Cultivar Preferences Affect Apple Maggot Fly Distribution in Orchards

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It has been known for decades that some apple cultivars are more susceptible to apple maggot fly (AMF) damage than others. Whether this is because trees of preferred cultivars attract more AMF than others and/or because the fruit they bear is more acceptable for oviposition than the fruit of less-preferred cultivars is not very clear. In general, it is thought that because fruit of early and mid-ripening cultivars reach a higher sugar content and soften earlier in the season, they are preferred by AMF over late-ripening cultivars (Dean and Chapman, 1973). Determining AMF cultivar preference is important because fly activity in apple orchards could concentrate in areas where preferred cultivars are found, which in turn could affect control measures using traps.

Here, we report results of a four-year experiment comparing AMF accumulation on unbaited traps among 13 apple cultivars grown in Massachusetts. Our objective was to generate cultivar preference information that would allow us to design optimal trap deployment strategies for AMF behavioral control using odor-baited traps.

Materials & Methods

We compared AMF preferences among apple cultivars grouped into three phenological categories: early, mid, and late ripening. Within each category, we selected three to six cultivars represented in New England apple orchards. Cultivar comparisons were made over a 4-year period (1997-2000) in six commercial orchards having different cultivar arrangements managed under first-level IPM practices (2-3 summer insecticide sprays against AMF).

Early-ripening cultivars included Akane, Jersey Mac, Paula Red, Red Astrachan, Tidemann Red, and Vista Bella. Mid-ripening cultivars included Cortland, Gala, and McIntosh. Late-ripening cultivars included Braeburn, Fuji, Golden Delicious, and Delicious.

Eight medium to large-size trees of each cultivar were selected in each orchard. Each tree received an unbaited red sphere coated with Tangletrap to capture alighting AMF. Spheres were placed on trees in early July and remained on trees until harvest of late cultivars in early October. Traps were inspected once per week, when captured AMF were counted and removed. Each cultivar was ranked in terms of preference by assigning a relative rank from 1 to 13, with 1 being the highest rank and 13 the lowest. The cultivar whose traps accumulated the most AMF received the highest rank.

Results

Because cultivar preferences varied along the growing season, we broke capture data into three distinct seasonal periods: early season (early July to early August), mid season (early August to early September), and late season (early September to early October). Average preference ranks among cultivars over the 4-year period reveal that during early season, two early-ripening cultivars ranked highest in terms of AMF preference: Red Astrachan and Tidemann Red (Table 1). These ranked numerically higher than Jersey Mac, Gala, Delicious, Fuji, Vista Bella, and Akane, with all other cultivars having statistically lower ranks. During mid season, Tidemann Red retained its high rank. Red Astrachan and Vista Bella, which had lost firmness and had begun dropping heavily from trees, experienced a dramatic drop in preference. Conversely, Jersey Mac and Akane, both early-ripening cultivars that ripen later than Red Astrachan, gained in average rank. Fuji gained substantially in rank while Gala retained a relatively high rank. During late season, Gala and Fuji were the most preferred cultivars. All late-ripening cultivars gained in rank. By contrast, all early-ripening cultivars (except Red Astrachan) dropped in rank. Paula Red, Jersey Mac, and Vista Bella ranked significantly lower than Gala, Fuji, and

Table 1. Average preference rank among apple cultivars according to seasonal period of captures of apple maggot flies on unbaited red sphere traps placed in trees of each cultivar.*

Early		Mid		Late	
Red Astrachan	1.0 a	Fugi	2.6 a	Gala	1.9 a
Tidemann Red	1.5 a	Tidemann Red	2.7 ab	Fuji	3.0 ab
Jersey Mac	4.1 ab	Akane	3.0 ab	Golden Del.	4.0 ab
Gala	4.3 ab	Jersey Mac	3.5 ab	Red Astrachan	4.2 abc
Delicious	4.4 ab	Gala	4.3 ab	Delicious	4.8 abc
Fuji	4.4 ab	Golden Del.	5.1 ab	Braeburn	5.5 abc
Vista Bella	4.5 abc	Delicious	5.2 b	Akane	5.7 bc
Akane	5.2 abcd	Vista Bella	5.9 bc	McIntosh	5.9 bc
Golden Del.	5.6 bcd	Red Astrachan	6.0 bc	Cortland	5.9 bc
Braeburn	6.5 bcd	Paula Red	6.2 bc	Tidemann Red	6.8 c
Paula Red	6.9 cd	McIntosh	6.7 bc	Paula Red	7.1 c
McIntosh	7.0 d	Braeburn	7.5 c	Jersey Mac	7.5 c
Cortland	7.5 d	Cortland	8.0 c	Vista Bella	8.1 c

* Values within a column followed by the same letter are not significantly different at odds of 19:1.

Golden Delicious. The early ripening cultivar Paula Red and the mid-ripening cultivars McIntosh and Cortland always ranked among the bottom six cultivars in terms of preference.

Discussion

Traps on early cultivars, with the exception of Paula Red, accumulated substantial numbers of AMF during the early and/or mid period of the AMF season. Preference among early cultivars appeared to shift depending on ripening stage and the onset of fruit drop or harvest. For mid-ripening cultivars, traps on Gala accumulated relatively high numbers of AMF in most years and in most orchards early in the season, maintained their high preference rank across mid season, and reached their peak late in the season. With the exception of trees of a specific strain (Rogers Red McIntosh), and trees at one locale in one year (Cortland), traps on McIntosh and Cortland accumulated few AMF. Among late-ripening cultivars, traps on Fuji trees accumulated large numbers of flies during mid and late season. Both Delicious and Golden Delicious accumulated moderate numbers of AMF early in the season. By late season, these two late-ripening cultivars, along with Braeburn, reached a comparatively high rank.

Cultivar composition strongly influenced AMF distribution in orchards in our study. Contrary to earlier findings (Murphy et al., 1991), we found that AMF preference for some apple cultivars is not governed exclusively by the time of fruit ripening but rather by specific properties of fruit, possibly odor composition. Indeed, in some cases more than 80% of total AMF captures in a trapping period occurred on traps placed on trees of a single mid-ripening and a single late-ripening cultivar (Gala and Fuji). Moreover, AMF accumulated in considerable numbers on traps on Fuji trees in mid-season, despite the fact that those trees bore relatively unripe green fruit at that time. Findings here, in combination with findings on AMF oviposition preferences among cultivars (see following article), could have a substantial influence on success of using odor-baited traps to control AMF.

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