STRAWBERRY (*Fragaria* x *ananassa* 'Florida 127')
Phytophthora crown rot; *Phytophthora cactorum*

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Evaluation of biological products for the control of Phytophthora crown rot in annual strawberry, 2018-2019.

On 11 Oct 2018, bare root strawberry transplants from Canada were set into plots on plastic-mulched beds previously fumigated with Telone C-35 (300 lb/A). The beds were 32-in. wide at the base on 4-ft centers. The plots were 9.5 ft long and consisted of 20 plants in two staggered rows of 10 plants each. Plant spacing was approximately 12 in. within and between rows. Treatments were arranged in a randomized complete block design with four blocks in adjacent beds. For all biological treatments, whole green top bare root transplants were dipped for 5 min in an aqueous suspension of product before transplanting. After transplanting, the experimental area was overhead watered during the day for 10 days to facilitate rooting and establishment. The plants were subsequently irrigated and fertilized through a central drip tape in each bed. On 23 Oct, an EZject Soil Injector® was used to deposit 0.6 fl oz of inoculum approximately 2 in. from each plant at a 2-in. depth. The inoculum consisted of a suspension of 1×10^4 zoospores/ml produced from two mefenoxam-resistant and one mefenoxam-sensitive isolate of *P. cactorum*. Inoculated and non-inoculated controls were included. Post-plant treatments were applied from 25 Oct to 27 Dec or 3 to 11 weeks after planting (WAP) through dedicated drip tapes with 10 emitters at 12-in. spacing. Two tapes were installed per plot, one next to each plant row. Drip applications were made in 0.4 gal water per foot of bed (4,350 gal/A). In one treatment, Helena Prophyt was applied as a foliar spray with a CO_2 powered back-pack sprayer at 60 PSI and 100 gal/A. The sprayer was equipped with two TeeJet® 8002 hollow-cone nozzles spaced 12 in. apart on the wand. Plots were evaluated for disease at 2-wk intervals from 15 Nov to 23 Jan (5 to 15 WAP). Plants that were dead, partially collapsed, or severely stunted were considered diseased. Fruit were harvested twice weekly from 6 Dec to 31 Jan (14 times) to obtain yields of marketable fruit weighing more than 10 g each. Data were analyzed by two-way ANOVA using the GLM procedure in SAS (SAS Institute, Cary, NC).

Plants began developing symptoms in mid- to late Nov, approximately 4 weeks after inoculation. Disease incidence increased rapidly in Dec. but tapered off before the last evaluation on 24 Jan. (15 WAP), when disease incidence reached 43.7% in the inoculated control. At that time, disease incidence was reduced to 12.7% by A22556, a conventional product containing mefenoxam and oxathiapiprolin that was included for comparison, and to 23.5% by Mycostop, a biological product containing *Streptomyces* spp. No other product or program significantly reduced disease incidence 15 WAP. Yields of marketable fruit were analyzed for harvests 1-7, harvests 8-14, and all 14 harvests ending on 31 Jan. Yields were not significantly affected by treatment for any of the three periods, according to an ANOVA for each period. This was especially evident for the first seven harvests when yields were confined to a relatively narrow range of 3,056 to 4,570 lb/A. For harvests 8-14, yields ranged from 1,566 lb/A in the inoculated control to 3,176 lb/A in the A22556 treatment. Interestingly, yields of biological treatments consistently exceeded the control during this later period, suggesting that benefits from these treatments may take time to develop. Additional late-season harvests should be made in future Phytophthora trials. No phytotoxicity was observed with any treatment.

Plant dip treatments (amount/100 gal)	Post-plant drip applications (rates/A)[z]	Post-plant timing (WAP)[y]	Yield (lb/A)[x]			DI[w]
			Harv 1-7	Harv 8-14	All Harv	(15 WAP)
na	Non-inoculated control	na	4259	3143	7402	7.5 a[v]
no plant dip	A22556 20 fl oz	3,7,11	4570	3176	7748	12.7 ab
Mycostop 1.67 lb	Mycostop 0.2 lb	3,5,7,9,11	3748	2351	6100	23.5 abc
no plant dip	Ridomil Gold 480SL 16 fl oz	3,7,11	4236	3114	7350	26.4 bcd
MBFi TC WP 2.5 lb	MBFi TC WP 2.0 lb	3,7,11	3812	2993	6805	26.5 bcd
MBFi TC WP 2.5 lb	MBFi TC WP 1.0 lb	3,7,11	3056	2907	5963	28.5 bcd
Actinovate AG 12 oz	Actinovate AG 6 oz	3,5,7,9,11	3550	2690	6241	30.0 b-e
Onix 0.8 qt	Onix 7 fl oz	3,5,7,9,11	4135	2342	6477	30.0 b-e
no plant dip	Helena Prophyt 2 pt foliar spray	3,5,7,9,11	3613	1770	5383	30.3 cde
MBFi TC WP 2.5 lb	MBFi TC WP 0.5 lb	3,7,11	3644	2892	6536	31.2 cde
Onix 0.8 qt + Prestop WG 2.5 lb	Prestop WG 0.5 lb Onix 7 fl oz	3,7,11 5,9	3858	2094	5952	31.6 cde
Prestop WG 2.5 lb	Prestop WG 0.5 lb	3,5,7,9,11	3619	2106	5725	36.3 cde
Mycostop 1.67 lb	Prestop WG 0.5 lb Mycostop 0.2 lb	3,7,11 5,9	3754	2262	6016	36.3 cde
Onix 0.8 qt + Mycostop 1.67 lb	Mycostop 0.2 lb Onix 7 fl oz	3,7,11 5,9	3639	2294	5933	40.0 cde
Mycostop 1.67 lb	Ridomil Gold 480SL 16 fl oz Mycostop 0.2 lb + Prestop 0.5 lb	3,11 7	3924	1873	5797	41.3 de
Rootshield WP 2.5 lb	Rootshield WP 2 lb	3,7,11	4020	2308	6328	46.8 e
na	Inoculated control	na	3726	1566	5292	43.7 de
P > F (type III sums of squares for treatment)			0.1967	0.1587	0.1134	0.0041

[z] Drip application rates were calculated as banded applications made to beds only, which occupied approximately 67% of an acre.
[y] Post-plant applications were made from 26 Oct (3 weeks after planting) to 27 Dec (11 WAP).
[x] Yields are presented for harvests 1-7 (6 Dec to 3 Jan), harvests 8-14 (7 Jan to 31 Jan) , and for all 14 harvests.
[w] Disease incidence (DI) of dead, partially collapsed, or severely stunted plants on 24 Jan 2019 (15 WAP).
[v] Values in a column followed by the same letter are not significantly different by Fisher's Protected LSD (α = 0.05).