Early-season Performance of Diluted Concord Grape Juice and Commercial Lures at Attracting Spotted Wing Drosophila and Effects of Juice Fermentation on Trap Captures

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Commercial synthetic food-based lures are available to monitor spotted wing drosophila (SWD). While effective, most commercial lures are based on fermentation materials and consequently they attract a comparatively high number of non-target insects. Captures of unwanted insects hinders trap performance and increases sorting time. For the past two years we have been evaluating the attractiveness of diluted Concord grape juice, a low-cost and readily available material, to male and female SWD. When diluted at a ratio of 1:3 (= 1 part of grape juice and three parts of water), diluted grape juice showed to be three times more attractive to males and females than one commercial lure under field conditions (see Piñero and Foley, 2018). In addition, grape juice diluted at the 1:3 ratio attracted significantly fewer (about three times less) non-targets than one commercial lure, highlighting a potential greater selectivity of diluted Concord grape juice.

Here, we assessed the efficacy of traps baited with diluted Concord grape juice at monitoring SWD early in the season when compared to four commercial lures. A secondary objective was to elucidate the effects of grape juice fermentation, as influenced by aging, on SWD captures in traps. For all experiments, we assessed the selectivity of the materials evaluated by relating captures of SWD to non-target insects.

Materials & Methods

Experiment 1: Early-season SWD monitoring using grape juice and commercial lures. Here, we quantified the ability of 1-quart traps baited with diluted grape juice at the 1:3 dilution ratio (thereafter referred to as 'DGJ') to detect the first adult SWD of the growing season, compared with 1-quart traps baited with commercial lures. Five olfactory treatments were evaluated (1) DGJ, (2) Scentry® lure, (3) AlphaScents® lure, (4) Trécé broad spectrum PEEL-PAK multi-component lure, and (5) Trécé high-selectivity 3-component lure. DGJ-baited traps received 6 oz. of this material whereas traps baited with commercial lures received 6 oz. of unscented soapy water as a drowning solution. On May 4, five traps (one trap of each treatment) were deployed at each of four locations: Deerfield (on cherry trees), Belchertown (cherry), Whately (raspberry), and Amherst (elderberry). Traps were deployed on May 4 and they were removed on July 8, 2020. Once a week, all traps were serviced and all captured insects were brought back to the laboratory, for identification. At each trap inspection session, DGJ was replaced. The commercial lures remained in place until traps were removed.

Experiment 2. Effects of DGJ fermentation. This field test was conducted during June and July, 2019, in a cherry block at the UMass Cold Spring Orchard. The objective of this evaluation was to quantify the response of male and female SWD to volatiles emitted by DGJ (1:3 ratio) that had been aged for either, 7 or 14 days, compared to fresh DGJ. The four treatments evaluated were (1) fresh DGJ, (2) 7-day old DGJ, (3) 14-days old

DGJ, and (4) water as control. DGJ was prepared in the laboratory using 1-gallon containers with a gauze secured with rubber bands to allow for air exchange. GJD was prepared three times a week, and aged inside a chamber at 77°F and 65-75% relative humidity. The baits were prepared following a schedule that allowed for simultaneous evaluations of aged materials. Each treatment was replicated 5 times (= 5 cherry trees). Twice a week, traps were serviced, and insects were collected and transported to the lab, for identification. At each inspection session, clean traps were re-baited with newly-prepared materials.

Results

Experiment 1: Early-season comparison of diluted grape juice and commercial lures. As shown in Table 1, traps baited with diluted grape juice (DGJ) and with Trécé lures captured the first adult SWD of the season. This occurred on May 25, 2020. On June 1, DGJ was the only treatment that attracted SWD to traps. On June 10, all treatments except for AlphaScents attracted SWD. Results from the June 17 trapping date showed that the Scentry lure attracted the highest number of SWD. The Trécé broad spectrum lure ranked second on this date. DGJ attracted the highest number of SWD on June 30 and on July 8 (Table 1).

The selectivity of each treatment is presented in Table 1 (see section 'Ratio (other drosophilids to SWD)'). DGJ was the most selective treatment (lower values

Table 1. Early-season captures (expressed as average number per trap) of spotted wing drosophila (SWD) and non-target insects (other insects belonging to the SWD family) in traps baited with diluted grape juice (DGJ) and four commercial lures at four Massachusetts locations. Boxes highlighted in orange indicate the date of first SWD captures in 2020.

Treatment	May 11	May 18	May 25	June 1	June 10	June 17	June 22	June 30	July 8
SWD									
DGJ	0	0	0.7	0.3	0.8	4.8	1.3	8.3	16.8
AlphaScents	0	0	0	0	0	4.3	2.8	2.3	2.8
Scentry	0	0	0	0	2.0	11.3	3	3.3	1.5
Trécé broad spectrum	0	0	0.7	0	0.5	8.3	1.3	3.0	1.5
Trécé selective	0	0	1.0	0	0.3	2.0	0.5	2.0	0.3
Other drosophilids									
DGJ	0	0.7	16.7	11	3.3	6.8	1.8	14.3	32.3
AlphaScents	14.3	39.7	4	6.5	18.8	58.3	23.3	8.0	13.0
Scentry	2	27	66	11.8	5	35.5	64.5	6.0	12.0
Trécé broad spectrum	55.7	88.3	76	14	54	106.8	10.5	10.3	22.0
Trécé selective	3	9.7	30.3	4	5.3	9.0	1.7	2.0	3.8
Ratio* (other drosophilids to SWD)									
DGJ	---	---	23.9	36.7	4.1	1.4	1.4	1.7	1.9
AlphaScents	---	---	---	---	---	13.6	8.3	3.5	4.6
Scentry	---	---	---	---	2.5	3.1	21.5	1.8	8.0
Trécé broad spectrum	---	---	108.6	---	108.0	12.9	8.1	3.4	14.7
Trécé selective	---	---	30.3	---	17.7	4.5	3.4	1.0	12.7

*=Numbers represent ratio of non-targets captured for each SWD captured; hence, a value of 1 would indicate one SWD captured for each non-target insect (= high selectivity). Conversely, high values indicate less selectivity for SWD. For each week, the most selective treatment (= the one with the lowest ratio) is highlighted in green.

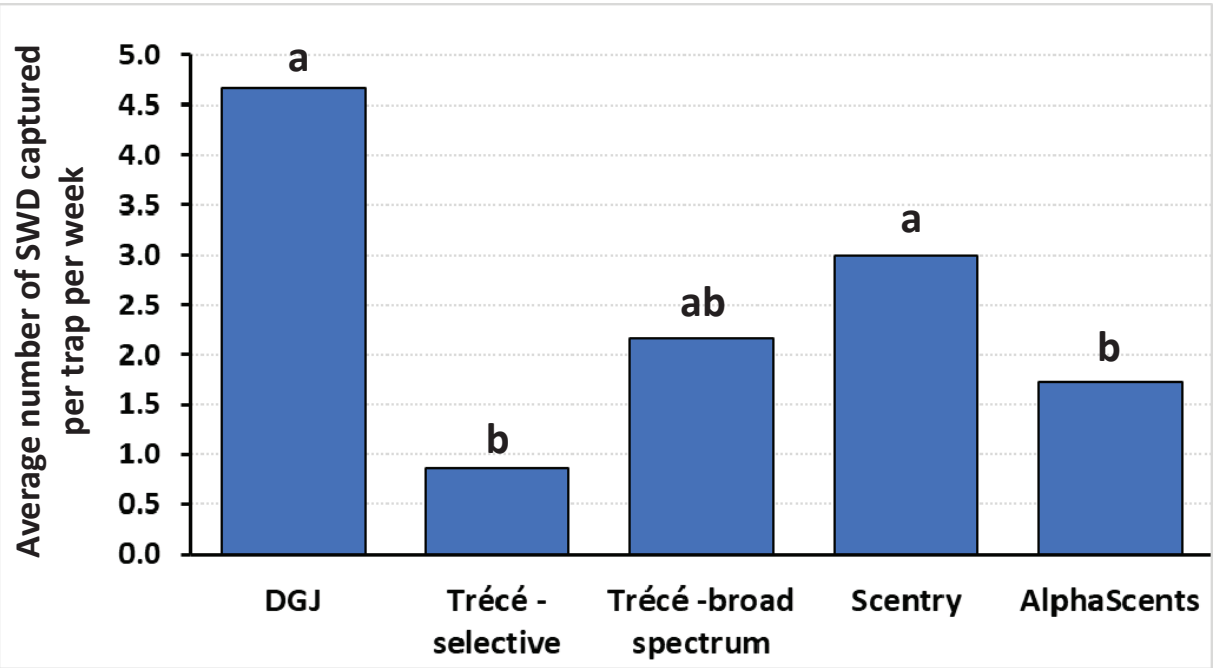

Figure 1. Early-season (11 May to 8 July, 2020) captures of male and female spotted wing drosophila (SWD) in traps baited with diluted grape juice (DGJ) and four commercial lures, in four Massachusetts locations. Bars superscribed by the same letter are not significantly different at odds of 19:1.

represent greater number of SWD captured relative to non-targets) in 5 out of the 6 dates for which such ratios were calculated. On June 1, the only treatment that attracted SWD was DGJ, therefore no comparisons of ratios could be made. The Scentry lure had the best selectivity on the Jun 10 trapping date.

Figure 1 shows that, across the entire trapping period (May 11 to July 8) DGJ was a very attractive material to adult SWD. More specifically, DGJ captured 5.5, 2.2, 1.6, and 2.7 times more SWD than did Trécé -selective, Trécé -broad spectrum, Scentry, and AlphaScents lures, respectively (Figure 1). It is important to note that DGJ was replaced every week whereas the commercial lures were not replaced throughout the study. The expected lure longevity is 4-6 weeks for the two Trécé lures and for the Scentry lure, and 8 weeks for the AlphaScents lure.

Experiment 2: Effect of grape juice fermentation on SWD attraction. Aging DGJ for 1 or 2 weeks did no influence captures of male SWD in traps. In contrast, twice as many females were captured when DGJ was fermented for 1 or 2 weeks compared to fresh DGJ (Figure 2A). No statistical difference in captures was noted between the two levels of fermentation. Captures of non-target insects followed the same pattern

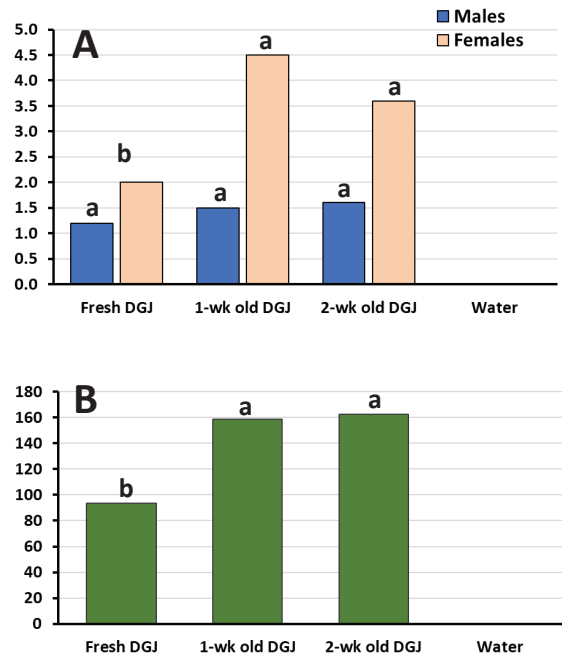

Figure 2. Captures (average number per trap) of **(A)** adult SWD (males and females combined) and **(B)** non-target insects (other insects belonging to the SWD family), according to treatment. This study was conducted at the UMass Cold Spring Orchard in 2019. For each SWD gender (top chart) and for non-targets (bottom chart), bars superscribed by the same letter are not significantly different at odds of 19:1.

described for female SWD. For instance, the number of other drosophilids was 70% and 74% greater when DGJ was fermented for 1 or 2 weeks, respectively, when compared to fresh DGJ (Figure 2B).

Conclusions

The results from the first study confirmed that DGJ is attractive to male and female SWD, it has high selectivity, and therefore this low-cost material can be used for monitoring SWD populations. Our fermentation study revealed that female captures can be increased if traps are left for up two weeks in the field (we did not evaluate longer intervals). However, the fermentation process will also attract more non-target insects. Further research will be conducted to determine ways in which fermentation can be manipulated so as to attract fewer non-target insects without affecting SWD captures.

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References

Piñero, J.C. Foley, N. 2018. Evaluation of diluted grape juice as an inexpensive attractant for the invasive fruit pest spotted wing Drosophila. Fruit Notes 83(3) 1-7.