Evaluation of Host-odor Compounds for Attractiveness to Plum Curculio Adults: 2000 Results

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As reported in the summer 1999 issue of *Fruit Notes*, 56 compounds have thus far been identified as components of odor of plum or apple fruit at its most attractive stage to plum curculio (PC). Results presented in that report showed that of 30 such compounds evaluated, 13 proved attractive to PC at either a high, medium or low release rate of compound.

Here, we describe results of 2000 tests in which these 13 compounds (plus four others from 1999) were re-evaluated for attractiveness to PC along with 11 other host-odor compounds evaluated for the first time.

Materials & Methods

Each compound was introduced into a high-density polyethylene vial (VWR Chemical Incorporated) and assessed at three different release rates so as to create a very low, low, or moderate amount of odor concentration in the surrounding air. Desired release rates were achieved by varying the number of vials used per trap and were approximately 0.4, 2.0, and 10.0 milligrams of odor per day.

Compounds were evaluated in association with yellow-green boll weevil traps placed on the ground at the edge of unsprayed apple tree canopies in Massachusetts and Ohio. PCs frequently drop from host tree canopies to the ground and may encounter odor from a nearby baited trap. Each trap was baited with a single compound at a single

Table 1. Response index (RI) of plum curculio adults to 22 host fruit odor compounds evaluated in both Ohio and Massachusetts in 2000 at three different release rates. For each compound, only that release rate which yielded the highest RI value of all is given.

Compound	Release rate	RI	(1999 RI value)**
Benzaldehyde	M	45*	(L 46)*
Benzothiozole	L	20	(H 27)
Benzyl Alcohol	M	27	(L 44)*
Decanal	L	11	(L 64)*
Ethyl isovalerate	M	38*	(M 40)*
Geranyl propionate	VL	33*	(M 59)*
2-hexanol	VL	14	(H 32)*
E-2-hexenal	VL	29	(M 90)*
hexyl acetate	M	50*	(H 67)*
Z-3-hexenyl acetate	M	50*	---
Z-3-hexen-1-ol	VL	0	---
3-hydroxy-2-butanone	VL	25	(H 27)
Isopropyl acetate	L	33*	(L 20)
R(+) Limonene	L	20	(M 64)*
S(-) Limonene	VL	65*	---
Nonanal	VL	33*	(M 0)
1-pentanol	L	71*	(M 59)*
2-pentanol	M	11	(H 35)*
3-penten-2-ol	L	45*	---
Phenylacetaldehyde	L	64*	(H 32)*
Plum essence***	L	0	---
2-propanol	L	33*	(M 32)*

*RI values of 32 or greater can be considered significantly different from zero at odds of 9:1.
**Release rate giving highest RI value in 1999 tests.
***Synthetic version of plum odor made by Milne, Inc.

Table 2. Response index (RI) of plum curculio adults to six host fruit odor compounds evaluated in Massachusetts in 2000 at three different release rates. For each compound, only that release rate which yielded the highest RI value of all is given.

Compound	Release rate	RI
Beta-caryophyllene	VL	0
Cubebene	VL	33*
2,4-decadienal	M	0
Alpha-farnesene	M	0
Ocimene	VL	56*
3-penten-2-one	M	14

*RI value of 32 or greater can be considered as significantly different from zero at odds of 9:1.

release rate or was unbaited. Vials were placed inside the cylinder component of the screen funnel top of the trap. Over a 7-week period from early May to late June, 264 traps were deployed in Massachusetts and another 264 in Ohio for re-evaluation of 17 compounds tested in 1999 plus five other compounds that were comparatively inexpensive to purchase from a commercial supplier (Table 1). In addition, six compounds that were much too expensive to evaluate in both states were evaluated only in Massachusetts (Table 2). Traps were examined for captured PCs every 2-3 days and rotated in position after each examination.

To measure attractiveness of a particular release rate of a particular compound, a Response Index (RI) was created by subtracting the total number of PCs responding to an unbaited control trap (C) from the total number responding to its corresponding baited trap (BT), dividing by the total number of PCs captured by the C and BT traps and multiplying by 100. Thus, RI = [(BT-C)/BT+C)] x 100. The greater the RI, the more attractive the compound was at that release rate. RI values of 32, 50 and 60 correspond to PC captures by baited traps as being two, three and four times greater, respectively, than captures by control traps.

Results

Of the 22 compounds evaluated in both Massachusetts and Ohio (Table 1), 12 had a RI value of 32 or greater (= minimum RI value suggestive of significant attractiveness) at the most attractive release rate. In descending order of attractiveness, these were 1-pentanol (71), S (-) limonene (65), phenylacetaldehyde (64), hexyl acetate (50), Z-3-hexenyl acetate (50), benzaldehyde (45), 3-penten-2-ol (45), ethyl isovalerate (38), geranyl propionate (33), isopropyl acetate (33), nonenal (33) and 2-propanol (33).

Also given in Table 1 are highest RI values from 1999 tests involving 17 of the 22 compounds. Together, data from 1999 and 2000 tests show that seven of the 17 compounds tested in both years had RI values each year of 32 or greater at the most attractive release rate. In descending order of attractiveness (where RI values were averaged across both years even though corresponding release rates may have been different), these seven compounds were: 1-pentanol (65), hexyl acetate (59), phenylacetaldehyde (48), benzaldehyde (46), geranyl propionate(46), ethyl isovalerate (39), and 2- propanol (33). In addition, the average RI value for R(+) limonene in 1999 and S(-) limonene (which contains 25% R(+) limonene) in 2000 was 65.

Results for the six expensive compounds evaluated only in Massachusetts (Table 2) show that only two had RI values of 32 or greater at the most attractive release rate: ocimene (56) and cubebene (33). Ocimene is a biochemical byproduct of limonene.

Conclusions

Results from 2000 tests in conjunction with those from 1999 tests suggest that 10 compounds are especially worthy of further consideration as affordable odor attractants for PC. In alphabetical order these are: benzaldehyde, ethyl isovalerate, geranyl propionate, hexyl acetate, Z-3-hexenyl acetate, limonene, 1-pentanol, phenylacetaldehyde, 3-penten-2-ol, and 2-propanol.

As reported elsewhere in this issue of *Fruit Notes*, benzaldehyde and ethyl isovalerate proved attractive to PCs when each was in combination with synthetic pheromone in traps intended to capture PCs immigrating into orchards as well as in traps intended to capture PCs beneath or within apple tree canopies. Limonene in combination with pheromone also showed evidence of attractiveness to PCs under the latter condition. Each of the 10 most promising host odor compounds reported here merits evaluation in combination with pheromone for attractiveness to PC.

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