

SUGARBEET ROOT MAGGOT RESPONSES TO PLANT VOLATILES

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INTRODUCTION

Management of the sugarbeet root maggot, *Tetanops myopaeformis* Röder [Diptera: Otitidae], primarily depends on insecticides applied at-planting or early post-emergence to kill maggots in the soil. Only five active ingredients are registered for maggot control: aldicarb, chlorpyrifos, diazinon, phorate and terbufos. Because each faces an uncertain regulatory future, we began studies during 1999 that might lead to an entirely new strategy — *Attract-and-Kill*. Rather than look for new ways to kill maggots, we instead seek to exploit adult host-seeking behavior by fatally luring adult flies to insecticides that have been formulated with “soft” insecticides and thus kill adults before they lay eggs. Attract-and-kill has proven successful in the Midwest, where corn growers manage rootworm beetle infestations by aerially applying low-doses of insecticide formulated with an arrestant and feeding stimulant that lures beetles to their death.

Our idea is based on research conducted more than 30 years ago in Idaho by USDA Research Entomologists Swenson and Peay, who reported [1969. JEE 62: 910-912] that fresh and fermented preparations of raw beet juice or processed juice from the factory diffuser were highly attractive to root maggot flies. Although their work suggests that volatile air-borne chemicals from sugarbeet plants are innately attractive to adult flies, certain elementary questions have yet to be answered, particularly

- Are flies really attracted to beet juice? It is impossible to know from the data of Swenson and Peay if flies were attracted to the scent of beet juice or to the presence of other root maggot flies captured live in their traps.
- Are host-plant extracts other than factory juice attractive to flies?
- If flies indeed respond to baits, is there preferential attraction of one sex over the other?
- Does fly response change through time?
- Does bait attractiveness change through time?
- Does the surrounding crop alter bait attractiveness?

We report here preliminary field studies conducted during 1999 to begin sorting out these questions. Our objective was simple: to determine the relative attractiveness of sugarbeet plant extracts and other potential adult sugarbeet root maggot fly baits under field conditions. We hoped to identify candidate baits that subsequently could be studied in more detail.

PROCEDURES:

We evaluated four potential sources of SBRM attractants: 2 whole-plant baits and 2 factory-processed sugarbeet preparations. Whole-plant baits were prepared by grinding in water entire 4-5 leaf growth-stage sugarbeet or spinach plants from greenhouse stocks; these were standardized as 10 whole-plant sugarbeet equivalents or 7 whole-plant spinach equivalents in 250-ml distilled water and frozen until placed in the field. The Amalgamated Sugar Company provided two processed baits: sugarbeet juice from the factory diffuser and sugarbeet root pulp. The latter was prepared by re-hydrating dry pulp pellets in water with sugar and holding at field temperatures until it fermented.



FIGURE 1. Box trap [after Swenson & Peay]

Bait attractiveness was measured by using 12x11x6-inch wooden screened box traps [Figure 1] placed over a 9-inch diameter aluminum pie pan that held 250-ml of each candidate bait 250 ml distilled water. Box traps were entirely open along the bottom for fly access; an interior A-shaped tent of window screen with 3/16th-inch holes punched along the top trapped flies in the box. Water-baited traps provided controls for bait comparisons. A second control consisted spraying trap screening with diazinon to kill flies on entry and so eliminate potential confounding from the presence of other living flies; these traps were baited with diffuser juice.

Study sites were a commercial wheat field and an adjacent commercial sugarbeet field in Minidoka County, ID. The wheat field had been planted to sugarbeets during 1998 and served as a reservoir of overwintering root maggot flies. The beet field was immediately east of the wheat field but separated from it by a paved road running north to south. Experimental design at both sites was a randomized complete block with 4 replications of each bait. Wheat-field traps were placed north-to-south along the easternmost field edge at 15-m intervals to intercept overwintering root maggot flies moving on prevailing winds; beet-field traps were placed north-to-south along the westernmost edge of the field to intercept colonizing flies.

We operated traps for 24-hr periods on 4 different dates between initial fly emergence during late-May through peak fly activity and decline in June. At the end of each 24 hour period, we placed traps inside black plastic bags and left them in the sunlight for several hours until captured flies died. Specimens were identified and sexed in the lab.

RESULTS and DISCUSSION:

Traps baited with diffuser juice captured significantly more sugarbeet root maggot flies than any other treatment. The single best treatment was beet juice traps that had been surface-sprayed with diazinon, followed by beet juice in unsprayed traps; together they accounted for nearly 60% of seasonal captures [Figure 2].

Crude water-based preparations of whole sugarbeet plants or whole spinach plants were no better than water alone [Figure 2]; similarly, beet pulp was no better than water by itself. Water by itself accounted for 15% of total SBRM captures; this unexpectedly high percentage suggests that visual cues also play a role in adult habitat-finding behavior.

Flies other than the sugarbeet root maggot (i.e., anthomyiids, sarcophagids and calliphorids) were most commonly captured from traps baited with fermented beet pulp [Figure 2]; more than one-third of the non-SBRM captures were from pulp-baited traps whereas less than 10% of SBRM captures were from pulp-baited traps. This difference in responses between SBRM and non-SBRM flies is encouraging as it suggests there indeed exists a SBRM odor cue that justifies further study.

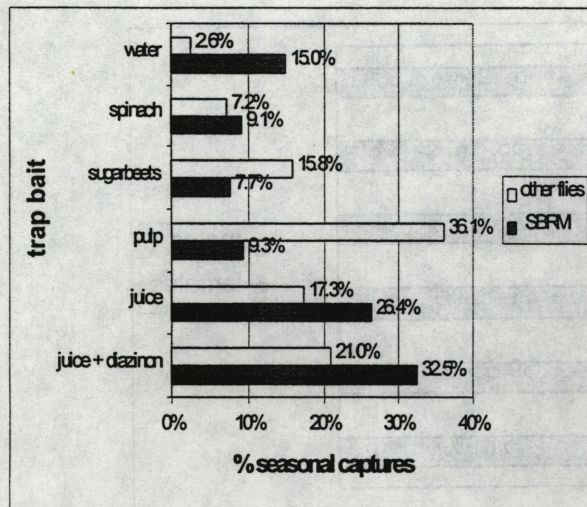


FIGURE 2. Relative seasonal captures of sugarbeet root maggot flies and other flies from traps in wheat and sugarbeet fields, Minidoka County 1999.

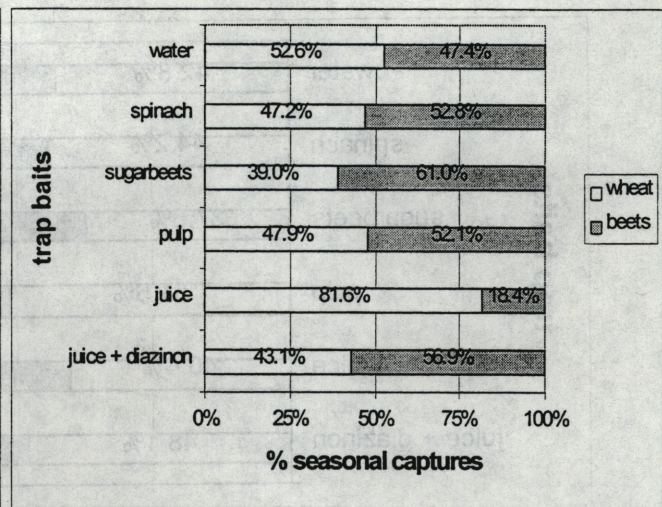


FIGURE 3. Relative seasonal captures of sugarbeet root maggot flies within each bait treatment as a function of trap location, Minidoka County 1999

Relative attractiveness of treatments depended on field site [Figure 3]. Of all the SBRM captured in juice-baited traps, 8 in 10 were recorded from traps in the wheat field; conversely, of all the SBRM captured in juice-baited traps that had been surface sprayed with diazinon, nearly 6 in 10 came from traps in the adjacent beet field. And though the whole-plant sugarbeet bait was infective compared to beet juice, the beet plant bait was more effective in the beet field than in the wheat field.

With the exception of beet pulp, all treatments captured more female SBRM flies than males [Figure 4]. Female-to-male ratios were highest in traps baited with beet juice and whole-plant sugarbeets. This result too is encouraging because attract-and-kill strategies particularly depend on eliminating ovipositing females.

Relative attractiveness also depended on time. Juice-baited traps accounted for an increasing proportion of SBRM captures as the season progressed [Figure 5]. In addition, sex ratios of captures varied with time. Initially, more than 60% of SBRM captures were females; this value subsequently declined to 50:50

Current work is focusing on identifying candidate volatiles from beet juice that can be tested by conducting behavioral bioassays with sugarbeet root maggot flies in Y-olfactometers.

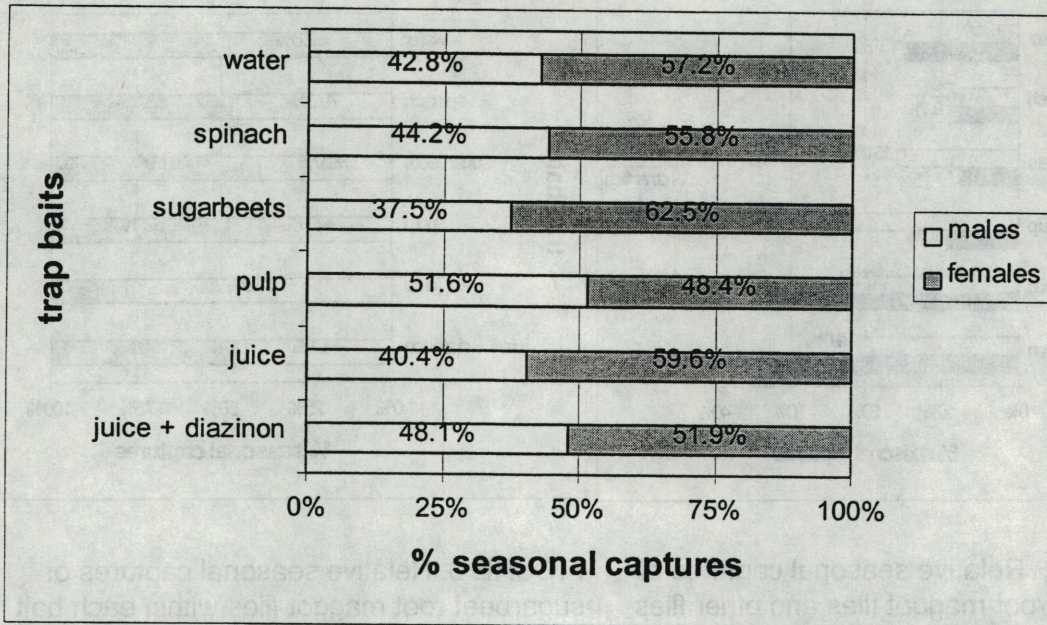


FIGURE 4. Relative seasonal captures of male and female sugarbeet root maggot flies within each bait treatment from traps in wheat and beet fields, Minidoka County 1999

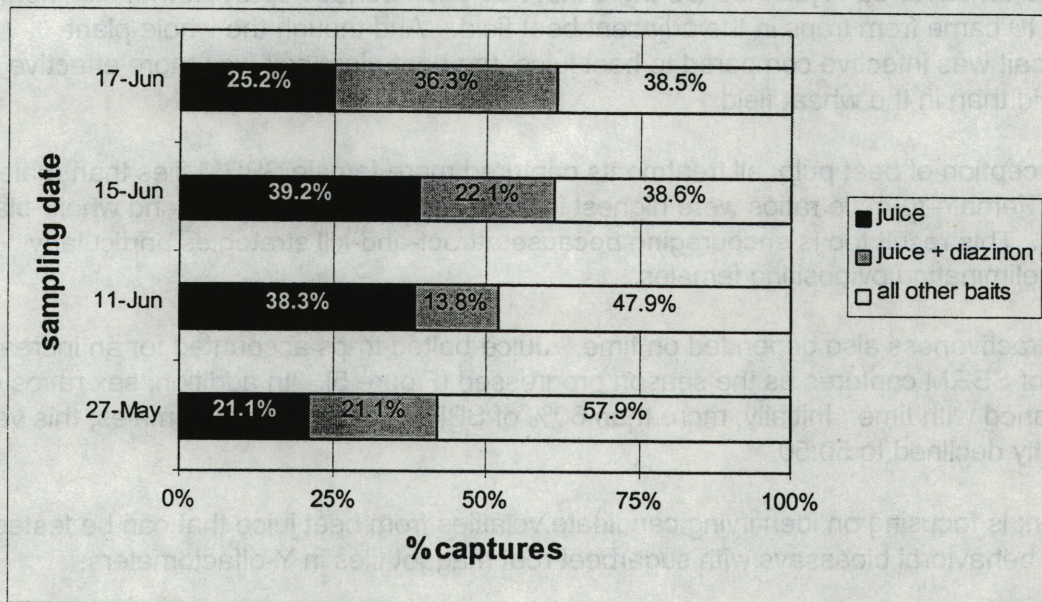


FIGURE 5. Relative captures of sugarbeet root maggot flies within juice and non-juice bait treatments from traps in wheat and beet fields on four sampling dates, Minidoka County 1999