Evaluation of Herbicide Programs in Florida Cabbage Production

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Abstract. In Florida, cabbage (*Brassica oleracea* L.) is typically grown without a plastic mulch and as a result, weeds are a significant problem in most fields. Experiments were conducted from Nov. 2015 to Apr. 2016 in Balm, Citra, and Parrish, FL, to evaluate weed control and ‘Bravo’ cabbage tolerance to multiple herbicide programs applied pretransplanting (PRE-T), posttransplanting (POST-T), PRE-T followed by (fb) a sequential application at 3 weeks after transplanting (WATP), and POST-T fb sequential application at 3 WATP. PRE-T herbicide treatments of 277 g a.i./ha clomazone, 280 g a.i./ha oxyfluorfen, and 798 g a.i./ha pendimethalin and POST-T herbicide treatments of 6715 g a.i./ha dimethyl tetrachloroterephthalate (DCPA) were ineffective, and weed control never exceeded 70% in Balm and provided <50% weed control in Citra and Parrish at 6 and 8 WATP, respectively. POST-T applications of napropamide + S-metolachlor at 2242 + 1770 g a.i./ha, DCPA + S-metolachlor at 6715 + 1170 g a.i./ha, and S-metolachlor POST-T fb clopyralid at 1170 g a.i./ha fb 210 g ae/ha were the most effective herbicide treatments and consistently provided >70% weed control. In addition, results showed that all of the herbicide treatments evaluated except the PRE application of clomazone at 277 g a.i./ha are safe for cabbage with no adverse effect on yield.

Cabbage (*B. oleracea* L.) is an important vegetable crop in Florida. In 2010, Florida ranked third nationally in the production of fresh market cabbage accounting for 12.7% of the U.S. total cabbage production (USDA, 2017a). In 2016, cabbage growers in Florida planted 3439 ha fresh market cabbage and harvested 3197 ha, and the average yield was 36,980 kg·ha⁻¹ (USDA, 2017b). Cabbage produced in Florida is exclusively for fresh market with the late fall, winter, and early spring harvests supplying the northern United States (USDA, 2017b).

In Florida, cabbage is typically grown without a plastic mulch and as a result, weeds are a significant problem in most fields. Weed competition may reduce cabbage growth, quality, and yield by competing for nutrients, sunlight, and soil moisture (Al-Khatib et al., 1995; Bhowmik and McGlew, 1986; Hoyt et al., 1996; Webster, 2010). The most common weeds in Florida cabbage production during the peak production period (December through February) are winter annuals such as cutleaf evening primrose (*Oenothera laciniata* Hill.) and wild radish (*Raphanus*

raphanistrum L.). However, in late fall or near the end of harvest in early spring, summer annual broadleaf weeds, such as common lambsquarters (*Chenopodium album* L.), and annual grass species, such as crabgrass (*Digitaria* spp.) and goosegrass [*Eleusine indica* (L.) Gaertn.], can be problematic. Yellow (*Cyperus esculentus* L.) and purple (*Cyperus rotundus* L.) nutsedges are also a serious issue. Because of its small stature, shallow root system, and thin canopy, cabbage seedlings are poor competitors with weeds. Therefore, controlling weeds early in the season is particularly important to maintain crop vigor and yield (Miller and Hopen, 1991; Weaver, 1984).

As with most minor crops, registered herbicides for use in cabbage are limited. Bensulide, clomazone, DCPA, oxyfluorfen, and trifluralin are registered for preplant incorporated application (Zotarelli et al., 2016). Clethodim, clopyralid, DCPA, napropamide, and sethoxydim are registered for over-the-top applications (Zotarelli et al., 2016). S-metolachlor controls annual broadleaf and grass weeds and suppress nutsedge species (Anonymous, 2014; Bellinder et al., 1989; Sikkema et al., 2007). It is registered with a third-party identified label in Florida, and growers need to sign an agreement with the third-party indemnitors. The field half-life of S-metolachlor is generally 15–25 d based on direct bioassay measurements in southern states (Shaner, 2014). Now, most cabbage growers in Florida use a single application of S-metolachlor

immediately after transplant for weed control. However, a single application typically does not provide season-long weed control.

There are few published studies evaluating weed control and cabbage tolerance of herbicides applied PRE-T or POST-T over the top. The objectives of this research were to evaluate weed control and cabbage tolerance to multiple herbicide programs.

Materials and Methods

Experiment description. Three field experiments were conducted from Nov. 2015 to Apr. 2016 in Balm (lat. 27.75°N, long. 82.26°W), Citra (lat. 29.41°N, long. 82.14°W), and Parrish, FL (lat. 27.58°N, long. 82.42°W). Soil at Balm, FL, was Myakka series fine sand (sandy, siliceous, and hyperthermic Aeric Alaquods) with 1.5% organic matter and a pH of 6.0. Soil at Citra was Hague sand (loamy, siliceous, semiacidic, and hyperthermic Arenic Hapludalfs) with 0.8% organic matter and a pH of 6.5. Soil at Parrish, FL, was Manatee series fine sand (coarse-loamy, siliceous, superactive, and hyperthermic Typic Argiaquolls) with 1.2% organic matter and a pH of 6.

Cabbage ‘Bravo’ was transplanted on 20 Nov. 2015, 15 Dec. 2015, and 25 Nov. 2015 in Balm, Citra, and Parrish, respectively, when the transplants had four to five leaves. The plots were fertilized and irrigated throughout the season as per industry standards (Zotarelli et al., 2016). Plots consisted of a single raised bed 7.6-m long and 0.71-m wide with two rows of cabbage per bed. Plants were transplanted 38 cm apart in rows 20 cm apart. The principal broadleaf weeds were carpetweed (*Mollugo verticillata* L.), cutleaf evening primrose, FL pusley (*Richardia scabra* L.), and wild radish in Balm; cudweed (*Gamochaeta* spp.), cutleaf evening primrose, FL pusley, and red sorrel (*Rumex acetosella* L.) in Citra; and cutleaf evening primrose, common purslane (*Portulaca oleracea* L.), and wild radish in Parrish. Goosegrass and purple nutsedge were also present in the experimental area in Citra and Parrish, respectively.

Herbicide treatments were applied with a CO₂-pressurized backpack sprayer calibrated to deliver 280 L·ha⁻¹ of spray volume with a single 8002EVS nozzle (Teejet Technologies, Wheaton, IL) and a pressure of 0.24 MPa. PRE-T treatments included clomazone at 277 g a.i./ha, oxyfluorfen at 280 g a.i./ha, pendimethalin at 798 g a.i./ha, DCPA + pendimethalin at 6715 + 798 g a.i./ha, and oxyfluorfen + pendimethalin at 280 + 798 g a.i./ha (Table 1). PRE-T treatments were applied to the bed top at 1 d before transplanting. POST-T treatments included DCPA at 6715 g a.i./ha, napropamide at 2242 g a.i./ha, S-metolachlor at 1170 g a.i./ha, napropamide + S-metolachlor at 2242 + 1170 g a.i./ha, and DCPA + S-metolachlor at 6715 + 1170 g a.i./ha. POST-T treatments were applied immediately after transplanting. In addition, the PRE-T fb sequential application at 3 WATP included oxyfluorfen at 280 g a.i./ha

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Table 1. Product information of herbicides included in programs for Florida cabbage production.

Herbicide	Trade name	Manufacturer
Clopyralid	Stinger® 3 EC	Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268
Clomazone	Command® 3 ME	FMC Corporation, Agricultural Products Group, Philadelphia, PA 19103
DCPA	Dacthal® 75 WP	AMVAC, 4100 E. Washington Blvd. Los Angeles, CA 90023
Napropamide	Devrinol® 50 DF	United Phosphorus, Inc., 630 Freedom Business Center, Suite 402, King of Prussia, PA 19406
Oxyfluorfen	Goal® 2XL	Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268
Pendimethalin	Prowl® H ₂ O	BASF Corporation, 26 Davis Drive, Research Triangle Park, NC 27709
S-metolachlor	Dual Magnum II®	Syngenta Crop Protection, LLC, Greensboro, NC 27419

fb pendimethalin at 798 g a.i./ha. The POST-T fb sequential application at 3 WATP included S-metolachlor at 1770 g a.i./ha fb pendimethalin at 798 g a.i./ha or clopyralid at 210 g ae/ha. Weed-free treatments were hand-weeded once per week, whereas nontreated control remained undisturbed throughout the growing season.

Data collection. Weeds were counted in a 61 × 71-cm quadrat in each plot at 4, 5, and 13 WATP in Balm, and 2 and 8 WATP in Parrish. Grassy weeds and nutsedge were not counted in Balm because they did not occur at this location. Weed control was visually evaluated in Citra at 2, 4, and 6 WATP on a percent scale where 0 equals no control and 100 equals complete desiccation.

Cabbage injury where 0 represents no injury and 100 represents complete desiccation was evaluated at 2, 4, and 8 WATP at all sites. Five cabbage plants in each plot were randomly selected for measuring height and width. Cabbage height was measured at 6 WATP at all sites. Cabbage width was measured at 10 WATP at Balm and Citra. Cabbage heads were harvested on 8 Mar. and 24 Mar. 2016 in Balm and 21 Mar. and 12 Apr. 2016 at Citra. Cabbage was not harvested at the Parrish location because it was accidentally harvested by a farm crew.

Experimental design and data analysis. Treatments were arranged in a randomized complete block design with four replications at all sites. Weed count data were converted to percentage of control. Data were analyzed in SAS (version 9.2; SAS Institute, Inc., Cary, NC) using the PROC GLM. Data were checked for normality and constant variance before analysis. Logarithmic transformation was used when needed to normalize the data. Nontransformed data are presented. Treatment means were compared using the least squares means statement in SAS with the Tukey adjustment at $P = 0.05$. Data collected on multiple dates, such as weed control and cabbage yield, were analyzed using the repeated statement.

Results and Discussion

Weed control. The treatment by date interaction was significant at all sites and as a result, the weed control data are presented separately by date (Table 2). In Balm, POST-T application of S-metolachlor, napropamide + S-metolachlor, and DCPA + S-metolachlor provided $\geq 75\%$ weed control throughout the growing season (Table 2). Sequential treatments included oxyfluorfen PRE-T fb pendimethalin 3 WATP and S-metolachlor POST-T fb pendimethalin

3 WATP initially provided $<70\%$ weed control at 4 WATP. However, these treatments were more effective at the end of growing season and provided 90% and 89% weed control at 13 WATP, respectively. S-metolachlor POST-T fb clopyralid 3 WATP provided $>75\%$ weed control throughout the growing season. The PRE-T application of clomazone, oxyfluorfen, and pendimethalin, as well as the POST-T application of DCPA and napropamide were less effective and weed control never exceeded 70%.

In Citra, POST-T application of napropamide, napropamide + S-metolachlor, and DCPA + S-metolachlor, and PRE-T application of oxyfluorfen + pendimethalin, as well as the sequential treatment of S-metolachlor POST-T fb clopyralid provided $>70\%$ weed control at all ratings (Table 2). POST-T application of S-metolachlor fb clopyralid 3 WATP was the most effective treatment and provided $\geq 84\%$ weed control at all ratings. PRE-T application of clomazone at 277 g·ha⁻¹ and DCPA + pendimethalin at 6715 + 798 g·ha⁻¹ initially provided $>70\%$ weed control at 2 WATP but control declined to $<45\%$ at 4 and 6 WATP. PRE-T application of pendimethalin and POST-T application of DCPA were less effective and weed control never exceeded 70%.

In Parrish, broadleaves and nutsedges were counted separately at 2 WATP. PRE-T application of oxyfluorfen and DCPA + pendimethalin, and POST-T application of DCPA + S-metolachlor, as well as sequential treatment of S-metolachlor fb pendimethalin provided $\geq 95\%$ control of broadleaf weeds. POST-T application of S-metolachlor, napropamide + S-metolachlor, and DCPA + S-metolachlor provided $>80\%$ control of nutsedges. Sequential treatments included S-metolachlor POST-T fb pendimethalin 3 WATP and S-metolachlor POST-T fb clopyralid 3 WATP provided 90% and 71% control of nutsedges, respectively. POST-T application of napropamide + S-metolachlor and DCPA + S-metolachlor provided 78% and 76% weed control at 8 WATP (Table 2). Sequential herbicide treatments included S-metolachlor POST-T fb pendimethalin 3 WATP and S-metolachlor POST-T fb clopyralid 3 WATP provided 81% and 92% weed control at 8 WATP. The other herbicide treatments were less effective and weed control never exceeded 70% at 8 WATP.

In summary, the POST-T application of napropamide + S-metolachlor and DCPA + S-metolachlor, and sequential treatment of S-metolachlor fb clopyralid were the most effective herbicide treatments because they

consistently provided $>70\%$ weed control across sites. In addition, PRE-T application of oxyfluorfen, POST-T application of napropamide and S-metolachlor, and PRE-T application of DCPA + pendimethalin, as well as sequential treatments of oxyfluorfen fb pendimethalin and S-metolachlor fb pendimethalin were less effective but consistently suppressed weeds across all sites.

A single PRE-T or POST-T application of clomazone, oxyfluorfen, pendimethalin, DCPA, and napropamide did not provide a season-long weed control. A single POST-T application of S-metolachlor was effective in Balm, but this treatment was less effective and provided poor weed control by the end of growing season in Citra and Parrish. This response is not surprising because weeds germinate throughout the growing season, but herbicides break down over time in the soil (Choi et al., 1988; Das et al., 2003; Gillespie et al., 2011; Shaner, 2014). As a result, sequential herbicide applications generally resulted in better weed control compared with a PRE-T-only or POST-T-only application program.

In previous research, Al-Khatib et al (1995) evaluated the control of broadleaf weeds, including common lambsquarters (*C. album* L.), common chickweed [*Stellaria media* (L.) vill], hedge mustard [*Sisymbrium officinale* (L.) Scop.], pineapple weed [*Matricaria matricarioides* (less.) Porter], shepherd's purse [*Capsella bursa-pastoris* (L.) Medic.], and redroot pigweed (*Amaranthus retroflexus* L.), with clopyralid, trifluralin, oxyfluorfen, pendimethalin, primate, and S-metolachlor in cabbage grown for seed and found that no single herbicide controlled these broadleaf weeds adequately, with the exception of pendimethalin at 1.92 and 3.84 kg·ha⁻¹, but the combinations of trifluralin + oxyfluorfen, pendimethalin + clopyralid, and oxyfluorfen + pyridate provided effective control. In the present study, improved weed control observed with combinations might be due to the complementary weed control spectrum of each herbicide in the combinations.

Cabbage injury and productivity. Results of variance analysis showed that the site effect was significant (<0.0001) for cabbage injury, height, width, total count, and cumulative yield, and thus, data are presented separately by site. The treatment by time interaction was not significant in any site and as a result, cumulative cabbage counts and yields are presented, whereas cabbage injury, height, and width data are averaged across dates.

In Balm, all herbicide treatments were safe on cabbage and injury never exceeded

Table 2. Weed control with herbicide programs in cabbage in three field experiments conducted from Nov. 2015 to Apr. 2016 in Balm, Citra, and Parrish, FL.

Herbicide	Timing	Rate ^a (g a.i./ha)	Balm			Citra			Parrish		
			4 WATP	5 WATP	13 WATP	2 WATP	4 WATP	6 WATP	2 WATP	2 WATP	8 WATP
			Weed control (%)			Weed control (%)			control (%)		
Nontreated			0 d (—)	0 b (—)	0 (—)	0 h (—)	0 g (—)	0 g (—)	0 b (—)	0 b (—)	0 b (—)
Weed free			100 a (—)	100 a (—)	100 a (—)	100 a (—)	100 a (—)	100 a (—)	100 a (—)	100 a (—)	100 a (—)
Clomazone	PRE-T	277	-5 d (C)	29 ab (A)	63 a-c (AB)	75 e (BC)	40 e (B)	30 d-f (CD)	29 ab (A)	17 ab (A)	20 a (A)
Oxyfluorfen	PRE-T	280	18 b-d (A-C)	95 a (A)	53 a-c (AB)	94 ab (A)	78 b-d (A)	41 de (B-D)	95 a (A)	32 ab (A)	27 a (A)
Pendimethalin	PRE-T	798	4 cd (B-C)	50 ab (A)	50 a-c (AB)	63 fg (CD)	35 e (B)	17 e-g (D)	50 ab (A)	41 ab (A)	32 a (A)
DCPA	POST-T	6,715	33 a-d (A-C)	33 ab (A)	69 a-c (AB)	58 g (D)	23 f (B)	8 fg (D)	33 ab (A)	40 ab (A)	46 a (A)
Napropamide	POST-T	2,242	32 a-d (A-C)	75 ab (A)	46 b-d (AB)	92 bc (A)	77 cd (A)	70 bc (A-C)	75 ab (A)	35 ab (A)	21 a (A)
S-metolachlor	POST-T	1,770	84 ab (A)	91 a (A)	83 ab (AB)	87 b-d (AB)	71 d (A)	42 de (B-D)	91 a (A)	81 ab (A)	66 a (A)
DCPA + pendimethalin	PRE-T	6,715 + 798	29 a-d (A-C)	95 a (A)	84 ab (AB)	70 ef (CD)	41 e (B)	37 de (B-D)	95 a (A)	61 ab (A)	32 a (A)
Oxyfluorfen + pendimethalin	PRE-T	280 + 798	39 a-d (A-C)	74 ab (A)	34 cd (B)	88 b-d (A)	77 cd (A)	83 ab (AB)	74 ab (A)	30 ab (A)	43 a (A)
Oxyfluorfen fb pendimethalin	PRE-T fb 3 WATP	280 fb 798	33 a-d (A-C)	71 ab (A)	90 ab (A)	85 d (AB)	88 b (A)	90 ab (A)	71 ab (A)	14 ab (A)	11 a (A)
Napropamide + S-metolachlor	POST-T	2,242 + 1,770	84 ab (A)	87 ab (A)	86 ab (A)	85 d (AB)	72 d (A)	73 bc (A-C)	87 ab (A)	81 ab (A)	78 a (A)
DCPA + S-metolachlor	POST-T	6,715 + 1,770	75 a-c (A-B)	99 a (A)	75 a-c (AB)	85 d (AB)	76 cd (A)	80 ab (AB)	99 a (A)	84 ab (A)	76 a (A)
S-metolachlor fb pendimethalin	POST-T fb 3 WATP	1,770 fb 798	65 a-d (A-C)	99 a (A)	89 ab (A)	86 cd (AB)	80 b-d (A)	50 cd (A-D)	99 a (A)	90 ab (A)	81 a (A)
S-metolachlor fb clopyralid	POST-T fb 3 WATP	1,770 fb 210	76 a-c (AB)	77 ab (A)	83 a-c (AB)	90 b-d (A)	84 bc (A)	84 ab (AB)	77 ab (A)	71 ab (A)	92 a (A)

Different lowercase letters within columns denoted significant difference for treatments that included nontreated and weed-free controls by Tukey tests at 0.05 *P*; different uppercase letters within columns indicated significant difference for treatments that excluded nontreated and weed-free controls by Tukey tests at 0.05 *P*.

^aClopyralid rate is listed as g ae/ha.

PRE-T = pretransplanting; POST-T = posttransplanting; fb = followed by; WATP = weeks after transplanting.

1% (Table 3). In Citra, clomazone injured cabbage 64%, whereas all other herbicide treatments injured cabbage <5%. In Parrish, POST-T application of DCPA, and sequential application of oxyfluorfen PRE fb pendimethalin 3 WATP, and S-metolachlor POST-T fb clopyralid 3 WATP injured cabbage the most, but injury never exceeded 11%. All other herbicide treatments injured cabbage ≤9%. In addition, individual cabbage head height and diameter were not significantly affected by herbicide treatments (data not shown).

Al-Khatib et al (1995) reported that the PRE-T application of pendimethalin, trifluralin, and oxyfluorfen and POST-T application of clopyralid and metolachlor caused transitory cabbage injury. The authors also noted that sequential treatments included PRE-T fb POST-T treatments of oxyfluorfen fb clopyralid and pendimethalin fb clopyralid injured cabbage <7% by 70 d after initial treatment. Bhowmik and McGlew (1986) noted that PRE-T application of oxyfluorfen alone at 430 g·ha⁻¹ or fb sequential post-emergence grass herbicides provided effective weed control without negative effects on cabbage yield and quality. Our results indicated that treatments including S-metolachlor POST-T application is safe on cabbage without harmful effect on cabbage yield. A field research trial conducted in Ontario, Canada, showed that S-metolachlor applied PRE-T and POST-T at 800, 1600, and 2400 g·ha⁻¹ had an acceptable level of crop safety in cabbage (Sikkema et al., 2007).

There were no significant differences among herbicide treatments and the weedy and weed-free checks for the number of cabbage heads harvested and cumulative yield in Balm. In Balm, the cumulative cabbage head and yield averaged across treatments were 32,117 number/ha and 67,635 kg·ha⁻¹, respectively (Table 3). In Citra, the lowest cumulative cabbage yield was obtained with the clomazone treatment. There was no cabbage harvested from the plots treated with PRE-T application of clomazone. The other herbicide treatments were not significantly different from the weed-free checks. Overall, although several herbicide treatments injured cabbage, the injury was temporary and did not significantly reduce total head count and yield compared with weed-free plots, except the treatment of clomazone.

It is important to note that the PRE-T application of clomazone might be safe for other cabbage varieties. Hopen et al (1993) examined 36 cabbage varieties with differential genetic makeup and found that the cabbage varieties 'Bravo', 'Cheers', and 'Genesis' developed the most severe chlorosis symptoms, whereas the other varieties such as 'Bently', 'Carlton', and 'Cecile' had the least chlorosis following clomazone at 600 and 1100 g a.i./ha. In the present study, inconsistent cabbage damage across sites by clomazone might be attributed to different environments (Hopen et al.,

Table 3. Cabbage injury and yield following herbicide treatments in three field experiments conducted from Nov. 2015 to Apr. 2016 in Balm, Citra, and Parrish, FL.

Herbicide	Timing	Rate ^a (g a.i./ha)	Visual injury			Head count			Yield	
			Balm	Citra	Parrish	Balm	Citra	Balm	Citra	
			(%)			(no./ha)			(kg·ha ⁻¹)	
Nontreated			0 a (—)	0 c (—)	0 a (—)	29,575 a (—)	19,749 a-c (—)	58,190 a (—)	18,299 b (—)	
Weed-free			0 a (—)	0 c (—)	0 a (—)	35,582 a (—)	22,442 a (—)	85,545 a (—)	27,547 ab (—)	
Clomazone		277	0 a (A)	64 a (A)	1 a (A)	35,582 a (A)	0 d (B)	72,887 a (A)	0 c (B)	
Oxyfluorfen	PRE-T	280	0 a (A)	1 c (B)	0 a (A)	36,505 a (A)	23,788 a-c (A)	77,833 a (A)	28,150 ab (A)	
Pendimethalin	PRE-T	798	0 a (A)	0 c (B)	0 a (A)	31,423 a (A)	29,623 a (A)	62,639 a (A)	34,440 a (A)	
DCPA	POST-T	6,715	0 a (A)	0 c (B)	11 a (A)	26,802 a (A)	23,329 a-c (A)	57,589 a (A)	27,764 ab (A)	
Napropamide	POST-T	2,242	0 a (A)	1 c (B)	5 a (A)	33,743 a (A)	21,095 a-c (A)	74,186 a (A)	24,527 ab (A)	
S-metolachlor	POST-T	1,770	0 a (A)	2 bc (B)	9 a (A)	32,810 a (A)	15,709 c (A)	68,486 a (A)	18,482 b (A)	
DCPA + pendimethalin	PRE-T	6,715 + 798	0 a (A)	0 c (B)	8 a (A)	33,272 a (A)	18,402 bc (A)	7,058 a (A)	17,159 b (A)	
Oxyfluorfen + pendimethalin	PRE-T	280 + 798	1 a (A)	0 c (B)	5 a (A)	31,423 a (A)	26,930 ab (A)	58,915 a (A)	33,463 a (A)	
Oxyfluorfen fb pendimethalin	PRE-T fb 3 WATP	280 fb 798	1 a (A)	1 c (B)	10 a (A)	32,348 a (A)	18,402 bc (A)	68,863 a (A)	26,597 ab (A)	
Napropamide + S-metolachlor	POST-T	2,242 + 1,770	0 a (A)	2 bc (B)	8 a (A)	3,096 a (A)	16,607 c (A)	64,840 a (A)	18,889 b (A)	
DCPA + S-metolachlor	POST-T	6,715 + 1,770	1 a (A)	4 b (B)	7 a (A)	32,348 a (A)	16,605 c (A)	64,169 a (A)	18,686 b (A)	
S-metolachlor fb pendimethalin	POST-T fb 3 WATP	1,770 fb 798	0 a (A)	0 c (B)	2 a (A)	34,658 a (A)	20,197 a-c (A)	71,336 a (A)	23,347 ab (A)	
S-metolachlor fb clopyralid	POST-T fb 3 WATP	1,770 fb 210	0 a (A)	1 c (B)	10 a (A)	27,726 a (A)	19,749 a-c (A)	58,469 a (A)	19,663 b (A)	

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