STRAWBERRY (*Fragaria* × *ananassa* 'Sweet Ann'; 'Monterey')
Macrophomina crown rot; *Macrophomina phaseolina*

K. A. Blauer and G. J. Holmes
Strawberry Center, California Polytechnic State University, San Luis Obispo, CA 93407

Evaluation of pre-plant chemigation, pre-plant dip, at-planting chemigation, and soil drench treatments for biological control of Macrophomina crown rot on fall-planted strawberries, 2020.

The trial was conducted in field 35b at the California Polytechnic State University campus in San Luis Obispo, CA (35°18'20.36" N 120°40'22.19" W). The soil type is a clay loam in its fifth consecutive year of strawberry production where each year plants were inoculated with *M. phaseolina*. Industry standard beds were used:12 in. high and 64 in. wide; 4 lines of plants spaced 12 in. between plant lines and 16 in. between plants within a line. Beds were covered with black TIF (totally impermeable film) polyethylene mulch (1 mil) (TriCal Inc., Hollister, CA). Bare root transplants were transplanted into raised beds on 6 Nov 19. Plots were 15.5 ft long (46 plants), replicated four times, and arranged in a randomized complete block design. A 16-in. non-planted buffer was used on both ends of each plot. Plants were irrigated and fertilized via two lines of drip irrigation tape per bed using Aqua-Traxx (Toro, Bloomington, MN) (0.5 gpm/100 ft @ 10 psi, 8-in. spacing between emitters). Plots had three additional drip irrigation lines used to apply treatments. Each bed had ¾ in. schedule-40 PVC pipe laid between two plant lines along one side of the bed. At the head of each plot, a manifold with three drip lines and a ¾ in. ball valve was used to apply treatments to plots. A booster pump with a 50-gal tank was used to pressurize the drip system and treatments were applied individually by opening and closing the ball valves at the head of each plot. To evaluate different cultivar responses to Macrophomina crown rot, a moderately susceptible cultivar (i.e., 'Monterey') was added as a non-treated, inoculated control. For all other treatments, 'Sweet Ann' was used. To assess the need for a post-planting inoculation, inoculated and non-inoculated controls were included. The treatment, Terramera Biological, was applied 14 days prior to planting (pre-plant chemigation, 22 Oct) and mixed with 100 gal of water (13,000 gal/A). Plants included in treatments SP2700 and SP2700 + Bio-Tam were fully submerged in product suspensions for 5 min and planted immediately (pre-plant dip). MycoUp Biological Inoculant was applied via drip with 50 gal of water (6,500 gal/A) immediately after planting (at-planting chemigation). For monthly chemigation sets (application sequence B-K), each treatment received 50 gal of water and application time was approximately 45 min per treatment. The application process was similar to a grower's chemigation set: pre-irrigation (25% of total time), treatment injection (50% of total time), and flush (25% of total time). Treatments not receiving a chemical application received a water application in order to hold the amount of water constant among all plots. Plants were inoculated at the crown using 5 g of *M. phaseolina* cornmeal-sand inoculum two wk after transplanting (20 Nov), except for the "non-treated 'Sweet Ann' control". Plant mortality was recorded at a 1-mo interval from Jan through Apr, a 2-wk interval for Apr through Jun, and a 1-wk interval for Jun through Jul. Plants were recorded as dead if no green foliage was present. Fruit yield was collected before visual signs of disease appeared on 22 Apr, 29 Apr, and 7 May. Throughout the trial, a few plants showing disease symptoms were removed and disease diagnosis confirmed *M. phaseolina* as the causal agent. To increase plant stress, irrigation was applied 25% less frequently beginning 1 Jun through 31 Jul. Data were subjected to analysis of variance and Fisher's LSD mean separation test. Area under the disease progress curve (AUDPC) was calculated using all the plant mortality ratings from 1 Jan through 31 Jul.

The 2020 growing season consisted of below average rainfall (13.3 in. vs. average rainfall of 19 in.), and average summer temperatures (Apr to July, average high 73.5°F). Plant mortality between Dec and May showed no significant differences among treatments. Plant mortality did not significantly increase until plants were water stressed with the combination of daytime maximum temperature above 80°F. There were 19 d recorded above 80°F between May and Jul. The relatively high level of disease mortality in the "non-treated, 'Sweet Ann', non-inoculated" indicates there is a very high level of resident inoculum in the soil. Only a few of the evaluations are shown to validate the lack of disease early in the year and to illustrate the rapid progression of disease when the plant is stressed. At some evaluation dates, the "non-treated, 'Sweet Ann', non-inoculated" treatment had numerically higher disease mortality than the "non-treated, Sweet Ann" treatment, but was never significantly different (data not shown). The only treatment to significantly separate and have the lowest amount of disease mortality was the "non-treated, 'Monterey', inoculated". The other biological treatments did not result in a reduction of Macrophomina crown rot under the use patterns of this study. There was no significant difference in the fruit yields between the treated plots and the two non-treated 'Sweat Ann' treatments. (data not shown). No phytotoxicity was observed in any treatment.

Treatment (dip rate/100 gal, drip rate/A)	Treatment timing[z]	% Mortality			
		31 Mar	1 Jul[y]	31 Jul	AUDPC[x]
Non-treated, Monterey[w]	-----	0.0	10.6 b	38.5 b	7.6 b
Non-treated, Sweet Ann, non-inoculated	-----	0.0	32.0 a	65.8 a	15.9 a
Non-treated, Sweet Ann	-----	0.0	32.6 a	67.2 a	14.7 a
MycoUp Biological Inoculant (---, 2.5 lb)	DG				
TrichoSym Bio (---, 2 qt)	B				
TrichoSym Bio (---, 1 qt)	EFH-K	0.0	37.5 a	73.9 a	15.7 a
Terramera Biological (---,0.8% v/v)	AD-K	0.0	34.8 a	74.7 a	18.2 a
SP2700 (7.8 oz, 7.8 oz)	B-K	0.0	29.1 a	67.8 a	14.6 a
SP2700 (7.8 oz, 7.8 oz)	B-K				
Bio-Tam 2.0 (2.5 lb, 2.5 lb)	B-K	0.0	30.8 a	72.4 a	17.0 a
LSD		0.0	11.8	12.0	4.2

[z] Application timing sequence: A=22 Oct 19 (pre-plant chemigation), B= 6 Nov (pre-plant drip), C= 20 Nov, D= 4 Dec, E= 2 Jan 20, F= 5 Feb, G= 4 Mar, H= 1 Apr, I= 6 May, J= 3 Jun, K= 1 Jul.

[y] Numbers within a column followed by the same letter are not significantly different (α=0.05) per Fisher's LSD simultaneous comparison calculated using ARM version 2020.1 (Gylling Data Management, Inc., Brookings, SD).

[x] Area Under the Disease Progress Curve for all mortality ratings was calculated using ARM version 2020.1.

[w] All treatments were inoculated two weeks after transplanting with *Macrophomina phaseolina* unless otherwise noted.