Cinnamaldehyde is highly attractive to SCR and moderately attractive to WCR, but not appreciably attractive to NCR. trans-Cinnamyl alcohol is highly attractive to NCR, although only slightly attractive to SCR and WCR.

Indole is highly attractive to WCR (LR 1 mg), but not appreciably attractive to NCR and SCR (2). The terpenoid beta-ionone is highly attractive to WCR (LR 3 mg), but unattractive to NCR and SCR. Its isomer alpha-ionone is completely unattractive to all three Diabrotica spp. For comparison, the most effective volatile attractants yet identified for the respective species and their LR values are eugenol for NCR (LR 10 mg), estragole for WCR (LR 3 mg), and p-methoxycinnamaldehyde for WCR (LR 0.03 mg) (5).

Literature Cited

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Table 1. Counts of western corn rootworm (WCR), southern corn rootworm (SCR), and spotted cucumber beetle on traps containing flower blossoms from an accession of Cucurbita maxima and Cucurbita moschata

Treatment	Trapping period	WCR	SCR	SCB
control	60 min.	6.8 + 7.5	0.5 + 0.6	1.8 + 0.5
<u>C. maxima</u>	60 min.	86.0 + 30.6	3.0 + 1.4	11.8 + 4.5
<u>C. moschata</u>	60 min.	11.3 + 6.2	0.5 + 1.5	2.8 + 1.5

Table 2. Activity of volatile compounds in field traps as attractants for the northern corn rootworm (NCR), southern corn rootworm (SCR), and western corn rootworm (WCR) beetles

<u>Volatile Compound</u>	<u>Attractant Rating* For</u>		
	<u>NCR</u>	<u>SCR</u>	<u>WCR</u>
<u>Green Volatiles</u>			
1-hexanol	0	0	0
1-hexanal	0	0	0
<u>trans</u> -2-hexanol	0	+1	+1
<u>cis</u> -3-hexenol	0	0	+1
<u>trans</u> -2-hexenal	0	0	0
<u>Aromatics</u>			
1,4-dimethoxybenzene	0	0	0
1,2,4-trimethoxybenzene	0	+1	+1
benzyl alcohol	0	0	0
benzaldehyde	0	0	0
phenylethanol	0	+1	0
phenylacetaldehyde	0	+2	0
<u>p</u> -methoxybenzyl alcohol	0	0	0
<u>p</u> -methoxybenzaldehyde	0	0	0
<u>Phenyl propanoids</u>			
indole	0	0	+4
cinnamyl alcohol	+3	+2	+1
cinnamaldehyde	0	+4	+3
<u>Terpenoids</u>			
alpha-ionone	0	0	0
beta-ionone	0	0	+4
nerolidol	0	0	0

LR= Limit of Response = 200 mg(0), 30-100 mg(+1), 10-30 mg(+2), 3-10 mg(+3), and 1-3 mg(+4).