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Weed Control Studies on Selected Vegetable Crops in South Texas

Lynn Brandenberger[1], Bob Wiedenfeld[2] and Brad Minton[3]

[1]Texas Agricultural Extension Service
[2]Texas Agricultural Experiment Station
Texas A&M Research and Extension Center, 2401 East Highway 83, Weslaco, TX 78596
[3]Novartis Crop Protection, Inc. Southern Regional Office 5950 Fairview Rd., Ste 716, Charlotte, NC 28210

ABSTRACT

Previous work indicated that Metolachlor has potential for use with several vegetable crops, but preliminary data was needed to begin work on new labeling. Field studies utilizing Metolachlor preemergent herbicide were initiated to determine the efficacy and safety of this material for weed control with several vegetable crops in the Lower Rio Grande Valley of Texas. Two studies were conducted on direct seeded pepper, and one study each was conducted with transplanted celery, direct seeded cabbage and onion. Results from the studies indicate that Metolachlor has potential for use in weed control for direct seeded pepper, cabbage and onions when used as a lay by treatment following crop emergence, but further study is needed to determine its efficacy on selected weed species. The results also indicate that celery in South Texas is sensitive to Metolachlor which responded to the material with yellowing foliage and stunted growth.

RESUMEN

Investigación anterior indicó que Metolachlor tiene potencial para usarse en el cultivo de varias hortalizas pero eran necesarios datos preliminares para empezar a trabajar en una nueva clasificación. Se iniciaron estudios de campo en los que se usó herbicida preemergente Metolachlor para determinar la eficacia y las condiciones de seguridad del uso de este material para el control de malezas en varias hortalizas en la parte baja del Valle del Río Grande en Texas. Se condujeron dos estudios en chile, uno en repollo y otro en cebolla plantados directamente de semilla, y un estudio con apio transplantado. Los resultados de los estudios sugieren que Metolachlor tiene potencial para ser usado en el control de malezas de chile, repollo y cebolla sembrados directamente de semilla cuando se usa como un tratamiento aplicado después de la emergencia del cultivo, pero se necesitan más estudios para determinar su eficacia sobre especies de malezas selectas. Los resultados también indican que el apio en el sur de Texas es sensible a Metolachlor ya que respondió a la aplicación del material con amarillamiento del follaje y enanismo.

Additional Index words. Efficacy, phytotoxicity, Metolachlor, preemergence, weed control, vegetable, herbicide, pepper, celery, cabbage, onion.

Weed control in various vegetable crops is one of the most limiting factors that commercial vegetable producers face. In a recent survey of melon growers (Riley et al., 1997) weed control was listed as the most serious problem facing producers of this crop. Poor control of weeds reduces yield and can particularly affect young seedlings (Glaze, 1988). Management of weeds is often limited because of a lack of herbicides labeled for use on vegetables (Masiunas and Weller, 1989). Within the last several years the number of herbicides available for use on vegetable crops have been reduced, resulting in fewer labeled herbicides for use in these crop production systems. Research and result demonstrations in South Texas on weed control in vegetable crops has also lagged, further reducing the possibility of providing data to support new labeling of compounds for weed control.

One of the problems inherent in adopting new chemistries for weed management is the initial lack of data relating to the efficacy and phytotoxic effects of a given material. Therefore studies were conducted to determine the efficacy of Metolachlor (Dual, Novartis Crop Protection Inc. Charlotte, NC 28210) preemergent herbicide for the control of weeds in commercial vegetable crops and to determine what phytotoxic effects to the crop may occur from its use.

MATERIALS AND METHODS

Five different field studies were carried out on four different vegetable crops utilizing Dual[1] preemergent herbicide in the Lower Rio Grande Valley of Texas during the fall of 1996. Of these five studies, two were completed with direct seeded bell pepper and one each with direct seeded cabbage and onion and transplanted celery.

Each study was located in Hidalgo County, Texas except the onion study which was conducted in Starr County, Texas. Soil types ranged from various loams for cabbage, celery, and onion to silty clays for both pepper studies (Table 1). The studies were completed in commercial fields and each site utilized the same cultural practices as the crop in the adjacent field including weed control programs. Furrow irrigation was used

Table 1. Fall 1996 Dual herbicide studies; site, soil types, establishment, cultivar, spacings and treatment dates.

Crop	Site	Soil type	Crop Establishment	Cultivar	Spacing	Treatment date
Pepper	Duda Texas	Cameron silty clay	Direct seeded on 7-10-96	Valiant	Single rows	8-21-96
Pepper	Plantation	Runn silty clay	Direct seeded on 7-4-96	Valiant	Double rows	8-21-96
Cabbage	Duda Texas	Hidalgo sandy clay loam	Direct seeded on 10-1-96	Cheers	Double rows	10-23-96
Celery	Duda Texas	Hidalgo sandy clay loam	Transplanted on 9-13-96	Tall Utah	Double rows	9-19-96
Onion	Starr Produce	Rio Grande silt loam	Direct seeded on 10-15-96	Linda Vista	Double rows	11-12-96

Table 2. Fall 1996 Dual herbicide trial at Duda Texas Inc., phytoxicity and efficicacy data for direct seeded peppers.

	September 4	September 14	September 23		October 4		Overall average	
Dual rate k a.i ha^{-1}	Phytotoxicity % damage[x]	Phytotoxicity % damage	Phytotoxicity % damage	% weed coverage[y]	Phytotoxicity % damage	%weed coverage	Phytotoxicity % damage	%weed coverage
No Dual	0.0	0.0	0.0	10.0	0.0	17.6	0.0 c[z]	16.0
Dual 0.28	0.9	0.9	0.0	20.0	0.0	12.2	0.54 a	13.8
Dual 0.42	0.1	0.1	0.0	20.0	0.0	18.8	0.1 bc	19.0
Dual 0.56	0.0	0.0	0.0	15.0	0.0	16.2	0.0 c	16.0
Dual 0.84	0.0	0.0	0.0	20.0	0.0	15.0	0.0 c	16.0
Dual 1.12	0.0	0.0	0.0	20.0	0.0	17.0	0.0 c	17.6
Dual 1.68	0.6	0.6	1.0	20.0	0.0	14.8	0.46 ab	15.8

[x] Phytotoxicity % damage = the estimated percent damage to the crop compared to the untreated check.

[y] % weed coverage = the estimated percentage of soil surface between crop rows covered by weed growth.

[z] Numbers in a column followed by the same letter exhibited no significant differences, based on Duncan's Multiple Range Test where P=0.05.

Table 3. Fall 1996 Dual herbicide trial at Plantation Produce Inc., phytoxicity and efficicacy data for direct seeded peppers.

	September 4	September 14	September 23		October 4		Overall average	
Dual rate Kg a.i ha^{-1}	Phytotoxicity % damage[x]	Phytotoxicity % damage	Phytotoxicity % damage	% weed coverage[y]	Phytotoxicity % damage	%weed coverage	Phytotoxicity % damage	%weed coverage
No Dual	0.0	0.4	0.0	28.8	0.0	17.0	0.1 b[z]	22.8 a
Dual 0.28	0.0	0.0	0.0	20.0	0.0	05.2	0.0 b	12.6 b
Dual 0.42	0.3	0.5	0.0	16.2	0.0	06.8	0.2 b	11.6 b
Dual 0.56	0.3	0.1	0.3	17.6	0.0	07.2	0.0 b	12.4 b
Dual 0.84	0.0	0.0	0.0	10.0	0.0	04.8	0.0 b	07.4 b
Dual 1.12	1.8	1.9	0.1	13.8	0.0	08.6	0.9 ab	11.2 b
Dual 1.68	3.8	2.5	0.1	17.6	0.0	04.8	1.6 a	11.2 b

[x] Phytotoxicity % damage = the estimated percent damage to the crop compared to the untreated check.

[y] % weed coverage = the estimated percentage of soil surface between crop rows covered by weed growth.

[z] Numbers in a column followed by the same letter exhibited no significant differences, based on Duncan's Multiple Range Test where P=0.05.

exclusively for the cabbage and onion studies. The Plantation pepper site used drip irrigation and the Duda Texas pepper and celery sites utilized overhead sprinkler irrigation for crop establishment followed by furrow irrigation.

The pepper and celery studies utilized six different rates of metolachlor and a check which received no herbicide treatment. Cabbage and onion studies utilized five rates of metolachlor and also included an un-treated check. Plots were 5m long by 1.7m wide (two beds wide). Treatments were applied as an over the top application with a hand held spray boom at an overall rate of 72 liters ha^{-1} of spray material on each application date. Each site was treated when plants were in the four to six leaf stage of growth.

Efficacy and phytotoxicity data were recorded a minimum of two times up to a maximum of four times for some crops in the studies. Efficacy was recorded as the percentage of the soil surface between crop rows covered by weed growth and phytotoxicity was recorded as the percentage of damage to the

crop compared to the untreated check.

The trials were arranged in randomized block designs with four replications and data were analyzed using Analysis of Variance and Duncan's multiple range test with P=0.05.

RESULTS

Efficacy varied significantly between treatments in two of the five studies conducted. In the pepper study at Plantation Produce and the celery study, treatments that utilized metolachlor had a significantly lower percent weed coverage compared to the untreated check in the overall average (Tables 3, 4). The untreated check in the Plantation Produce pepper study had an overall percent weed coverage of 22.8% compared to 12.6, 11.6, 12.4, 7.4, 11.2 and 11.2% for the 0.28, 0.42, 0.56, 0.84, 1.12, and 1.68 Kg a.i. ha^{-1} rates of metolachlor, respectively (Table 3). In the celery study, the untreated check had a significantly higher percent weed coverage for both the October 10 rating and for the overall average compared to all Metolachlor treatments (Table 4). The untreated check had 2.1% overall weed coverage compared to 1.3% for the 0.84 Kg a.i. ha^{-1} rate of metolachlor which was the next highest rating for overall percent weed coverage.

Metolachlor caused only 0.5% pepper crop injury at 0.28 and 1.68 Kg a.i. ha^{-1} in the Duda study (Table 2) and 0 and 1.6% crop injury in the Plantation Produce study (Table 3).

Table 4. Fall 1996 Dual herbicide trail, phytotoxicity and efficacy data for transplanted celery.

	October 10		October 23		Overall average	
Dual rate Kg a.i ha^{-1}	Phytotoxicity % damage[x]	% weed coverage[z]	Phytotoxicity % damage	% weed coverage	Phytotoxicity % damage	%weed coverage
No Dual	1.2c[y]	3.3 a	06.1 d	0.9	03.7 c	2.1 a
Dual 0.28	2.8 bc	1.6 bc	09.5 cd	0.6	06.1 bc	1.1 bc
Dual 0.42	3.1 bc	1.8 b	09.5 cd	0.7	06.3 bc	1.3 b
Dual 0.56	5.1 ab	0.6 cd	14.5 bc	0.6	09.8 bc	0.6 bc
Dual 0.84	5.1 ab	0.8 cd	15.8 bc	0.4	10.4 abc	0.6 bc
Dual 1.12	6.6 a	0.3 d	18.0 b	0.3	12.3ab	0.3 c
Dual 1.68	7.1 a	0.6 cd	28.8 a	0.3	17.9 a	0.4 bc

[x] Phytotoxicity % damage = the estimated percent damage to the crop compared to the untreated check.

[y]Numbers in a column followed by the same letter exhibited no significant differences, based on Duncan's Mltiple Range Test where P=0.05

[z] % weed coverage = the estimated percentage of soil surface between crop rows covered by weed growth.

Table 5. Fall 1996 Dual herbicide trial, phytotoxicity and efficacy data for direct seeded cabbage.

	November 8		November 18		December 4		Overall average	
Dual rate Kg a.i ha^{-1}	Phytotoxicity % damage[x]	% weed coverage[y]	Phytotoxicity % damage	% weed coverage	Phytotoxicity % damage	% weed coverage	Phytotoxicity % damage	% weed coverage
No Dual	0.3	2.3	0.5	0.1	0.6	0.0	0.5	0.8
Dual 0.28	0.0	1.0	0.1	0.0	1.6	0.0	0.6	0.4
Dual 0.42	0.0	1.0	0.0	0.2	0.3	0.0	0.1	0.4
Dual 0.56	0.3	1.0	0.0	0.1	0.6	0.1	0.3	0.4
Dual 0.84	0.0	1.0	0.0	0.1	0.0	0.0	0.0	0.4
Dual 1.12	0.0	1.3	0.8	0.2	0.3	0.0	0.3	0.5

[x] Phytotoxicity % damage = the estimated percent damage to the crop compared to the untreated check.

[y] % weed coverage = the estimated percentage of soil surface between crop rows covered by weed growth.

Table 6. Fall 1996 Dual herbicide trial, phytotoxicity and efficacy data for direct seeded onions.

	November 26		December 3		December 13		Overall average	
Dual rate Kg a.i ha^{-1}	Phytotoxicity % damage[x]	% weed coverage[y]	Phytotoxicity % damage	% weed coverage	Phytotoxicity % damage	% weed coverage	Phytotoxicity % damage	% weed coverage
No Dual	0.0	3.3	0.5	0.2	0.5	0.1	0.4	1.2
Dual 0.28	0.3	2.8	0.5	0.2	1.5	0.2	0.8	1.1
Dual 0.42	0.0	3.0	0.0	0.2	0.0	0.1	0.0	1.1
Dual 0.56	0.5	1.3	1.5	0.1	2.5	0.1	1.5	0.5
Dual 0.84	0.5	1.8	1.8	0.1	1.8	0.2	1.3	0.7
Dual 1.12	0.3	1.0	0.5	0.1	1.3	0.1	0.7	0.4

[x] Phytotoxicity % damage = the estimated percent damage to the crop compared to the untreated check.

[y] % weed coverage = the estimated percentage of soil surface between crop rows covered by weed growth.

Phytotoxic effects to the celery crop manifested itself as yellowing of plant foliage and severe stunting. Percent damage was significantly higher for most metolachlor treatments compared to the untreated check for each rating and for the overall average in the celery study(Table 4). On October 10 and 23 the untreated check had percent damage of 1.2 and 0.6%, respectively, compared to 7.1 and 28.8%, for the 1.68 Kg a.i. ha^{-1} rate of metolachlor. Metolachlor at the 1.12, and 1.68 Kg a.i. ha^{-1} rates had overall percent damage of 12.3 and 17.9%, respectively, compared to the untreated check which had 3.7% overall damage.

DISCUSSION

Each of the five field studies were located in a commercial field and was in addition to the existing weed control program that a particular producer already had in place. As a result, the response of a given location for improved weed control from the use of metolachlor generally was much less than would normally be expected. There were instances of improved weed control from the use of metolachlor in both peppers and celery; and with all the crops tested, plots with metolachlor generally had less weed growth than untreated ones.

In the cabbage and onion studies no significant differences were found between treatments for either efficacy or phytotoxicity. The overall average phytotoxicity in both of these studies was relatively low as were the amounts of weed coverage. The data indicates that metolachlor has low potential for causing damage to either cabbage or onions, but further studies will be needed to determine the effectiveness of this material for weed control.

Generally metolachlor treatments caused very little damage to peppers, cabbage or onions. For a majority of the treatments overall average damage was less than 1% with two of the higher rates resulting in 1.5 to 1.6% damage. These results would indicate that this material is relatively safe for use on these crops, but use of metolachlor for weed control in celery does not appear to be very plausible. In celery, all treatments with metolachlor resulted in severe yellowing of plant foliage and in stunting of the crop. The results of this study indicate that metolachlor preemergent herbicide has potential for use in weed control for direct seeded pepper, cabbage and onions when used as a lay by treatment following crop emergence, but further study is needed to determine its effectiveness.

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