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**IR-4 Environmental Horticulture Program
Leafminer Efficacy Summary & Literature Review**

Liriomyza sp.
Liriomyza trifolii
Ophiomyia kwansonis

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Abstract

From 2009 to 2015, numerous products representing 15 active ingredients were evaluated in the greenhouse to control dipteran leafminers (*Liriomyza trifolii* and other species). Nine trials were conducted on chrysanthemum, daisies and daylily. Depending upon product characteristics either foliar, drench or topdress applications were made. Although there were insufficient data for definitive conclusions, 2 relatively new products may be effective management tools: Arena provided good efficacy for *Liriomyza* spp., and Mainspring provided good efficacy for both *Liriomyza trifolii* and *Ophiomyia kwansonis*. The established standards Avid and Terraguard generally provided variable efficacy.

Introduction

In 2009, IR-4 initiated a high priority project to determine efficacy of several insecticides on dipteran leafminers (*Liriomyza trifolii* and other species) to obtain data supporting current and future registrations on ornamentals. The following research was conducted during 2014 and 2015. In addition to research collected through the IR-4 program, this summary includes a review of experiments conducted from 1999 to 2014 on ornamental horticulture crops published in Arthropod Management Tests (AMT). The source of report is included under each data table.

Materials and Methods

From 2009 to 2015, numerous products representing 15 active ingredients were evaluated in the greenhouse to control dipteran leafminers (*Liriomyza trifolii* and other species). Nine trials were conducted on chrysanthemum, daisies and daylily. Depending upon product characteristics either foliar, drench or topdress applications were made. A minimum of four plants (replicate treatments) were required with most researchers exceeding this minimum. Insect counts were recorded pre-treatment and then 7, 14 (prior to 2nd application), 28 and 42 days after initial application. Phytotoxicity was recorded on a scale of 0 to 10 (0 = No phytotoxicity; 10 = Complete kill) at each rating date. For IR-4 testing, the following protocols were used: 09-018, 14-012, 15-012. Please visit <https://www.ir4project.org/about-environmental-horticulture/ehc-registration-support-research/env-hort-researcher-resources/> to view and download these protocols.

Products were supplied to researchers (See list of researchers in Appendix 1) by their respective manufacturers.

Table 1. List of Products and Rates Tested on Environmental Horticulture Plants from 1999 to 2015.

Active Ingredient(s)	Products	Manufacturer	Rate(s) Tested		# Trials
Abamectin	Avid	Syngenta	Spray	4 fl oz per 100 gal	1
				8 fl oz per 100 gal	5
Azadirachtin	AzaGuard	BioSafe	Spray	16 fl oz per 100 gal	1
				32 fl oz per 100 gal	2
	Azatin O	OHP	Spray	12 fl oz per 100 gal	1
	Azatin XL 3%	OHP	Spray	16 fl oz per 100 gal	1
Clothianidin	Arena	Valent	Spray	1.26 oz per 100 gal	2
Cyantraniliprole	Mainspring	Syngenta	Spray	1 fl oz per 100 gal	1

Active Ingredient(s)	Products	Manufacturer	Rate(s) Tested		# Trials
				2 fl oz per 100 gal	1
				4 fl oz per 100 gal	4
				8 fl oz per 100 gal	5
				12 fl oz per 100 gal	1
				26 fl oz per 100 gal	1
			Drench	8 fl oz per 100 gal	1
				12 fl oz per 100 gal	4
Cyclaniliprole	IKI-3106	ISK	Spray	22 fl oz per 100 gal	1
				28 fl oz per 100 gal	3
Dinotefuran	Safari 2G	Valent	Topdress	2.2 g/pot	2
	Safari 20SG		Spray	24 oz per 100 gal	2
Cyromazine	TriGard	Syngenta	Spray	2.7 oz per 100 gal	3
Pyrifluquinazon	Rycar, SP3009	SePro	Spray	1.6 fl oz per 100 gal	1
				3.2 fl oz per 100 gal	1
				6.4 fl oz per 100 gal	2
Pyriproxifen	Distance	Nufarm, Valent	Spray	12 oz per 100 gal	3
Spinetoram + sulfoxaflor	GF-2860, XXpire	Dow	Spray	3.5 oz per 100 gal	3
Spinosad	Conserve SC	Dow	Spray	11 fl oz per 100 gal	1
				22 fl oz per 100 gal	1
Spirotetramat	Kontos	OHP	Drench	3.4 fl oz per 100 gal	3
			Spray	3.4 fl oz per 100 gal	4
Thiamethoxam	CGA 293343 25WG	Syngenta	Drench	4 fl oz per 100 gal	1
			Spray	4 fl oz per 100 gal	1
	Flagship WG		Drench	6 oz per 100 gal	1
	Flagship G		Topdress	20 g per pot	1
Tolfenpyrad	Hachi-Hachi	Nichino	Spray	21 fl oz per 100 gal	1
				32 fl oz per 100 gal	1

Results

Comparative Efficacy on *Liriomyza* sp.

For 2009, Ludwig conducted a trial to determine efficacy of several insecticides to control leafminer (*Liriomyza* sp.) on transvaal daisy (*Gerbera* sp.). No mines were present on gerbera plants at the start of the experiment (June 2, 2010). They were then placed into a greenhouse with a heavy leaf miner infestation. Safari 20SG and Safari 2G provided 100% control of a heavy infestation, Avid, and Arena provided good control, while Kontos did not provide a commercially acceptable control (Table 2).

Table 2. Efficacy on Leafminer (*Liriomyza* sp.) on Transvaal Daisy (*Gerbera* sp.), Ludwig, TX, 2009.

Treatment	Rate Per 100 Gal	Applic Method	Number of Mines Per 5 Leaves ^x				
			7 DAT	14 DAT	21 DAT	28 DAT	35 DAT
Arena (clothianidin)	1.26 oz	Foliar	0.0±0.0 c	0.0±0.0 c	0.8±0.5 b	5.0±1.8 b	*
Avid (abamectin)	4 fl oz	Foliar	0.9±0.3 c	1.0±0.4 c	2.9±0.9 b	14.9±2.4 a	*
Kontos (spirotetramat)	3.4 fl oz	Drench	11.1±1.4 b	8.3±0.9 b	10.1±0.9 a	*	*
Kontos (spirotetramat)	3.4 fl oz	Foliar	12.0±2.0 b	6.9±1.4 b	10.1±2.0 a	*	*
Safari 20SG (dinotefuran)	24 oz	Drench	0.0±0.0 c	0.0±0.0 c	0.0±0.0 b	0.0±0.0 c	0.1±0.1 b
Safari 2G (dinotefuran)	2.2 g/pot	Top dress	0.0±0.0 c	0.0±0.0 c	0.0±0.0 b	0.0±0.0 c	0.0±0.0 b
Untreated	-	-	18.2±2.1 a	13.1±2.5 a	10.1±2.3 a	18.4±2.4 a	15.0±1.7 a

^x Means followed by same letter do not differ significantly based on LSD test (P > 0.05).

*Mine counts not conducted.

Comparative Efficacy on *Liriomyza trifolii*

In 1999, Bethke conducted a trial to determine efficacy of several insecticides to control serpentine leafminer (*Liriomyza trifolii*) on chrysanthemum (*Dendranthema grandiflora*). All treatments significantly reduced the number of mines per plant (Table 3). However, Avid, CGA 293343 (thiamethoxam), and Conserve reduced the severity of the damage to leaves by causing mortality in early larval stages. Other treatments allowed the larvae to mine the leaf, but significantly reduced the amount of emerging adults. All treatments except CGA 293343 spray treatment provided greater than 96% mortality. No phytotoxicity was observed throughout the length of the trial.

Table 3. *Efficacy on Leafminer (*Liriomyza trifolii*) on Chrysanthemum (*Dendranthema grandiflora*), 'White Diamond', Bethke, CA, 1999.

Treatment	Rate Per 100 Gal	No. Mines/Plant Pretreatment ^x	% Mortality Larva to Pupa	% Mortality Larva to Adult
Avid 0.15EC (abamectin)	8 fl oz	20.2 a	100.0	-
Azatin XL 3% (azadirachtin)	16 fl oz	18.0 a	29.1 d	100.0 a
CGA 293343 25WG (thiamethoxam)	4 oz	19.0 a	73.7 c	83.0 b
CGA 293343 25WG (thiamethoxam)	4 oz ^y	0.8 b	100.0 a	-
Conserve 1SC (spinosad)	11 fl oz	20.6 a	95.6 a	97.3 a
	22 fl oz	18.8 a	92.7 ab	96.4 a
Untreated	-	20.0 a	2.0 e	6.3 c

* Not an IR-4 Experiment: Arthropod Management Tests Vol 25: G50. Not all treatments included in table.

^x Means followed by same letter do not differ significantly based on LSD test (P = 0.05).

^y Applied as a drench 2 days before leafminer exposure.

In 2009, Uber conducted a trial to determine efficacy of several insecticides to control serpentine leafminer (*Liriomyza trifolii*) on African daisy (*Gerbera jamesonii*). The majority of treatments, including the standard Avid, provided ineffective control (Table 4). One potential explanation responsible for poor efficacy for Avid could be that the leafminer larvae samples collected from the commercial grower to inoculate the test plants could be resistant to Avid. This grower had experienced a documented resistant leafminer population. Arena provided the best overall efficacy by 7 DAT and a quite significant increased rate of efficacy at the 16 DAT. The efficacy comparison of Kontos, Safari 20SG, 2G as drench, topdress, foliar applications provided no significant differences. All treatments types for both products were considered ineffective in this study.

Table 4. Efficacy on Serpentine Leafminer (*Lyriomyza trifolii*) on African Daisy (*Gerbera jamesonii*) 'Heat Wave', Uber, CA, 2009.

Treatment	Rate Per 100 Gal	Applic Method, Timing ^w	Population Counts ^z , Means Separations ^y , and Henderson's Percent Control ^x				
			0 DAT	7 DAT	16 DAT	26 DAT	35 DAT
Arena (clothianidin) + Capsil	1.26 + 6 fl oz	Foliar, AB	22.5 cd	11.0 b (30)	12.0 d (86)	22.0 b (60)	45.0 b (44)
Avid (abamectin) 1.5E + Capsil	8 + 6 fl oz	Foliar, AB	34.0 a	16.0 ab (30)	54.3 ab (57)	45.0 a (47)	64.0 a (48)
Kontos (spirotetramat)	3.4 fl oz	Drench, A	24.5 c	12.8 b (26)	68.0 a (26)	27.8 ab (54)	47.3 b (46)
Kontos + Capsil	3.4 + 6 fl oz	Foliar, AB	31.0 ab	22.3 a (0)	61.0 a (47)	40.8 ab (47)	49.0 ab (56)
Safari (dinotefuran) 20SG	24 oz	Drench, A	26.8 bc	11.0 b (42)	40.8 bc (59)	38.8 ab (41)	43.5 b (55)
Safari 2G	2.2 g/plant	Topdress, A	26.5 bc	11.0 b (41)	32.8 c (67)	33.8 ab (48)	38.0 b (60)
Untreated	-	-	17.5 d	12.3 b (0)	65.3 a (0)	43.3 a (0)	62.8 a (0)

^y Means followed by same letter do not differ significantly based on LSD test (P = 0.10).

^z Number of larvae per leaf.

^x Percent control was calculated on the number of larvae per leaf.

^w Application timing: A - Aug 17, B - Aug 25.

In 2013, Parella conducted a trial to determine efficacy of several insecticides to control serpentine leafminer (*Liriomya trifolii*) on gerbera daisy (*Gerbera jamesonii*). Although leafminer pressure was high during the trial, Cyantraniliprole provided significant control at all concentrations and application methods at 14 DAT. (Table 5). Control continued for all but the 8 fl oz foliar rate of Cyantraniliprole through 21 DAT. The Cyantraniliprole drenches maintained control until the end of the trial at 49 DAT. The commercial standard Trigard 75WP was not found to be different from the check at any date.

In 2014, Parella conducted a trial to determine efficacy of several insecticides to control serpentine leafminer (*Liriomya trifolii*) on gerbera daisy (*Gerbera jamesonii*). Mainspring drenches provided significant control through 34 DAT and were constantly the lowest treatment counts (Table 6). Very low count numbers occurred at 20 DAT due to population cycling in the greenhouse; there were no significant differences between treatments. Avid and Trigard were not different from the check at any date.

In 2014, Parella conducted another trial to determine efficacy of several insecticides to control serpentine leafminer (*Liriomya trifolii*) on gerbera daisy (*Gerbera x hybrida*). Avid, AzaGuard and the 3 Mainspring treatments provided excellent leafminer control, with all products reducing leafminers to fewer than 5 mines per leaf, the commonly accepted action threshold, by the second week of the trial (Table 7). Among these products, however, there were differences in the duration of control and number of applications needed. Control with Avid lasted for 4 weeks after the second application, while AzaGuard provided only a week of control after 3 applications. Mainspring provided excellent control at all tested rates. A single drench application at the highest rate reduced leafminers to 3 mines per leaf after 2 weeks and held them below 1 mine per leaf for an additional 5 weeks. While not as effective, the other two Mainspring treatments also gave excellent control with 3 applications maintaining leafminer levels below 5 per leaf for the duration of the trial. The other products were also effective at reducing the high leafminer populations seen in the first week of the trial but none was able to consistently maintain leafminers at levels below an average of 5 per leaf.

Table 5. *Efficacy on Serpentine Leafminer (*Lyriomyza trifolii*) on Gerbera Daisy (*Gerbera jamesonii*), Parella, CA, 2013.

Treatment	Rate Per 100 Gal	Applic Method	No. of Applic ^y	Number of Mines Per 25.5 cm ² x					
				0 DAT	7 DAT	14 DAT	21 DAT	35 DAT	49 DAT
Cyantraniliprole	1 fl oz	Spray	2	8.6 a	4.9 a	2.0 c	13.3 a	9.0 a	14.8 ab
Cyantraniliprole	8 fl oz	Drench	1	8.2 a	4.6 a	0.3 c	9.4 ab	0.5 bc	3.3 bc
Cyantraniliprole	8 fl oz	Spray	1	8.0 a	3.8 a	1.1 c	8.6 ab	9.2 a	13.5 abc
Cyantraniliprole	12 fl oz	Drench	1	9.1 a	6.3 a	1.0 c	4.5 bc	0.2 c	1.7 c
Cyantraniliprole	26 fl oz	Spray	1	8.7 a	5.3 a	0.2 c	3.5 bc	4.8 abc	10.4 abc
Cyantraniliprole	2 fl oz	Spray	2	8.5 a	6.5 a	2.8 bc	3.2 bc	5.7 abc	17.3 a
Cyantraniliprole	4 fl oz	Spray	2	8.9 a	3.4 a	1.2 c	1.8 c	1.7 abc	15.1 ab
Cyantraniliprole + Induce	4 + 16 fl oz	Spray	2	8.1 a	3.8 a	1.3 c	1.2 c	3.7 abc	12.7 abc
TriGard (cyromazine)	2.7 oz	Spray	2	8.2 a	6.7 a	6.3 ab	0.3 c	8.5 ab	15.3 ab
Untreated	-	-	-	9.0 a	9.2 a	7.0 a	0.2 c	9.6 a	21.3 a

* Not an IR-4 Experiment: Arthropod Management Tests 2016, 1-1, tsw092.

x Means followed by same letter do not differ significantly based on Tukey's HSD test (P < 0.05).

y Second application applied on day 14.

Table 6. *Efficacy on Serpentine Leafminer (*Lyriomyza trifolii*) on Gerbera Daisy (*Gerbera jamesonii*) 'Raffinee', Parella, CA, 2014.

Treatment	Rate Per 100 Gal	Applic Method	No. of Applic ^y	Number of Mines Per 25.5 cm ² x					
				-1 DAT	6 DAT	13 DAT	20 DAT	27 DAT	34 DAT
Avid 0.15EC	8 fl oz	Spray	2	3.0 a	1.6 ab	3.7 abc	2.0 a	1.6 ab	2.1 a
Mainspring	8 fl oz	Spray	2	2.9 a	2.8 ab	4.1 ab	1.4 a	1.5 abc	1.0 abc
Mainspring + Capsil	8 + 6 fl oz	Spray	2	3.0 a	1.3 b	1.8 b-e	0.8 a	0.5 a-d	1.0 abc
Mainspring	12 fl oz	Drench	1	3.0 a	1.2 b	0.8 cde	0.3 a	0.6 a-d	0.8 abc
Mainspring	12 fl oz	Drench	2	2.9 a	1.7 ab	0.3 e	0.3 a	0.3 cd	0.2 bc
Mainspring + Capsil	4 + 6 fl oz	Spray	2	2.9 a	0.8 b	0.5 de	0.2 a	0.1 d	0.1 c
Trigard 75WP	2.7 oz	Spray	2	3.0 a	2.0 ab	3.5 abc	1.4 a	2.0 a	0.0 c
Untreated	-	-	-	3.1 a	3.8 a	5.0 a	2.7 a	2.0 a	1.3 abc

* Not an IR-4 Experiment: Arthropod Management Tests 2016, 1-1, tsw091. Not all treatments included in table.

x Means followed by same letter do not differ significantly based on Tukey's HSD test (P < 0.05).

y Avid, Mainspring and Trigard sprays were applied on 14 day intervals.

Table 7. Efficacy on Serpentine Leafminer (*Lyriomyza trifolii*) on Gerbera Daisy (*Gerbera x hybrida*) 'Mermaid', Parella, CA, 2014.

Treatment	Rate Per 100 Gal	Applic Dates	Population Counts ^z , Means Separations ^y , and Henderson's Percent Control ^x							
			Pre	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Avid (abamectin)	8 fl oz	6/19; 7/3	5.04 a	14.79 a-d (14)	3.83 abc (61)	3.75 cd (48)	2.58 bc (42)	2.46 bcd (71)	4.46 abc (53)	-
AzaGuard (azadirachtin)	16 fl oz	6/19; 6/26; 7/10; 7/14	5.04 a	11.67 a-d (32)	4.38 abc (55)	2.25 de (68)	2.17 cd (51)	3.08 bcd (64)	4.63 ab (51)	-
Distance (pyriproxifen)	12 oz	6/19; 7/14	4.83 a	16.21 abc (0)	4.46 abc (52)	8.21 ab (0)	4.79 abc (0)	3.92 a-d (74)	8.83 a (3)	-
GF-2860 WDG (spinetoram+ sulfoxaflor)	3.5 oz	6/19; 6/26	4.54 a	17.25 ab (0)	6.50 abc (26)	7.13 abc (0)	5.88 abc (0)	6.50 ab (15)	8.29 a (4)	-
Hachi-Hachi (tolfenpyrad)	21 fl oz	6/19; 7/3	4.29 a	16.08 a-d (0)	7.13 ab (14)	6.75 abc (0)	6.63 a (0)	8.50 a (0)	6.71 a (17)	-
	32 fl oz	6/19; 7/3	4.54 a	11.88 a-d (23)	7.17 ab (19)	6.17 abc (4)	6.04 ab (0)	6.71 ab (13)	7.54 a (12)	-
IKI-3106 (cyclaniliprole)	22 fl oz	6/19; 7/3; 7/14	5.67 a	14.08 a-d (27)	4.38 abc (60)	4.33 bcd (46)	6.29 ab (0)	4.54 a-d (53)	8.13 a (24)	-
	28 fl oz	6/19; 7/3; 7/14	5.63 a	17.50 ab (9)	7.67 ab (30)	5.67 abc (29)	5.83 abc (0)	2.79 bcd (71)	6.83 a (36)	-
Kontos (spirotetramat)	3.4 fl oz	6/19	3.54 a	8.63 a-d (29)	8.63 a (0)	9.75 a (0)	4.25 abc (0)	7.08 ab (0)	6.29 a (6)	-
	3.4 fl oz	6/19 7/3	3.96 a	16.42 abc (0)	5.0 abc (35)	5.71 abc (0)	4.96 abc (0)	5.38 abc (20)	6.67 a (11)	-
Mainspring (cyantraniliprole)	4 fl oz	6/19; 7/3; 7/14	4.08 a	6.92 bcd (50)	2.29 bc (86)	1.13 ef (80)	0.42 e (88)	1.00 cd (86)	0.13 bc (98)	3.21 b (64)
	8 fl oz	6/19; 7/3; 7/14	4.00 a	5.71 cd (58)	0.79 c (90)	0.33 f (94)	0.04 e (99)	0.29 d (96)	0.96 c (87)	0.75 b (91)
	12 fl oz*	6/19	4.83 a	5.25 d (68)	3.00 abc (68)	0.75 ef (89)	0.46 de (89)	0.17 cd (98)	0.17 c (98)	0.88 b (92)
SP3009 (pyrifluquinazon)	1.6 fl oz	6/19; 7/3	5.17 a	17.63 ab (0)	6.46 abc (36)	5.58 abc (24)	5.21 abc (0)	2.92 bcd (67)	7.83 a (20)	-
	3.2 fl oz	6/19; 7/3	4.58 a	18.21 a (0)	7.58 ab (15)	6.50 abc (0)	4.92 abc (0)	5.00 a-d (36)	7.58 a (13)	-
Untreated	-	-	4.38 a	14.96 a-d (0)	8.5 a (0)	6.21 abc (0)	3.88 abc (0)	7.42 ab (0)	8.29 a (0)	9.58 a (0)

^y Means followed by same letter do not differ significantly based on Tukey's test (P < 0.05).

^z Number of mines per leaf.

^x Percent control was calculated on the number of mines per leaf.

* Applied as drench.

In 2014, Heinz conducted a trial to determine efficacy of two insecticides applied foliar to control serpentine leafminer (*Liriomyza trifolii*) on chrysanthemum (*Chrysanthemum indicum*). While no differences were found in the number of *L. trifolii* pupae collected, differences between treatments were found in the number of eclosed adults (Table 8). Both Azatin O and Kontos treatments reduced the number of adults by almost half, indicating that both insecticides may be used to control leafminers in a commercial setting.

Table 8. *Efficacy on Serpentine Leafminer (*Liriomyza trifolii*) on Chrysanthemum (*Chrysanthemum indicum*) 'Venus Purple,' 'Eureka Yellow', Heintz, TX, 2014.

Treatment	Rate Per 100 Gal	No. Pupae Collected ^x	No. Adults Eclosed
Azatin O (azadirachtin)	12 fl oz.	7.2 a	2.5 a
Kontos (spirotetramat)	3.4 fl oz.	5.3 a	2.5 a
Untreated	n/a	7.7 a	4.9 b

* Not an IR-4 Experiment: Arthropod Management Tests 2016, 1–2,tsv181.

^x Means followed by same letter do not differ significantly based on Wilcoxon each pair (P > 0.05).

In 2015, Parella conducted a trial to determine efficacy of several insecticides to control serpentine leafminer (*Liriomyza trifolii*) on gerbera daisy (*Gerbera x hybrida*). Only the 3 Mainspring treatments provided excellent leafminer control, with all rates maintaining leafminers to fewer than 5 mines per leaf, the commonly accepted action threshold, by the second week of the trial (Table 9). The two other products that provided the best control were AzaGuard and IKI-3106, with mean numbers of mines per leaf of 8.1 and 8.4, respectively, over the course of the entire trial. As each has a different mode of action; in combination with Mainspring they could form an effective leafminer rotation. The last applications were made at week 4. Leafminer populations for all but the Mainspring treatments continued to rise but dropped after week 5. This is likely due to high leafminer damage causing a lack of leaf material for continued population growth.

Table 9. Efficacy on Serpentine Leafminer (*Lyriomyza trifolii*) on Gerbera Daisy (*Gerbera x hybrida*) 'Verdana', Parella, CA, 2015.

Treatment	Rate Per 100 Gal	Applic Dates	Number of Mines Per Leaf ^x						
			Pre	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
AzaGuard (azadirachtin)	32 fl oz	Oct 1, 8, 15, 22, 29	3.58±0.65 a	7.58±1.1abc	6.58±.54 a	5.50±0.39 cd	8.83±1.12 ab	12.83±0.57 a	11.42±1.51 a
Distance (pyriproxifen)	12 oz	Oct 1, 29	3.33±0.44 a	11.58±1.02 a	9.50±2.45 a	11.08±1.11 ab	12.75±1.73 a	11.83±1.97 a	14.08±0.4 a
IKI-3106 (cyclaniliprole)	28 fl oz	Oct 1, 8, 15, 22, 29	3.58±0.65 a	5.75±0.83 bcd	4.67±0.46 ab	7.83±0.82 ab	12.92±0.98 a	12.17±0.86 ab	12.00±1.44 a
Kontos (spirotetramat)	3.4 fl oz	Oct 1, 15	3.50±0.58 a	9.67±0.9 ab	6.25±1.26 a	7.58±0.92 bc	12.83±0.48 a	14.58±1.45 a	10.50±1.1 a
Mainspring (cyantraniliprole)	4 fl oz	Oct 1, 15, 29	3.67±0.61 a	1.58±0.65 d	0.58±0.24 c	2.75±0.68 de	2.58±1.61 bc	5.92±2.19 bc	1.08±0.72 b
	8 fl oz	Oct 1, 15, 29	3.50±0.52 a	3.33±0.4 cd	1.08±0.44 c	0.50±0.32 e	0.08±0.08 c	0.33±0.25 c	0.17±0.11 b
	12 fl oz*	Oct 1	3.67±0.65 a	3.83±1.12 cd	1.92±0.54 bc	1.40±0.24 de	0.40±0.29 c	1.00±0.52 c	0.20±0.12 b
Rycar (pyrifluquinazon)	6.4 fl oz	Oct 1, 11	3.42±0.51 a	8.58±0.86 ab	4.92±0.87 ab	9.33±1.01 abc	13.25±1.56 a	12.42±0.62 a	12.50±0.83 a
Rycar+CapSil	6.4 fl oz	Oct 1, 11	3.92±0.85 a	8.58±1.21 ab	7.58±1.31 a	11.42±0.85 ab	12.92±0.64 a	15.17±1.12 a	11.75±1.02 a
TriGard (cyromazine)	2.7 oz	Oct 1, 8, 15, 22, 29	3.42±0.62 a	11.33±1.16 a	6.33±1.03 a	11.58±0.74 bc	11.58±1.09 a	16.5±1.18 a	12.25±0.66 a
XXpire (spinetoram+ sulfoxaflor)	3.5 oz	Oct 1, 15	3.75±0.69 a	9.00±0.85 ab	7.17±0.59 a	6.92±1.57 c	11.25±2.69 a	15.75±1.76 a	11.25±1.18 a
Untreated	-	-	4.00±1.08 a	10.83±1.2 a	7.00±0.79 a	12.83±0.59 a	11.25±0.84 a	13.67±0.71 a	12.92±1.16 a

^x Means followed by same letter do not differ significantly based on Tukey's test.

* Applied as drench.

Comparative Efficacy on *Ophiomyia kwansonis*

In 2015, Frank conducted a trial to determine efficacy of several insecticides to control leafminer (*Ophiomyia kwansonis*) on daylily (*Hemerocallis* sp.). By 14 DAT plants treated with Mainspring and AzaGuard had the least mines (Table 10). Plants treated with Rycar had half as many mines as the untreated plants. By 21 and 28 DAT AzaGuard and Mainspring treated plants continued to have the least mines. Since mines may be initiated then abandoned if the larvae dies the length of mines on each plant was also measured. In this response plants treated with IKI-3106 had the least mine length followed by AzaGuard and Mainspring. These products continued to perform well through the end of the experiment at 35 DAT. Results suggest IKI-3106 may reduce larvae survival soon after mine initiation but that products like AzaGuard and Mainspring kill larvae quicker or prevent oviposition.

Table 10. Efficacy on Leafminer (*Ophiomyia kwansonis*) on Daylily (*Hemerocallis* sp.), 'Mary's Gold', Frank, NC, 2015.

Treatment	Rate Per 100 Gal	Applic Dates	Pre	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT
<i>Number of Mines per Leaf^x and Henderson's Percent Control</i>								
Avid (abamectin)	8 fl oz	Jun 3, 17	4.7 a	5.7 a (0)	3.7 bcd (13)	3.7 cde (1)	3.2 cd (46)	3.0 efg (47)
AzaGuard (azadirachtin)	32 fl oz	Jun 3, 10, 17, 24, Jul 1	4.8 a	6.8 a (0)	2.8 cd (35)	2.7 de (29)	2.3 cd (62)	4.2 efg (27)
Distance (pyriproxifen)	12 oz	Jun 3, Jul 1	7.7 a	9.2 a (0)	6.7 abc (4)	5.3 b-e (13)	6.3 bcd (36)	11.3 ab (0)
Flagship G (thiamethoxam)	20 g/pot	Jun 3	6.5 a	5.5 a (29)	4.8 a-d (18)	7.7 ab (0)	7.3 bc (12)	7.8 a-f (0)
Flagship WG	6 oz*	Jun 3	6.0 a	6.3 a (12)	6.8 abc (18)	4.3 b-e (10)	5.2 cd (32)	6.5 b-f (9)
GF-2860 (spinetoram+sulfoxaflor) + Capsil	3.5 oz	Jun 3, 17	5.0 a	7.7 a (0)	5.3 a-d (0)	4.2 b-e (0)	5.3 cd (17)	5.7 d-g (0)
IKI-3106 (cyclaniliprole) + Capsil	28 fl oz	Jun 3, 10, 17, 24, Jul 1	2.5 a	4.3 a (0)	5.3 a-d (0)	4.0 b-e (0)	5.3 cd (0)	2.8 efg (0)
Kontos (spirotetramat) + Capsil	3.4 oz	Jun 3, 17	3.8 a	3.7 a (19)	7.5 ab (0)	9.3 a (0)	14.5 a (0)	12.0 a (0)
Mainspring + Capsil	4 fl oz	Jun 3, 17, Jul 1	7.5 a	5.7 a (36)	4.3 a-d (36)	1.8 e (70)	3.7 cd (61)	1.3 fg (86)
Mainspring + Capsil	8 fl oz	Jun 3, 17, Jul 1	4.3 a	3.8 a (26)	2.0 d (48)	2.5 e (27)	1.5 d (73)	0.8 g (84)
Mainspring (cyantraniliprole)	12 fl oz	Jun 3	3.8 a	3.7 a (19)	2.3 d (33)	1.7 e (44)	1.5 d (69)	0.8 g (82)
Rycar (pyrifluquinazon)	6.4 fl oz	Jun 3, 13	2.5 a	5.8 a (0)	4.2 bcd (0)	4.0 b-e (0)	6.3 bcd (0)	6.0 c-g (0)
Rycar + Capsil	6.4 fl oz	Jun 3, 13	5.8 a	8.0 a (0)	7.0 ab (0)	6.5 a-d (0)	11.5 ab (0)	10.5 a-d (0)
Untreated	-	-	9.2 a	11.0 a (0)	8.3 a (0)	7.3 abc (0)	11.7 ab (0)	11.0 abc (0)
<i>Total Length of Mines (mm)</i>								
Avid (abamectin)	8 fl oz	Jun 3, 17	579	696	531 bcd	317 cde	418 de	232 def
AzaGuard (azadirachtin)	32 fl oz	Jun 3, 10, 17, 24, Jul 1	572	719	364 d	156 e	151 e	123 ef
Distance (pyriproxifen)	12 oz	Jun 3, Jul 1	1148	1492	1047 abc	848 abc	576 cde	437 c-f
Flagship G (thiamethoxam)	20 g/pot	Jun 3	845	1007	763 bcd	774 a-d	765 cde	802 abc
Flagship WG	6 oz*	Jun 3	757	1043	809 bcd	410 b-e	571 cde	615 b-e
GF-2860 (spinetoram+sulfoxaflor) + Capsil	3.5 oz	Jun 3, 17	743	1042	729 bcd	478 b-e	440 cde	309 c-f
IKI-3106 (cyclaniliprole) + Capsil	28 fl oz	Jun 3, 10, 17, 24, Jul 1	302	482	295 d	271 de	201 de	72 ef
Kontos (spirotetramat) + Capsil	3.4 oz	Jun 3, 17	656	918	1484 a	1289 a	1752 a	1345 a
Mainspring + Capsil	4 fl oz	Jun 3, 17, Jul 1	653	583	406 cd	175 e	331 de	53 f

Mainspring + Capsil	8 fl oz	Jun 3, 17, Jul 1	608	607	382 cd	237 de	186 e	118 ef
Mainspring (cyantraniliprole)	12 fl oz*	Jun 3	603	645	309 d	261 de	185 e	119 ef
Rycar (pyrifluquinazon)	6.4 fl oz	Jun 3, 13	406	862	681 bcd	618 b-e	818 cd	700 bcd
Rycar + Capsil	6.4 fl oz	Jun 3, 13	640	1351	1181 ab	952 ab	1044 bc	1315 a
Untreated	-	-	945	1429	1194 ab	788 a-d	1521 ab	1051 ab

^x Means followed by same letter do not differ significantly based on ANOVA test, (P = 0.05).

* Applied as drench.

Efficacy Summary by Product/Active Ingredient

A brief efficacy summary for select products is given below, with a reminder that there are very limited data available to draw definitive conclusions for product efficacy on dipterous leafminers. Products were selected based on interest in these products for testing in the 2014 - 2015 Leafminers efficacy projects, and on whether product is registered or not for dipteran leafminers.

Abamectin. Avid provided excellent efficacy on *Liriomya* sp. in a transvaal daisy experiment, and on *Liriomya trifolii* on chrysanthemum, but poor to mediocre efficacy on *Liriomya trifolii* in 3 gerbera daisy experiments, and poor efficacy on *Ophiomyia kwansonis* in a daylily trial.

Azadirachtin. This active ingredient provided excellent and mediocre efficacy on *Liriomya trifolii* in 2 chrysanthemum experiments, and poor efficacy on *Liriomya trifolii* in 2 gerbera daisy trials. Good efficacy on *Ophiomyia kwansonis* was obtained in a daylily experiment.

Clothianidin. Arena provided excellent efficacy on *Liriomya* sp. in a transvaal daisy experiment, and good efficacy on *Liriomya trifolii* in an African daisy trial.

Cyantraniliprole. Mainspring applied as drench or spray provided excellent efficacy on *Liriomya trifolii* in 4 gerbera daisy experiments, and good efficacy on *Ophiomyia kwansonis* in a daylily trial.

Cyclaniliprole. IKI-3106 provided poor efficacy on *Liriomya trifolii* in 2 gerbera daisy experiments, and good efficacy on *Ophiomyia kwansonis* in a daylily trial.

Cyromazine. TriGard provided poor efficacy on *Liriomya trifolii* in 3 gerbera daisy experiments.

Dinotefuran. Safari applied as drench or topdress provided excellent efficacy on *Liriomya* sp. in a transvaal daisy experiment, but poor efficacy on *Liriomya trifolii* in an African daisy trial.

Pyrifluquinazon. This active ingredient provided poor efficacy on *Liriomya trifolii* in 2 gerbera daisy experiments, and poor efficacy on *Ophiomyia kwansonis* in a daylily trial.

Pyriproxifen. Distance provided poor efficacy on *Liriomya trifolii* in 2 gerbera daisy experiments, and good efficacy on *Ophiomyia kwansonis* in a daylily trial.

Spinetoram + sulfoxaflor. This active ingredient provided poor efficacy on *Liriomya trifolii* in 2 gerbera daisy experiments, and poor efficacy on *Ophiomyia kwansonis* in a daylily trial.

Spinosad. Conserve provided excellent efficacy on *Liriomya trifolii* in a chrysanthemum experiment.

Spirotetramat. Kontos provided poor efficacy on *Liriomya trifolii* in 3 gerbera daisy experiments, mediocre efficacy on *Liriomya trifolii* in a chrysanthemum, and poor efficacy on *Ophiomyia kwansonis* in a daylily trial.

Thiamethoxam. This active ingredient provided excellent efficacy on *Liriomya trifolii* on chrysanthemum when applied a drench but mediocre as a spray. In a daylily trial, poor efficacy was obtained on *Ophiomyia kwansonis*.

Tolfenpyrad. Hachi-Hachi provided poor efficacy on *Liriomya trifolii* in a gerbera daisy experiment.

Phytotoxicity

None of the products caused injury to the treated crops.

Table 11. Summary of product efficacy by insect species and crop.

Note: Table entries are sorted by product, pathogen Latin name, and then by crop Latin name. Only those IR-4 trials received by 8/3/2018 are included in the table below.

PR#	Product (ActiveIngredients)	Target	Crop	Production Site	Researcher	TrialState	TrialYear	Application Type	Results
29122	Arena 50WDG (Clothianadin)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.)	Greenhouse	Ludwig	TX	2009	Foliar	Acceptable control up to 28 DAT with 1.26 oz per 100 gal.
29122	Arena 50WDG (Clothianadin)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) G. jamisonii 'Heat Wave'	Greenhouse	Uber	CA	2009	Spray-to-wet	SC used. Fair to good control of L. trifolii larvae at 1.26 floz per 100 gal + Capsil; may be Avid - resistant population.
30074	Avid 0.15EC (Abamectin)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.)	Greenhouse	Ludwig	TX	2009	Foliar	Acceptable control up to 21 DAT with 4 floz per 100 gal.
30074	Avid 0.15EC (Abamectin)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Excellent control (< 5 mines/leaf) with 8 floz per 100 gal applied twice.
33603	Avid 0.15EC (Abamectin)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Mediocre efficacy with 8 floz per 100 gal.
32144	AzaGuard (Azadirachtin)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Verdana'	Greenhouse	Parrella	CA	2015	Foliar	Reduced number of mines per leaf, but not significantly in most observations, with 32 floz per 100 gal applied 5 times.
32144	AzaGuard (Azadirachtin)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Excellent control (< 5 mines/leaf) with 16 floz per 100 gal applied 4 times.
28967	AzaGuard (Azadirachtin)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Good efficacy with 32 oz per 100 gal; better than the standard Avid.

PR#	Product (ActiveIngredients)	Target	Crop	Production Site	Researcher	TrialState	TrialYear	Application Type	Results
32046	Cyclaniliprole (IKI-3106) 50SL (Cyclaniliprole)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.)	Greenhouse	Parrella	CA	2015	Foliar	Reduced number of mines per leaf, but not significantly in most observations, with 28 floz per 100 gal applied 5 times.
32046	Cyclaniliprole (IKI-3106) 50SL (Cyclaniliprole)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Reduced number of mines per leaf, but not significantly, with 22 and 28 floz per 100 gal applied 3 times.
28966	Cyclaniliprole (IKI-3106) 50SL (Cyclaniliprole)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Great efficacy with 28 floz per 100 gal + Capsil; better than the standard Avid.
32043	Distance (Pyriproxyfen)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Verdana'	Greenhouse	Parrella	CA	2015	Foliar	No significant reduction of mines per leaf with 12 floz per 100 gal applied twice.
32043	Distance (Pyriproxyfen)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Reduced number of mines per leaf, but not significantly, with 12 floz per 100 gal applied twice.
28964	Distance (Pyriproxyfen)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Poor efficacy with 12 oz per 100 gal; inferior to the standard Avid.
33604	Flagship 0.22G (Thiamethoxam)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Soil treatment	Poor efficacy with 20 g per pot; inferior to the standard Avid.
33605	Flagship 25WG (Thiamethoxam)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Poor efficacy with 6 oz per 100 gal; inferior to the standard Avid.
32045	Hachi-Hachi SC (Tolfenpyrad)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Reduced number of mines per leaf, but not significantly, with 21 and 32 floz per 100 gal applied twice.
29123	Kontos (BYI 8330 240SC) (Spirotetramat)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.)	Greenhouse	Ludwig	TX	2009	Drench	Poor control with 3.4 floz per 100 gal.
29123	Kontos (BYI 8330 240SC) (Spirotetramat)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.)	Greenhouse	Ludwig	TX	2009	Foliar	Poor control with 3.4 floz per 100 gal.

PR#	Product (ActiveIngredients)	Target	Crop	Production Site	Researcher	TrialState	TrialYear	Application Type	Results
29123	Kontos (BYI 8330 240SC) (Spirotetramat)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) G. jamisonii 'Heat Wave'	Greenhouse	Uber	CA	2009	Drench	No control of L. trifolii larvae at 3.4 floz per 100 gal; may be Avid - resistant population.
29123	Kontos (BYI 8330 240SC) (Spirotetramat)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) G. jamisonii 'Heat Wave'	Greenhouse	Uber	CA	2009	Spray-to-wet	No control of L. trifolii larvae at 3.4 floz per 100 gal + Capsil; may be Avid - resistant population.
29123	Kontos (BYI 8330 240SC) (Spirotetramat)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Verdana'	Greenhouse	Parrella	CA	2015	Foliar	Reduced number of mines per leaf, but not significantly in most observations, with 3.4 floz per 100 gal applied twice.
29123	Kontos (BYI 8330 240SC) (Spirotetramat)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Did not significantly reduce number of mines per leaf with 3.4 floz per 100 gal applied once or twice.
33600	Kontos (BYI 8330 240SC) (Spirotetramat)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Poor efficacy with 3.4 oz per 100 gal + Capsil; inferior to the standard Avid.
32047	Mainspring GNL 200SC (Cyantraniliprole)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Verdana'	Greenhouse	Parrella	CA	2015	Drench	Excellent control (< 5 mines/leaf) with 12 floz per 100 gal applied once.
32047	Mainspring GNL 200SC (Cyantraniliprole)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Verdana'	Greenhouse	Parrella	CA	2015	Foliar	Excellent control (< 5 mines/leaf) with 4 and 8 floz per 100 gal applied 3 times.
32047	Mainspring GNL 200SC (Cyantraniliprole)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Drench	Excellent control (< 5 mines/leaf) with 12 floz per 100 gal applied once; better than Avid.
32047	Mainspring GNL 200SC (Cyantraniliprole)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Excellent control (< 5 mines/leaf) with 4 and 8 floz per 100 gal applied 3 times; better than Avid.
33601	Mainspring GNL 200SC (Cyantraniliprole)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Drench	Great efficacy with 12 floz per 100 gal; better than the standard Avid.

PR#	Product (ActiveIngredients)	Target	Crop	Production Site	Researcher	TrialState	TrialYear	Application Type	Results
33601	Mainspring GNL 200SC (Cyantraniliprole)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Great efficacy with 4 and 8 floz per 100 gal + Capsil; better than the standard Avid.
32048	Rycar (SP3009/NNI-0101) (Pyrifluquinazon)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Verdana'	Greenhouse	Parrella	CA	2015	Foliar	Reduced number of mines per leaf, but not significantly, with 6.4 floz per 100 gal with or without Capsil applied twice.
32048	Rycar (SP3009/NNI-0101) (Pyrifluquinazon)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Reduced number of mines per leaf, but not significantly, with 1.6 and 3.2 floz per 100 gal applied twice.
33602	Rycar (SP3009/NNI-0101) (Pyrifluquinazon)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Poor efficacy with 6.4 floz per 100 gal, w/ or w/o Capsil; inferior to the standard Avid.
29124	Safari 20SG (Dinotefuran)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.)	Greenhouse	Ludwig	TX	2009	Drench	Excellent control up to 35 DAT with 24 oz per 100 gal; best product.
29124	Safari 20SG (Dinotefuran)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) G. jamisonii 'Heat Wave'	Greenhouse	Uber	CA	2009	Spray-to-wet	Poor control of L. trifolii larvae at 24 oz per 100 gal; may be Avid - resistant population.
29125	Safari 2G (V-10112 2G) (Dinotefuran)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.)	Greenhouse	Ludwig	TX	2009	Top Dress	Excellent control up to 35 DAT with 2.2 g per gal potting medium; best product.
29125	Safari 2G (V-10112 2G) (Dinotefuran)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) G. jamisonii 'Heat Wave'	Greenhouse	Uber	CA	2009	Top Dress	Poor control of L. trifolii larvae at 2.2 g per plant; may be Avid - resistant population.
32044	Xxpire (GF-2860) 40WG (Spinetoram + sulfoxaflor)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Verdana'	Greenhouse	Parrella	CA	2015	Foliar	Reduced number of mines per leaf, but not significantly in most observations, with 3.5 oz per 100 gal applied twice.
32044	Xxpire (GF-2860) 40WG (Spinetoram + sulfoxaflor)	Liriomyza Leafminers (Liriomyza sp.)	Transvaal Daisy (Gerbera sp.) Gerbera x hybrida 'Mermaid'	Greenhouse	Parrella	CA	2014	Foliar	Reduced number of mines per leaf, but not significantly, with 3.5 oz per 100 gal applied twice.

PR#	Product (ActiveIngredients)	Target	Crop	Production Site	Researcher	TrialState	TrialYear	Application Type	Results
28965	Xxpire (GF-2860) 40WG (Spinetoram + sulfoxaflor)	Daylily Leafminer (Ophiomyia kwansonis)	Daylily (Hemerocallis sp.) 'Mary's Gold'	Field Container	Frank	NC	2015	Foliar	Poor efficacy with 3.5 oz per 100 gal + Capsil; inferior to the standard Avid.

Label Suggestions

Based upon data contained within this summary, we suggest that Syngenta consider adding serpentine leaf miner (*Liriomya trifolii*) to the Mainspring label.

Appendix 1: Contributing Researchers

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