

Postemergence Weed Control Studies on Broccoli in the Salinas Valley

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Background: Broccoli and other cole crops have a waxy cuticle on their leaves that can provide a margin of safety for various postemergence weed control applications. For instance, topical applications of liquid fertilizers (i.e. ammonium nitrate and ammonium thiosulfate) kill small weeds but are relatively safe on broccoli. However, the waxy cuticle must be thick enough, and in the winter when cuticle development is minimal, substantial damage can occur to broccoli from topical fertilizer applications. Fertilizer applications provide substantial weed control in broccoli, however they do not effectively control weeds such as Common Purslane (*Portulaca oleracea*). As a result, we were interested in weed control that might be provided by postemergence herbicides. Over the past three years we evaluated the following materials as postemergence herbicides on broccoli: pyridate (Tough – Syngenta), glufosinate (Rely – Bayer), clove oil plus acetic acid (Matran – EcoSmart), ethanmetsulfuron methyl (Muster – Dupont), flumioxazin (Chateau – Valent), carfentrazone (Shark – FMC) and oxyfluorfen (Goal 4F and Goal 2XL – Dow AgroSciences). Many of the materials evaluated in 2001 and 2002 did not have sufficient safety for postemergence use on broccoli and were not evaluated in 2003. Carfentrazone, flumioxazin and oxyfluorfen were further evaluated in 2003.

Methods: Trials were conducted in several locations in the Salinas Valley. Trials were located in cool sites such as Castroville and in warmer locations such as Soledad with cooperating growers in order to examine the impact of cuticle development on crop safety. Plots were 20 feet long by one 40-inch bed wide replicated 4 times. Postemergence applications were applied to 30-35 day old direct seeded broccoli. Materials in all trials were applied 72 gallons of water with two passes of a single-nozzle wand with an 8008E tee jet nozzle at 30 psi pressurized by CO₂.

Results: Carfentrazone and flumioxazin were too phytotoxic on broccoli even if applied as directed sprays and were discontinued from later evaluations in 2003 (data not shown). The 4F formulation of oxyfluorfen is safer than the 2XL formulation for postemergence use on broccoli. For instance, less phytotoxicity was observed with Goal 4F at 0.0625 lb a.i./A than Goal 2XL at the same rate (table 1). Goal 4F provided improved control of Common Purslane at all rates over topical applications of AN20. Each incremental increase in the rate of Goal 4F further improved control of Common Purslane. However, Goal did not provide significantly greater control of Shepherds Purse than the untreated control or AN20 treatments. Increasing the rate of Goal 4F increased phytotoxicity ratings. Directed spray application at 0.0625 lb a.i./A had less phytotoxicity than the over-the-top application at the same rate. Most of the herbicide treatments reduced the yield of the first harvest (table 2). Goal 4F at 0.063 either applied over-the-top or as a directed spray had good total yields. A summary of four trials conducted in 2003 showed that Goal 4F as a directed spray and Goal 2XL at 0.031 had the highest yields (data not shown).

Discussion: Goal 4F, a flowable formulation of oxyfluorfen, is a promising postemergence herbicide for use on broccoli. In the trials conducted in 2002 and 2003 it showed acceptable phytotoxicity at 0.0312 to 0.0625 lb a.i./A; The 0.125 lb a.i. rate also looked promising, but was not consistently safe. Directed sprays improved the safety over over-the-top applications. Goal 4F at 0.0625 lb a.i./A had improved safety over the 2XL formulation at the same rate. However Goal 2XL at 0.0312 lb a.i./A also showed promising safety. Goal 4F provided improved weed control over AN 20 for Common Purslane but not Shepherds Purse in these studies. Postemergence applications on Goal 4F had greater safety on summer-grown broccoli away from the immediate coast. In 2002 we observed unacceptable phytotoxicity of broccoli grown in the Castroville area, presumably due to less cuticle development due to the cool weather. The same phenomena was observed with topical fertilizer applications, however no yield reduction was associated with the observed phytotoxicity for either material. Goal 2XL is registered for pretransplant use on broccoli. Postemergence use of Goal 4F on broccoli is a new use pattern. The 4F formulation of oxyfluorfen was granted an “A” priority at the IR-4 Food Use Workshop in September 2003 and a tolerance for its postemergence use will be developed.

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Table 1. Phytotoxicity, weed counts and weed biomass on August 25, 2003

Treatment	Rate lb ai/A	Material per acre	Application	Phyto*	No. of Weeds/ 8 sq. feet				Total Biomass (g)	
					Purslane	Goosefoot	S.Purse	Other		
Untreated	----	----	----	0.0	32.5	4.8	10.3	2.3	53.3	351.0
Dacthal 75W	7.5	10 lbs	Preemergence	0.0	0.0	0.0	11.3	1.3	15.5	12.8
Ammonium Nitrate	60 gallons	60 gallons	over top	4.0	31.3	1.5	2.5	0.0	38.3	72.5
Oxyfluorfen 4F	0.031	1.0 fl. oz	over top	2.0	20.3	5.3	9.8	1.5	40.8	34.8
Oxyfluorfen 4F	0.063	2.0 fl. oz	over top	3.0	10.3	6.8	10.3	1.0	32.5	31.4
Oxyfluorfen 4F	0.063	2.0 fl. oz	directed	1.0	5.0	4.8	11.5	0.0	22.3	23.2
Oxyfluorfen 4F	0.125	4.0 fl. oz	over top	3.8	0.8	1.5	7.0	0.8	11.0	11.2
Oxyfluorfen 4F	0.25	8.0 fl. oz	over top	4.5	2.8	3.3	8.8	0.0	17.0	13.4
Oxyfluorfen 4F	0.5	16.0 fl. oz	over top	5.3	1.3	2.0	11.8	0.0	16.3	8.3
Oxyfluorfen 2 XL	0.063	4.0 fl. oz	over top	4.8	3.8	2.5	10.0	0.0	19.8	13.4
Oxyfluorfen 2 XL	0.125	8.0 fl. oz	over top	6.3	1.5	3.3	12.8	0.0	18.8	11.6
LSD				1.0	9.0	3.8	9.0	1.4	15.1	60.7

Scale: 0 no crop injury to 10 crop dead

Table 2. Broccoli harvest data

Treatment	Rate lb ai/A	Material per acre	Application	Phyto	Oct. 23		Oct. 27		Oct. 30		Harvest Totals		
					No.	Wt	No.	Wt	No.	No.	No.	Wt	Mean Wt
Dacthal 75W	7.5	10 pounds	Preplant	0.0	3.00	3.30	8.25	4.05	4.25	17.50	7.35	0.6	
Ammonium Nitrate	72 gal	72 gal	over top	4.0	2.75	2.28	7.50	4.00	7.00	18.50	6.08	0.5	
Oxyfluorfen 4F	0.031	1.0 fl. oz	over top	2.0	2.75	1.83	9.00	4.65	7.75	19.50	6.48	0.4	
Oxyfluorfen 4F	0.063	2.0 fl. oz	over top	3.0	3.50	2.33	10.25	4.85	10.00	23.75	7.18	0.4	
Oxyfluorfen 4F	0.063	2.0 fl. oz	directed	1.0	3.50	2.53	10.75	4.75	9.00	23.25	7.28	0.6	
Oxyfluorfen 4F	0.125	4.0 fl. oz	over top	3.8	2.75	1.88	10.00	4.83	6.50	19.25	6.70	0.6	
Oxyfluorfen 4F	0.25	8.0 fl. oz	over top	4.5	2.50	1.68	7.75	3.53	9.25	19.50	5.20	0.4	
Oxyfluorfen 4F	0.5	16.0 fl. oz	over top	5.3	0.50	0.43	7.50	3.45	6.50	14.50	3.88	0.3	
Oxyfluorfen 2 XL	0.063	4.0 fl. oz	over top	4.8	4.50	2.93	7.75	3.83	6.00	18.25	6.75	0.6	
Oxyfluorfen 2 XL	0.125	8.0 fl. oz	over top	6.3	1.00	0.60	8.00	4.43	7.25	16.25	5.03	0.3	
LSD				1.0	2.35	1.5	2.75	1.38	5.33	5.88	1.82	0.33	