

INTEGRATED SOIL DISINFESTATION SYSTEMS FOR FLOWER AND STRAWBERRY

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Summary. Dominus (AITC) and TRX58 (chemistry not disclosed) were evaluated in commercial flower fields for control of soil pests. Standards such as methyl bromide (MB) + chloropicrin (Pic) provided best pest suppression. TRX58 appears to be effective on soil pests such as *Fusarium oxysporum*, *Pythium ultimum* and weeds. Varied performance by Dominus on soil pests suggests there is much to be learned about this compound if effectiveness is to be improved. Results from a carefully regulated microplot study found that Dominus alone at ambient temperatures did not disperse far from injection point. Because of Dominus' immobile nature, work will need to be done to improve its distribution in soil if it is to be a satisfactory fumigant.

Flowers

Studies during 2013-16 were conducted in Carlsbad (delphinium, ranunculus), Oceanside, (delphinium), Oxnard (sunflower), Santa Maria (gladiolus) and Santa Paula, CA (several species) to evaluate alternative fumigants in commercial cut flowers.

Methods. *Dominus field evaluation.* Pic-Clor 60 (40% 1,3-D + 60% chloropicrin) at 29 GPA and Dominus (100% AITC) at 40 GPA were evaluated on a commercial gladiolus field near Santa Maria, CA. The fumigants were commercially applied on 3 October 2013. Plots were 440 ft long by 22 ft wide and treatments were replicated twice. The site had previously been used for gladiolus production and there were numerous volunteer bulbs present at the time of fumigation. Bulb samples were taken from the field before and after fumigation to estimate the treatment effect on bulb viability. Bulbs were stratified at 7°C for 90 days and then were planted in soil in a greenhouse for 30 days. Viable bulbs sprouted within 30 days, and those not sprouting were considered dead. Data were analyzed in SAS Proc GLM, and LSD's were used for mean separation.

Dominus evaluation in high-tunnels. Pic-Clor 60 at 29 GPA, Dominus at 40 GPA and Dominus + Tri-Clor at 28 + 9.4 GPA were drip applied by TriCal on 5 September 2014 at Santa Paula, CA. Treatments were made to 20 by 200 ft high tunnels with 4 beds per tunnel. Treatments were replicated 3 times with one tunnel per plot. Weed control, pre and post soil sampling for pathogens, number of diseased plants and number of marketable stems were recorded.

Dominus & TRX58 evaluations in field grown flowers. Fumigants were shank applied by TriCal at Carlsbad, CA on 2 October 2014 and Oceanside, CA on 14

November 2014. Treatments at Carlsbad were MB:Pic 50:50 at 350 lb/A, Pic-Clor 60 at 350 lb/A, Dominus at 40 GPA, Dominus/Pic 67:33 at 40 GPA, TRX58 at 500 lb/A, TRX58/Pic 67:33 at 400 lb/A and nontreated. Plots were 11 ft wide by 160 ft long and each treatment was replicated 3 times. Fumigants shank applied at Oceanside were Pic-Clor 60 at 350 lb/A, Dominus/Pic 67:33 at 40 GPA, TRX58 at 400 lb/A, and nontreated. Plots were 11 ft wide by 120 ft long and treatments were replicated 3 times. Data were *Fusarium* and *Pythium* control based on pre- and post-fumigation analyses, weed densities and hand weeding times. Number of 10-stem delphinium bunches were recorded at Oceanside.

Fumigants were shank applied by TriCal at Oxnard on 25 May 2016. Treatments were TRX58 at 500 lb/A, TRX58 + Tri-Clor at 335 + 165 lb/A, Tri-Clor at 300 lb/A and nontreated. Plots were 11 ft wide by 220 ft long and treatments were replicated twice. The crop was ornamental sunflower which was transplanted June 9, 2016.

Dominus at 20 GPA equivalent rate was injected in the center of a 1 m² microplot at a depth of 8 inches. *Verticillium dahliae* infested soil (49 ms/g) and weed propagules were placed 1, 3, 5 and 7 inches from the injection point to measure the dispersion of this fumigant from the injection point. Treatments included Dominus at 20GPA alone, steam alone for 1 hour, Dominus at 20 GPA + steam, and nontreated. The results on Dominus + steam will be reported in a separate paper.

Results. *Fusarium* CFU per 10 cc soil was 0 for Pic-Clor 60; 4,000 for Dominus + Tri-Clor; and 9,000 for Dominus post-fumigation at Santa Paula. *Fusarium* counts post-fumigation at Carlsbad were variable and not significant (Table 1). Post-fumigation data reveal that MB:Pic, Pic-Clor 60 and TRX58 were the most effective on *Pythium* and weeds at Carlsbad while Dominus and Dominus + Pic treatments were not different from the nontreated. At Oceanside the fumigants all controlled *Fusarium*, *Pythium* and weeds better than the nontreated (Table 2).

At Oxnard, the percentage of harvested sunflower as of 11 August 2016 was 41% for nontreated, 72% for TRX-58, 73% for TRX58+TriClor, and 93% for Tri-Clor (Table 3). The fumigant treatments did not significantly improve nutsedge control relative to the nontreated. TRX58 + Tri-Clor and Tri-Clor alone did have fewer little mallow than the nontreated. All of the fumigant treatments reduced total weeds relative to the control (Table 3).

Dominus did not move from the injection point to control *V. dahliae* or yellow nutsedge (Table 4). Steam was most efficacious on *V. dahliae* or yellow nutsedge 1 inch from the injection point and less efficacious at 7 inches from injection point. Steam, which moves as an advancing front by convection, has the most effect on soil pests near the point of injection as shown here. Dominus by comparison did not appear to move from point of injection.

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Table 1. *Fusarium*, *Pythium* pre- and post-fumigation samples, weed densities and weeding times at the Carlsbad, CA flower trial in 2014-15.

Treatment	Rate	<i>Fusarium</i> (p/g soil)		<i>Pythium</i> (p/g soil)		Weeds	Weed time
		Pre	Post	Pre	Post	No. 1000 A ⁻¹	Hr. A ⁻¹
MBPic	350 lb/A	183	0	17	0 c	8.3 c	69 e
Pic-Clor 60	350 lb/A	1365	0	17	0 c	1.6 c	99 cde
Dominus	40 GPA	259	47	35	80 a	61.9 a	223 ab
Dominus + Pic	40 GPA	328	38	28	36 b	30.7 abc	169 bc
TRX-58	500 lb/A	469	201	16	0 c	17.1 c	87 de
TRX-58/Pic	400 lb/A	210	74	35	1 c	27.6 bc	157 bcd
nontreated	0	350	721	13	39 b	52.7 ab	266 a

Table 2. *Fusarium*, *Pythium* pre- and post-fumigation samples, weed densities, weeding times, and delphinium stem yield at the Oceanside, CA flower trial in 2014-15.

Treatment	Rate	<i>Fusarium</i> (p/g soil)		<i>Pythium</i> (p/g soil)		Weeds	Weed time	Stems
		Pre	Post	Pre	Post	No. 1000 A ⁻¹	Hr. A ⁻¹	No. 1000 A ⁻¹
Pic-Clor 60	350 lb/A	1184	286 bc	439	0 b	2.7 ab	12 b	15.7 a
Dominus + Pic	40 GPA	1112	424 b	867	0 b	0.6 b	10 b	18.1 a
TRX-58/Pic	400 lb/A	1030	89 c	803	0 b	0.2 b	11 b	20.7 a
nontreated	0	1197	2515 a	811	40 a	7.1 a	19 a	14.4 a

Table 3. Percentage of sunflower stems harvested and weed control in Oxnard, CA 2016.

Treatment	Rate /b/A	Sunflower % harvested	Nutsedge	Little mallow	Total weeds
			----- No. 1000 A ⁻¹ -----		
Nontreated	0	41 c	74 a	118 a	248 a
TRX-58	500	72 b	52 a	70 ab	135 b
TRX-58/Pic	335/165	73 b	44 a	57 b	100 b
TriClor	300	93 a	91 a	30 b	126 b

Table 4. Viability (viable microsclerotia g⁻¹) of *Verticillium dahliae* and yellow nutsedge samples exposed to Dominus and steam at distances of 1, 3, 5 and 7 inches from the site of injection.

Distance inches	<i>Verticillium dahliae</i>		Yellow nutsedge	
	Dominus	Steam	Dominus	Steam
	Microsclerotia g ⁻¹		Viability (%)	
1	80	2	28	0
3	54	15	30	13
5	59	43	38	23
7	68	71	33	20