

California Pepper Commission – Final Report, 2006

Title: Weed Control Trials in Peppers

Principle Investigators:

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Timeline: March 1, 2006 to February 28, 2007

Summary: The Central Coast trial was located on a site with a good spectrum of weeds. All pretransplant treatments provided excellent weed control for 28 days following transplanting and significantly reduced weeding time. All layby applications were effective and low weed pressure was observed in all preplant followed by layby treatments 85 days following the layby application. Postemergence applications were evaluated and provided good but not long-lasting weed control. All postemergence applications were safe on the pepper crop. Promising pretransplant materials include Goal Tender, Outlook and Spartan. V-10142 is a promising postemergence material.

The South San Joaquin Valley trial investigating the utility of several preemergent herbicides included preplant, at plant, and layby applications in transplanted bell peppers. Dual Magnum 7.62, Goal Tender 4F, and Outlook 6.0 were the herbicides that were evaluated. The 2006 field trial was conducted on a Panoche clay loam soil at the UC West Side Research and Extension Center (WSREC) near Five Points in Fresno County. Weed pressure in the field (especially purslane) were substantial throughout the entire season. All at-planting and layby applications of the above mentioned preemergent herbicides were very effective in providing excellent weed control with little crop phytotoxicity, certainly nothing that affected pepper yield. Post-emergence applications of several other herbicides ten days after layby were less effective and need further evaluations.

Background: Peppers are long-season vegetables that have several weed control challenges: They compete weakly with weeds for the first 40 to 60 days following transplanting. They are a long-season crop in many production districts that can be subject to flushes of both winter and summer weeds over the course of their growing cycle. The preemergence herbicides registered for peppers have gaps in the spectrum of weeds that they control (Smith et al., 2003). As a result, growers may spend from \$200 to \$350/acre (Klonsky et al., 1997) on weed management. Field selection, field sanitation, cultivation and the use of plastic mulches are cultural practices that reduce weed pressure in production fields. Fumigation provides substantial weed control and is frequently used in conjunction with plastic mulches which improves the level of weed control provided by both techniques. Goal Tender was registered in California in 2004 for use with plastic mulch and provides control of Little Mallow (*Malva parviflora*) which is only partially controlled by fumigants and other

preemergence herbicides registered for use on peppers. However, many acres of peppers are not grown with plastic mulch, and weed control is a challenge. Devrinol, Prefar and Treflan are registered preemergence herbicides in peppers. Dual Magnum is registered under a 24C and provides good control of hairy nightshade (*Solanum sarrachoides*) and yellow nutsedge (*Cyperus esculentus*) which are not controlled by the other preemergent materials. Late season weed control is also an important issue in this crop. The objective of these studies was to examine at transplant and layby herbicide combinations for peppers that can provide long-term and economical weed control for peppers grown without plastic mulch.

Objectives:

- 1) Examine the transplant weed control options (Goal Tender 4F, Dual Magnum, and Outlook) followed by combinations of layby herbicides (Dacthal – standard, Dual Magnum, and Outlook). Postemergence evaluations of Sandea and V-10142 were also conducted. Evaluations of weed control, crop safety and yield will be conducted.
- 2) Conduct the above trials in the Coastal and Central Valley production districts.

METHODS

Field trials were conducted on the Central Coast (Monterey County) and South San Joaquin Valley (Fresno County) in 2006 to provide an evaluation of the test herbicides over a wider range of growing conditions and weed spectra.

Central Coast Trial Methods: The following trial was established in cooperation with Peter Iverson in Soledad. The pretransplant applications were made on shaped beds on May 13; peppers were transplanted on May 15. Layby applications were made on June 12. Each plot was one 40-inch bed wide by 20 feet long and replicated three times in a randomized complete block design. Pretransplant treatments were applied to the entire bed in 74 gallons of water per acre with two passes of 1-8008E teejet nozzle at 30 psi. Layby applications were made with directed spray to the base of the plant. Two passes of a one nozzle wand with an 8008E teejet nozzle per seed line at 30 psi applying 148 gallons of water per acre. Soil type = Mocho silt loam. Variety = Pimento. See table for treatments and evaluation dates.

Fresno County Trial Methods: On April 27, 2006 the bell pepper variety “Baron” was transplanted in single rows into 40” beds. Within row plant spacing was 10”. Plot size was two 40-inch beds x 70 feet of row length and replicated 4 times in a Randomized Complete Block Design. All herbicide applications were applied to the entire plot with a CO₂ backpack sprayer at 30 psi and XR 8003evs Teejet nozzle tips mounted on a two nozzle boom with a water volume of 30 gallons per acre.

- Preplant applications of Goal Tender were made onto shaped beds on April 18, 9 days prior to transplanting the peppers.
- The at-planting treatments of Dual Magnum were applied two different ways: as a directed spray post transplant and over-the-top post transplant.
- Outlook was applied pre-transplant one hour in advance of planting the peppers.

The field was sprinkler irrigated applying 0.50 inch of water immediately following transplanting. Sprinkler irrigation continued as needed for a few weeks and then switched to furrow irrigation. On May 31 the whole field was hand weeded and machine cultivated. On June 5 the layby applications of the preemergence herbicides (Dacthal, Dual, and Outlook) were made as directed sprays to the base of the plants. Sandea, Staple, and V-10142 were applied 15 days later as directed sprays and evaluated as postemergence herbicides. Either a non-ionic surfactant or a crop oil concentrate was used with these products. The experiment included an untreated check.

Plots were evaluated for phytotoxicity to the peppers and weed control on May 26 (30 Days after transplanting [DAT]), July 13 (78 DAT), and August 3 (99 DAT). Throughout the season the pepper stand was very uniform and did not appear to be affected by the herbicide applications, so stand counts were not collected. A portion of each plot (25' row) was hand harvested on August 3 (west bed only). See table 6 for a list of treatments and results.

RESULTS

Central Coast Results: There was good weed pressure in the trial and a good spectrum of weed species. All pretransplant applications provided good weed control on the May 30 (15 days after transplanting) evaluation date (Table 1). There was notable leaf crinkling in the Goal Tender treatment, but this is not surprising in that the material was applied 2 days prior to transplanting, as opposed to 15 to 30 days prior to transplanting as was done in the past. Weed control by the pretransplant applications continued to be good on the June 12 (28 days after transplanting) evaluation date (Table 2). There was significant phytotoxicity in the Goal Tender and Spartan pretransplant treatments. All weed control treatments reduced weeding time significantly over the untreated control. The postemergence were reasonable safe on the peppers (Table 3). These treatments did not have any preemergent herbicides applied and the weeds were good size at the time of application (June 12). All material provided good weed control but the higher rates of V-10142 reduced weeding time over the lowest rate (0.10 lb a.i./A). All Dual Magnum, Goal Tender and Outlook pretransplant applications followed by the various layby treatments provided good weed control on September 5 (85 days following layby application) (Table 4). The postemergence treatments alone did not have as good of long-term weed control. The harvest data illustrated differences among the treatments. A sensitive indicator of negative impacts of a treatment was the percent of red fruit (Table 5). The treatments with the highest percent red fruit were untreated, all V-10142 treatments and Outlook (pretransplant). Spartan as a postemergence layby treatment was damaging to the crop. In the 2005 trial we observed that postemergence applications of Outlook were damaging to the crop. There is a trend in number of total marketable yield that indicates reduced yield within a pretransplant treatment when followed by a postemergence layby application of Outlook vs Dual Magnum.

Fresno County Results: Untreated plots rapidly became were very weedy. At layby weeds were removed but new seedlings continued to germinate. Particularly troublesome this year was purslane, but there was also substantial pressure from black and hairy nightshade, tumble and redroot pigweeds, nutsedge and barnyard grass. Lambsquarters, groundcherry, puncturevine, and sowthistle were also present, but were not as uniformly distributed throughout the field. The purslane sawfly built up substantial populations after layby and

was able to reduce some of the leaf surface area of the purslane, however substantial weed competition had already occurred. Towards the end of the season pepper plants in the untreated plots were yellower, weaker, and stunted compared to plants where herbicide applications were made; this result was listed in the category of phytotoxicity rating even though no chemical application was made. At harvest there was no phytotoxicity result from herbicide applications (data not shown).

Planting to layby results: At planting **Dual Magnum** was applied as a directed spray post transplant and an over-the-top post transplant spray, then again at layby. Weed control of nightshades, nutsedge and grasses was excellent at layby. A few pigweed and purslane plants and an occasional punturevine were observed in the plots. There was no crop phytotoxicity that was potentially damaging.

Goal Tender is labeled for application 30 days prior to transplanting with soil incorporation prior to transplanting. Applications at 30, and 15 days ahead of transplanting have been previously tested with no phytotoxicity problems. In 2006 Goal Tender applied 9 days with no soil cultivation prior to transplanting showed some pepper phytotoxicity for about 6 weeks after planting, but there was no crop symptoms at harvest and crop yields were not affected. Weed control (up to layby) of all broadleaves and grasses was excellent with the exception of nutsedge, which was not controlled. Goal Tender was not applied as a layby application.

Outlook was applied pre transplant over the entire bed top and at layby as a directed spray to the base of the peppers. No crop phytotoxicity was observed with these applications. Broadleaf weed control was very good, but not excellent with this application method. There were high amounts of purslane within the plant row. Grass and nutsedge control was excellent. Yields were equal to those plots receiving Dual and Goal applications.

Layby to harvest results: Dacthal, Dual and Magnum were applied or reapplied at layby. Final weed control ratings at layby indicated that all products provided excellent weed control with no effect on yield or crop phytotoxicity. Sandea, Staple, and V-10142 were also included, but were not the major emphasis of this project. We were however, curious about V-10142.

V-10142 - is a new Valent product for which we are still looking for a fit in peppers. It was tried as a postemergence application at layby, where we saw some temporary crop phytotoxicity. We may be interested in testing it as a preemergence application next season. Pepper yields were lower with this product, mainly because the weeds were not controlled and because weed control prior to layby was not as weed-free as is customary under commercial production.

Central Coast Evaluations

Table 1. Weeds number (per 20 ft²) and phytotoxicity ratings on May 30, 2006. Evaluation of preemergence treatments only.

Transplant Application	Lbs a.i./A	Layby Application	Lbs a.i./A	Sow Thistle	Cheno-pods	Night-shade	Total Weeds	Phyto
Dual Magnum 7.62	1.43	Dacthal 75W (standard layby)	7.00	0.3	0.0	0.0	0.3	0.0
Dual Magnum 7.62	1.43	Dual Magnum 7.62	1.43	0.0	0.3	0.0	0.3	0.0
Dual Magnum 7.62	1.43	Outlook 6.0	0.60	0.0	0.3	0.0	0.3	0.0
Goal Tender 4F	0.50	Dual Magnum 7.62	1.43	0.0	0.0	0.0	0.0	2.7
Goal Tender 4F	0.50	Outlook 6.0	0.60	0.0	0.0	0.0	0.0	2.7
Outlook 6.0	0.60	Dual Magnum 7.62	1.43	0.0	0.0	0.0	0.0	0.7
Outlook 6.0	0.60	Outlook 6.0	0.60	0.0	0.0	0.3	0.3	0.7
Spartan 75DF	0.10	----		0.3	0.7	0.3	1.3	2.3
Spartan 75DF	0.10	Spartan 75DF	0.10	0.0	0.0	0.0	0.0	1.7
----	----	Sandea (standard post) NIS	0.047 0.25%	----	----	----	----	----
----	----	V-10142 COC	0.10 1.0%	----	----	----	----	----
----	----	V-10142 COC	0.20 1.0%	----	----	----	----	----
----	----	V-10142 COC	0.30 1.0%	----	----	----	----	----
Untreated	---	Untreated	---	11.0	5.7	7.0	25.3	0.0
LSD (0.05)				4.7	4.0	3.4	7.4	1.0

Table 2. Weeds number (per 30 ft²) and phytotoxicity ratings on June 12, 2006. Evaluation of preemergence treatments only.

Transplant Application	Lbs a.i./A	Layby Application	Lbs a.i./A	Sow Thistle	Cheno-pods	Night-shade	Total Weeds	Phyto	Time to weed Hrs/A
Dual Magnum 7.62	1.43	Dacthal 75W (standard layby)	7.00	3.7	2.9	1.0	8.4	0.0	8.9
Dual Magnum 7.62	1.43	Dual Magnum 7.62	1.43	1.0	1.9	0.0	3.1	0.0	6.3
Dual Magnum 7.62	1.43	Outlook 6.0	0.60	1.4	2.9	1.3	6.4	0.0	8.0
Goal Tender 4F	0.50	Dual Magnum 7.62	1.43	2.4	0.0	1.0	3.4	2.9	6.4
Goal Tender 4F	0.50	Outlook 6.0	0.60	1.4	0.2	0.0	1.4	3.2	5.4
Outlook 6.0	0.60	Dual Magnum 7.62	1.43	1.0	0.2	0.3	1.4	0.2	4.9
Outlook 6.0	0.60	Outlook 6.0	0.60	2.7	1.5	1.0	5.1	0.9	8.5
Spartan 75DF	0.10	----		10.3	0.8	1.0	12.3	2.5	9.8
Spartan 75DF	0.10	Spartan 75DF	0.10	8.5	0.0	0.0	9.3	2.3	8.8
----	----	Sandea (standard post) NIS	0.047 0.25%	----	----	----	----	----	----
----	----	V-10142 COC	0.10 1.0%	----	----	----	----	----	----
----	----	V-10142 COC	0.20 1.0%	----	----	----	----	----	----
----	----	V-10142 COC	0.30 1.0%	----	----	----	----	----	----
Untreated	---	Untreated	---	46.4	18.2	13.3	85.4	0.0	53.5
LSD (0.05)				12.2	8.8	4.4	8.2	1.3	4.1

Table 3. Weeds ratings¹ of post emergence and phytotoxicity ratings of pre and post emergence treatments on June 19; and time to weed on July 6, 2006

Transplant Application	Lbs a.i./A	Layby Application	Lbs a.i./A	Sow Thistle	Cheno-pods	Night-shade	Purslane	Malva	Phyto	Time to Weed hrs/A
Dual Magnum 7.62	1.43	Dacthal 75W (standard layby)	7.00	----	----	----	----	----	0.3	----
Dual Magnum 7.62	1.43	Dual Magnum 7.62	1.43	----	----	----	----	----	0.0	----
Dual Magnum 7.62	1.43	Outlook 6.0	0.60	----	----	----	----	----	0.3	----
Goal Tender 4F	0.50	Dual Magnum 7.62	1.43	----	----	----	----	----	2.0	----
Goal Tender 4F	0.50	Outlook 6.0	0.60	----	----	----	----	----	2.3	----
Outlook 6.0	0.60	Dual Magnum 7.62	1.43	----	----	----	----	----	0.7	----
Outlook 6.0	0.60	Outlook 6.0	0.60	----	----	----	----	----	0.7	----
Spartan 75DF	0.10	----		----	----	----	----	----	3.3	----
Spartan 75DF	0.10	Spartan 75DF	0.10	----	----	----	----	----	7.3	----
----	----	Sandea (standard post) NIS	0.047 0.25%	5.3	7.3	0.7	1.7	4.7	1.7	13.5
----	----	V-10142 COC	0.10 1.0%	3.7	6.3	0.3	1.0	2.7	0.3	23.5
----	----	V-10142 COC	0.20 1.0%	3.3	6.7	0.0	1.7	3.3	0.3	14.2
----	----	V-10142 COC	0.30 1.0%	4.7	7.7	0.0	2.3	3.7	0.7	17.1
Untreated	---	Untreated	---	----	----	----	----	----	0.0	----
LSD (0.05)				0.9	n.s.	n.s.	1.1	n.s.	1.4	7.9

1 – Weed control scale: 0 = no weed control to 10 weeds completely dead.

Table 4. Number of weeds (30 ft²) on September 5. Evaluation of late season pre and postemergence treatments.

Transplant Application	Lbs a.i./A	Layby Application	Lbs a.i./A	Sow Thistle	Cheno-pods	Night-shade	Purslane	Malva	Total weeds
Dual Magnum 7.62	1.43	Dacthal 75W (standard layby)	7.00	3.0	0.0	0.0	0.0	0.0	3.0
Dual Magnum 7.62	1.43	Dual Magnum 7.62	1.43	0.0	0.0	0.0	0.0	0.0	0.0
Dual Magnum 7.62	1.43	Outlook 6.0	0.60	1.0	0.3	0.0	0.0	0.0	1.3
Goal Tender 4F	0.50	Dual Magnum 7.62	1.43	0.7	0.0	0.0	0.0	0.0	0.7
Goal Tender 4F	0.50	Outlook 6.0	0.60	0.0	0.0	0.0	0.0	0.0	0.0
Outlook 6.0	0.60	Dual Magnum 7.62	1.43	0.0	0.0	0.0	0.0	0.0	0.0
Outlook 6.0	0.60	Outlook 6.0	0.60	0.0	0.0	0.0	0.0	0.0	0.0
Spartan 75DF	0.10	----		2.0	0.0	0.0	0.0	0.0	2.0
Spartan 75DF	0.10	Spartan 75DF	0.10	1.0	0.0	0.3	0.0	0.0	1.3
----	----	Sandea (standard post) NIS	0.047 0.25%	3.0	0.7	1.0	0.0	0.0	4.6
----	----	V-10142 COC	0.10 1.0%	2.3	0.0	1.0	1.3	0.3	5.0
----	----	V-10142 COC	0.20 1.0%	5.0	0.0	0.0	0.0	0.0	5.0
----	----	V-10142 COC	0.30 1.0%	3.7	0.0	0.3	0.3	0.0	4.3
Untreated	---	Untreated	---	3.3	1.0	1.0	0.3	0.3	6.0
LSD (0.05)				1.9	0.9	0.9	0.7	n.s.	2.1

1 – Weed control scale: 0 = no weed control to 10 weeds completely dead.

Table 5. Number (1000's), weight (T/A) and mean fruit weight of red, green, intermediate (turning red), culls and marketable fruit on October 6, 2006

Transplant Application Material a.i./A	Layby Application Material a.i./A	Red No.	Percent No. Red	Red Wt.	Green No.	Green Wt.	Inter No.	Inter Wt.	Cull No.	Cull Wt.	Total Mkt No.	Total Mkt Wt.	Mean Wt. grams
Dual Magnum 1.43	Dacthal	60.54	32.7	10.38	104.54	11.12	23.52	4.01	11.32	1.24	188.62	25.51	125.8
Dual Magnum 1.43	Dual Magnum 1.43	76.23	38.6	12.23	106.72	10.75	23.08	3.98	17.42	1.89	206.04	26.96	119.3
Dual Magnum 1.43	Outlook 0.60	59.67	39.3	9.81	84.07	9.88	14.81	2.37	16.55	6.22	158.56	22.07	128.1
Goal Tender 0.50	Dual Magnum 1.43	57.49	30.8	9.42	111.51	13.06	19.60	3.37	10.45	0.95	188.62	25.85	123.6
Goal Tender 0.50	Outlook 0.60	58.37	32.4	9.86	104.11	13.12	17.86	3.02	12.19	1.17	180.34	26.01	130.3
Outlook 0.60	Dual Magnum 1.43	81.02	41.3	13.36	86.68	9.40	27.87	4.07	8.71	0.89	195.59	26.83	124.9
Outlook 0.60	Outlook 0.60	76.65	45.3	12.16	74.05	8.16	17.42	2.93	14.37	1.52	168.14	23.26	125.8
Spartan 0.10	----	69.26	35.4	10.92	101.49	11.10	29.62	4.78	9.58	1.17	200.38	26.81	121.0
Spartan 0.10	Spartan 0.10	18.73	9.4	3.35	179.47	20.56	12.19	1.65	1.74	0.15	210.40	25.57	110.7
----	Sandea 0.047 NIS 0.25%	68.38	33.9	12.58	118.92	14.62	15.68	3.00	5.22	0.71	202.99	30.21	134.9
----	V-10142 0.10 COC 1.0%	85.81	48.5	13.60	71.87	8.03	19.60	3.02	13.50	1.50	177.29	24.66	125.9
----	V-10142 0.20 COC 1.0%	79.27	41.2	12.92	95.40	9.70	20.90	3.28	12.19	1.30	195.59	25.92	120.7
----	V-10142 0.30 COC 1.0%	94.08	49.1	16.06	78.84	8.46	18.73	3.06	6.08	0.76	191.67	27.60	130.4
Untreated	Untreated	68.38	43.5	10.01	70.56	7.87	17.42	2.48	19.16	1.78	156.38	20.37	118.6
LSD (0.05)		17.57	11.5	2.71	48.53	5.42	12.01	2.04	12.16	3.89	52.27	6.96	17.4

South San Joaquin Valley Evaluations

Table 6: 2006 Fresno Herbicide Study in Peppers. Weed control, Phytotoxicity ratings, and Pepper Yield.

Code	Translant		Layby		May 20 (24 DAT)				July 13 (78 DAT)		August 3 (99 DAT)	
	Application*	Lbs ai/A	Application ⁵	Lbs ai/A	Control Ratings ⁶			Phyto Rating ⁷	Purse Control	Phyto Rating	Brdlf Control	Peppers Lbs/plot
					Brdlf	Grass	Sedge					
1	Dual Magnum 7.62 ¹	1.43	Dacthal 75W	7.00	8.6 c	10.0	10.0	0.5	9.0 a	0.0	9.1 a	40.1 abcd
2	Dual Magnum 7.62 ²	1.43	Dual Magnum 7.62	1.43	9.5 b	10.0	9.5	0.0	9.4 a	0.0	9.7 a	53.4 a
3	Dual Magnum 7.62 ²	1.43	Outlook 6.0	0.60	9.5 ab	10.0	10.0	0.4	9.1 a	0.1	9.6 a	48.9 a
4	Goal Tender 4F ³	0.50	Dual Magnum 7.62	1.43	9.9 ab	9.9	1.0	6.3	9.7 a	0.0	9.1 a	46.1 abc
5	Goal Tender 4F ³	0.50	Outlook 6.0	0.60	9.9 a	10.0	1.0	6.0	9.5 a	0.0	8.6 a	45.9 abc
6	Outlook 6.0 ⁴	0.60	Dual Magnum 7.62	1.43	7.9 d	10.0	9.5	0.5	8.9 a	0.0	8.6 a	47.3 ab
7	Outlook 6.0 ⁴	0.60	Outlook 6.0	0.60	7.5 d	10.0	9.8	0.0	9.0 a	0.0	8.6 a	43.8 abc
8	---	---	Sandea + NIS	0.047 + 0.25%					3.0 cd	1.8	6.1 c	34.9 bcde
9	---	---	V-10142 FL + COC	0.15 + 1.0%					3.5 c	1.0	7.1 bc	24.9 e
10	---	---	V-10142 FL + COC	0.30 + 1.0%					3.3 cd	1.0	7.4 b	32.6 cde
11	---	---	V-10142 WD + COC	0.15 + 1.0%					2.5 d	1.1	6.3 bc	29.8 de
12	---	---	V-10142 WD + COC	0.30 + 1.0%					3.8 c	1.0	7.0 bc	28.4 de
13	---	---	Staple (pyrithiobac) + NIS	0.15 + 1.0%					7.8 b	0.6	8.6 a	32.7 cde
14	Untreated	---	Untreated	---	1.0	1.0	1.0	1.0	1.0 e	2.3	4.0 d	24.7 e
	LSD (0.05)				0.46	0.05	0.73	1.06	0.86	0.98	1.22	13.62

* types of application sprays differed with product and are outlined below

1 - applied as directed spray post transplant; 2 - applied over-the-top post transplant; 3 - applied 9 days prior to transplanting to shaped beds; 4 - applied pre-transplant;

5 - all layby applications were post directed sprays; 6 - weed control ratings (1=no control; 10=very good control; 7 - phytotoxicity ratings (1 = no injury; 10 = dead pepper plants)