

Evaluation of products for the control of Pestalotia leaf spot and fruit rot in annual strawberry, 2021-22.

We evaluated the efficacy of fungicides for the management of Pestalotia leaf spot and fruit rot in a randomized complete block design experiment conducted at the University of Florida Gulf Coast Research and Education Center in Wimauma, FL, during the 2021-22 growing season. Four blocks were used for this experiment. Each block was divided into two beds due to the large number of treatments tested. Bare-root, green-top plants (Sensation® ‘Florida127’) from a strawberry nursery in Canada were transplanted into raised beds covered with black plastic mulch on 14 Oct 2021. Beds measured 32 in. wide at the base on 4 ft centers and had been previously fumigated with Telone C-35 (300 lbs/acre). Overhead irrigation was applied after transplanting during the day at 15-min intervals for 10 days to aid in plant establishment. After overhead irrigation, plants were irrigated and fertilized through a central drip tape in each bed. The plots contained 12 plants in two staggered rows spaced 15 in. apart within rows and 12 in. between rows. The LPC 5860-211 and LPC5860-211 + LPC 5860-212 treatments were applied 24 h before inoculation on 25 Oct 2021. On 26 Oct 2021, each plant was inoculated by spraying 100 ml of a suspension of 10^4 spores/ml with 0.1% Tween 20. The inoculum was prepared using three *Neopestalotiopsis* sp. isolates (18-749, 19-02, and 19-48 from petiole, leaf, and fruit, respectively) grown on PDA at 25°C under light for 10-14 days. A non-inoculated control was not sprayed with the pathogen suspension. Fungicide treatments were applied weekly (14 applications) from 29 Oct 2021 to 27 Jan 2022 using a CO₂ back-pack sprayer calibrated to deliver 100 gal/A at 60 psi through a wand fitted with two T-Jet 8002 hollow-cone nozzles spaced 12 in. apart. An inoculated and a non-inoculated control were not treated with fungicides. Several treatment programs included Switch 62.5WG or other fungicides of interest applied during weeks with high disease risk as determined by the Strawberry Advisory System (StAS) (<http://agroclimate.org/tools/sas/>) and Thiram SC or other fungicides of interest applied during weeks with low disease risk. We refer to the treatments applied during high risk as “alert” in the results table and “otherwise” for applications during weeks of low risk. StAS-based applications were made on 29 Oct, 4 Nov, 23 Nov, and 23 Dec 2021 (four applications). Fruit were harvested from 9 Dec 2021 to 10 Feb 2022 (16 harvests) to determine marketable yield and Pestalotia fruit rot incidence. Marketable fruit were counted and weighed to determine yield, and other cull fruit were enumerated to calculate disease incidence as the percentage of diseased fruit compared to total number of marketable and non-marketable fruit. Besides disease incidence on fruit, plants were rated three times (1 Dec 2021, 3 Jan 2022, and 7 Feb 2022) for leaf spot severity using an ordinal scale with seven score levels (0 – no symptoms; 1 – slight infection, a few leaf spots; 2 – moderate infection, a few large spots on the leaf; 3 – moderate infection, leaf spots and wilting of leaves; 4 – moderate to severe infection, some dead leaves, and all leaves with at least one *Neopestalotiopsis* sp. spot; 5 – severe infection, several dead leaves and all leaves with spots; 6 – plant dead). Fruit data were analyzed by fitting a generalized linear mixed model using the GLIMMIX procedure in SAS and means were separated by Fisher’s Protected LSD test ($\alpha = 0.05$). Leaf severity data was analyzed by the rank sum nonparametric Kruskal Wallis test followed by the post hoc Dunn’s test with p-values adjusted by the Holm’s method in R (version 4.1.2).

Typical leaf spot symptoms started to appear approximately 8 days after inoculation with the *Neopestalotiopsis* sp. isolates. The treatment that received weekly Omega 500F applications as well as Switch + JMS and Switch + Actigard alternated with Thiram were the most effective in reducing fruit disease incidence and improving yield. Omega is not currently labeled for commercial strawberry production, but is in the process of registration for open-field strawberry nurseries. Interestingly, Switch alternated with Thiram was as effective in reducing fruit disease incidence but yield was not as high as the treatments mentioned above. Compared to the previous season, environmental conditions were not very conducive for the disease. Nevertheless, fruit rot incidence reached 55% in the inoculated control, whereas the best-performing treatments had less than 10% of symptomatic fruit. Pestalotia leaf spot severity followed the trends observed for fruit rot incidence. In general,

treatments with the least leaf spot severity were also Omega as well as all treatments including either Switch or Thiram, in addition to Bravo Weather Stick. Yield in the inoculated control was 12281.3 lb/A, whereas yield in the Omega 500F and Switch alternated with Thiram was 53,802 and 31,104 lb/A, respectively.

Table 1. Treatment effects on strawberry yield and fruit disease incidence caused by *Neopestalotiopsis* sp.

Treatment ^w	Yield (lb/A) ^{xz}		Pestalotia fruit incidence		Pestalotia leaf severity ^{yz}	
			(%) ^{xz}			
Omega 500F 20 fl oz, weekly	53802.5	a	6.5	p	1.1	hi
Switch 62.5WG 14 oz + paraffinic mineral oil 1.6 pt (2%) alerts, alt Thiram SC 2.5 qt + paraffinic mineral oil 0.8 pt (1%) other weeks	50775.9	a	7.7	op	1.6	efghi
Switch 62.5WG 14 oz + Actigard 0.33 oz alerts, alt Thiram SC 2.5 qt + Actigard 0.33 oz other weeks	46128.8	ab	9.0	nop	1.4	fghi
Thiram SC 2.5 qt, weekly	40200.1	bc	17.6	k	2.2	abcdefghijkl
ProBlad Verde 45.7 fl oz alerts, Thiram SC 2.5 qt other weeks	39031.2	bcd	15.6	kl	2.0	cdefghi
ProBlad Verde 32 fl oz alerts, Thiram SC 2.5 qt other weeks	38086.9	bcd	11.7	lmn	2.0	bcdefghi
Bravo Weather Stik 1.5 pt, weekly	36592.6	bcd	11.7	lmn	1.3	ghi
Switch 62.5WG 14 oz alerts, alt Thiram SC 2.5 qt other weeks	36466.1	bcd	6.7	p	1.1	i
Yarden (YA2104) 26.6 oz, weekly	33562.1	cde	13.1	lm	2.0	bcdefghi
Switch 62.5WG 14 oz alerts, ProBlad Verde 32 fl oz other weeks	31104.5	cdef	30.7	j	2.3	bcdefghi
Control, non-inoculated	30010.4	def	10.9	mno	1.9	defghi
Aprovia Top 13.5 fl oz + Actigard 0.33 oz, weekly	29419.1	def	32.5	j	2.7	abcd
Aprovia Top 13.5 fl oz, weekly	26249.4	efg	31.2	j	2.0	bcdefghi
Regev (RE5928) 8.5 oz, weekly	23951.0	efgh	35.2	ij	2.6	abcde
Switch 62.5WG 14 oz alerts, alt Oxidate 5.0 0.39% v/v+OxiPhos 2.5 qt, alt PerCarb 3 lb other weeks	22306.9	fghi	40.8	hi	3.0	ab
Serenade Opti 1 lb, weekly	21993.6	fghij	45.0	fgh	2.3	abcdefg
Switch 62.5WG 14 oz alerts, ProBlad Verde 45.7 fl oz other weeks	21934.9	fghij	40.5	hi	2.1	bcdefghi
ProBlad Verde 32 fl oz, weekly	18015.9	ghijk	53.1	abcde	2.8	abcd
Actigard 0.33 oz, weekly	17384.5	ghijk	52.1	bcde	2.8	abcd
Kitogreen 120 g, weekly	16148.6	hijk	43.6	gh	2.9	abc
LPC 5860-211 100 g + LPC 5860-212 120 g, weekly (1st appl: 24h prior inoculation)*	15627.9	hijk	55.6	abc	2.8	abcd
AVIV(AV8000) 28 oz (first week) then QAM 2.7 lb, weekly	15467.3	hijk	51.3	cdef	2.3	abcdef
LPC 5860-211 100 g, weekly (1st appl: 24h prior inoculation)*	15296.0	hijk	48.2	defg	2.5	abcde
ProBlad Verde 45.7 fl oz, weekly	13729.4	ijk	58.1	ab	2.6	abcd
Timorex ACT (TA1040) 35 oz, weekly	13410.9	ijk	55.9	abc	3.1	abc
ProBlad Verde 45.7 fl oz alerts, Serenade Opti 1 lb other weeks	13180.9	ijk	56.2	abc	2.7	abcd
Howler 2.5 lb + Theia 1.5 lb + Induce 2pt, weekly	12665.3	jkl	48.0	efg	2.7	abcd
Control, inoculated	12281.3	jk	55.1	abcd	2.7	abcde
ProBlad Verde 32 fl oz alerts, Serenade Opti 1 lb other weeks	11243.8	k	53.3	abcde	3.3	a

Theia 3 lb + Induce 2 pt, weekly	9116.7	k	59.2	a	3.0	abc
Howler 5 lb + Induce 2 pt, weekly	8216.1	k	59.1	a	2.75	abcd

^w Weekly applications over 14 weeks from 29 Oct 2021 to 27 Jan 2022.

^x Yield and fruit rot incidence based on harvest data and fruit grading from 9 Dec 2021 to 10 Feb 2022 (16 harvests).

^y Leaf spot severity evaluated on 2 Feb 2022 using an ordinal severity scale with 7 score levels (0 – no symptoms; 1 – slight infection, a few leaf spots; 2 – moderate infection, a few large spots on the leaf; 3 – moderate infection, leaf spots and wilting of leaves; 4 – moderate to severe infection, some dead leaves, and all leaves with at least one *Neopestalotiopsis* sp. spot; 5 – severe infection, several dead leaves and all leaves have spots; 6 – plant dead).

^z Values in a column followed by the same letter are not significantly different by Fisher's Protected LSD test for yield and fruit rot incidence and Dunn's test for leaf severity using a scale ($\alpha = 0.05$).