Cooperative Extension University of California Riverside County

DESERT AG-NOTES

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In this Issue:

- **WEED MANAGEMENT SYSTEMS FOR LETTUCE**
- **MARKETING ALTERNATIVES AND NICHES**

PROJECT TITLE: WEED MANAGEMENT SYSTEMS FOR LETTUCE

PRINCIPAL INVESTIGATORS:

Steven A. Fennimore
Dept. of Vegetable Crops and Weed Science
U.C., Davis
Salinas, CA

Jose Aguiar
University of California
Cooperative Extension
Riverside County
Indio, CA

COOPERATING PERSONEL:

Jose Valdez, Jaime Saavedra and Kathy Roth
Dept. of Vegetable Crops and Weed Science
U.C., Davis
Salinas, CA

Beiquan Mou
USDA-ARS
Salinas, CA

SUMMARY

Field and lab studies were undertaken to evaluate four aspects of lettuce weed management. In the **first series**, field studies were conducted to evaluate the safety of herbicides on lettuce germplasm from the University of Idaho. The conventionally bred Idaho germplasm was reported to be tolerant to sulfonylurea herbicides. Preemergence and postemergence applications of Pursuit and Raptor as well as preemergence applications of Maverick and Upbeet were found to be safe on the Idaho germplasm. In a **second experiment**, we evaluated treatments to improve nutsedge control in fallow ground prior to lettuce planting. Nutsedge control was better where lettuce was planted in plots previously treated with sequential applications of Telone C35 followed by Eptam, compared to plots treated with Eptam alone. In our **third experiment series**, we examined whether high magnesium in irrigation water might contribute to poor weed control from Kerb. Under certain circumstances, such as high levels of irrigation, Kerb herbicide can be washed from the upper soil layer resulting in poor weed control. We did not detect large effects of magnesium on Kerb soil mobility. In the **fourth trial series**, Treflan applied post plant preemergence was evaluated as a potential lettuce herbicide. Treflan at 1 pint per acre was as safe to lettuce as Kerb, but at 2 pints per acre Treflan reduced lettuce stand.

OBJECTIVES:

A. Evaluate the tolerance of Idaho lettuce germplasm to selected imidazolinone (IMI) and sulfonylurea (SU) herbicides
B. Evaluate improved nutsedge management systems for lettuce
C. Magnesium salt effect on Kerb soil mobility
D. Evaluate the crop safety of Treflan on lettuce

PROCEEDURES AND RESULTS

A. Evaluate the tolerance of Idaho lettuce germplasm to selected IMI and SU herbicides.

Introduction

Prickly lettuce (*Lactuca serriola*), a weed that had developed tolerance to SU herbicides in northern Idaho wheat fields, was used by researchers at the University of Idaho to confer SU herbicide tolerance into domestic butterhead lettuce by conventional breeding methods. This SU tolerant lettuce germplasm will be referred to here as the "Idaho germplasm". Project collaborator Dr. Beiquan Mou, USDA-ARS Salinas, CA acquired a sample of the Idaho germplasm and has begun efforts to develop commercial lettuce breeding lines from this germplasm. The objective of this work was to evaluate the tolerance of Idaho lettuce germplasm to pre- and postemergence applications of selected herbicides compared with commercial butterhead lettuce.

Methods

A field trial was initiated on Aug. 4, 2003 at Spence Farm near Salinas, CA when Idaho germplasm and 'sharpshooter' iceberg lettuce (standard variety) were planted on a loamy sand soil, with 1.0 % organic matter and pH 7.2. A preemergence (PRE) herbicide application of Kerb at 1.2 lb/A was applied on Aug. 5, 2003. Postemergence (POST) applications of Matrix at 0.031 lb/A, Maverick at 0.036 lb/A, Accent at 0.063 lb/A, Raptor at 0.032 lb/A, Pursuit at 0.063 lb/A, Enfield at 0.029 lb/A, Upbeet at 0.0313 lb/A, and Sandea at 0.032 lb/A were made on Aug. 28, 2003. The trial design was a randomized complete block with 4 replicates. The plots were one 40-inch bed wide by 20 ft. long. Weed densities in a 0.25 m^2 quadrat were assessed on Sep. 9, 2003. Visual injury ratings (0 = no injury, 10 = dead) were assessed Sept. 19 and Oct.10, 2003. Idaho lettuce was harvested on Oct. 20, 2003, and iceberg lettuce was harvested on Oct. 27, 2003.

In a second field study, 'Dark Green Boston' (standard variety) and Idaho germplasm lettuce were planted at Spence Farm on Aug. 18, 2003. Matrix at 0.031 lb/A, Maverick at 0.036 lb/A, Accent at 0.063 lb/A, Raptor at 0.032 lb/A, Pursuit at 0.063 lb/A, Enfield at 0.029 lb/A, Upbeet at 0.0313 lb/A, Sandea at 0.032 lb/A, and Kerb at 1.2 lb/A were applied PRE on Aug. 19, 2003. All herbicides with the exception of Kerb, were applied POST Sept. 12, 2003 at the same rates as the PRE applications. Trial design, plot layout and soil type were the same as described above. One line of commercial lettuce and one line of Idaho germplasm were planted on each bed. Weed densities were measured Sept. 22, 2003. Visual injury ratings (0 = no injury, 10 = dead) were assessed Sept. 19 and Oct. 10, 2003. Both lettuce varieties were harvested Oct. 29, 2003.

Results

In the first trial, all treatments had similar total weed densities and no significant differences were found (data not shown). Visual injury ratings of $\leq$2.0 were considered safe to lettuce. The Sep. 19, and Oct, 10, 2003 injury ratings indicated the Matrix, Maverick, Accent, Enfield, Upbeet, and Sandea herbicide treatments applied POST were not safe to iceberg lettuce, while Raptor, Pursuit, and commercial standard Kerb were safe to iceberg lettuce (Table 1). On Idaho germplasm, Pursuit and Raptor were safe POST treatments, while Matrix, Maverick, Accent, Enfield, Upbeet and Sandea were not safe. All treatments except Raptor and Pursuit reduced the number of standard iceberg lettuce heads relative to Kerb, and all treatments reduced the iceberg fresh weights except Kerb (Table 2). Matrix, Accent, Enfield and Sandea reduced the number of Idaho lettuce heads and fresh weights compared to Kerb, while Maverick, Raptor, Pursuit and Upbeet had lettuce head numbers and fresh weights similar to Kerb.

In the second experiment, visual injury ratings of ≤2.0 were considered safe to lettuce as described above. In standard lettuce, PRE applications of Raptor, Pursuit, and Kerb were safe in both early and late visual injury ratings, and Pursuit was the only safe POST treatment on standard lettuce (Tables 3 & 4). In the Idaho germplasm, safe PRE treatments were Maverick, Raptor, Pursuit, Upbeet and Kerb and safe POST treatments were Pursuit and Raptor (Tables 3 & 4). PRE treatments that did not reduce standard lettuce stands at harvest, compared to Kerb were: Maverick, Accent, Raptor, Pursuit and Upbeet (Table 5). Compared to Kerb, POST treatments that did not reduce standard lettuce stand were: Maverick, Raptor and Pursuit. Idaho germplasm stands in all PRE treatments were not different from Kerb, except Matrix and Sandea. POST applications of Matrix and Accent reduced Idaho lettuce stand, while the remaining treatments did not reduce lettuce stands relative to Kerb. Compared to Kerb, the standard lettuce fresh weight yields were reduced by all PRE treatments except Raptor, Pursuit and Upbeet, and all POST treatments except Raptor, and Pursuit (Table 6). In the Idaho germplasm, PRE treatments with fresh weights not different from Kerb were Maverick, Raptor, Pursuit and Upbeet, and among POST treatments, Raptor and Pursuit lettuce fresh weights were similar to Kerb. The results of these two studies suggest that PRE and POST treatments of Raptor and Pursuit and PRE treatments of Maverick, and Upbeet are potential herbicides for Idaho germplasm lettuce.

Table 1. Visual injury ratings Sept. 19, and Oct. 10, 2003 in standard iceberg and Idaho germplasm treated with IMI and SU herbicides applied POST.

		---------- Iceberg [1] ----------		---------- Idaho germplasm --------	
Herbicide	Rate lb/A	Sept. 19	Oct. 10	Sept. 19	Oct. 10
		---------- Injury (0 = safe, 10 = dead) ----------			
Matrix	0.031	9.5 a	9.8 a	9.3 a	7.8 a
Maverick	0.036	6.1 a	2.0 c	2.1 c	0.4 b
Accent	0.063	8.0 a	7.9 b	5.9 b	2.5 b
Raptor	0.032	1.1 b	0.0 d	0.5 c	0.1 b
Pursuit	0.063	1.0 b	0.1 d	1.1 c	0.3 b
Enfield	0.029	7.4 a	9.5 a	3.4 bc	1.9 b
Upbeet	0.031	6.3 a	0.8 d	2.4 c	0.3 b
Sandea	0.032	8.4 a	7.6 b	5.6 b	2.8 b
Kerb	1.2	0.0 b	0.0 d	0.5 c	0.0 b
Untreated	0.0	1.5 b	0.0 d	0.3 c	0.0 b

[1] Data within a column sharing the same letter(s) were not different at P = 0.05

Table 2. Number of total plants and fresh weights at harvest on Oct. 20, 2003 in Idaho germplasm and on Oct. 27, 2003 in iceberg lettuce treated with IMI and SU herbicides applied POST.

		---------- Iceberg [1] ----------		---------- Idaho germplasm --------	
Herbicide	Rate lb/A	No. (1,000/A)	Weight (1,000 lbs/A)	No. (1,000/A)	Weight (1,000 lbs/A)
Matrix	0.031	0.0 c	0.0 d	4.9 d	0.8 c
Maverick	0.036	3.0 c	5.1 d	29.1 ab	13.7 a
Accent	0.063	0.0 c	0.0 d	18.0 bc	6.5 b
Raptor	0.032	31.1 a	65.2 b	31.1 a	15.7 a
Pursuit	0.063	28.1 a	58.0 b	28.5 ab	14.4 a
Enfield	0.029	0.0 c	0.0 d	16.3 c	7.1 b
Upbeet	0.031	17.6 b	34.8 c	26.5 abc	13.4 a
Sandea	0.032	0.0 c	0.0 d	17.0 c	6.7 b
Kerb	1.2	32.0 a	79.9 a	29.1 ab	16.6 a
Untreated	0.0	29.8 a	61.6 b	30.0 a	15.8 a

[1] Data within a column sharing the same letter(s) were not different at P = 0.05

Table 3. Crop injury ratings Sept. 19, 2003 on standard 'Boston' and Idaho germplasm treated with IMI and SU herbicides.

		Standard lettuce [1]		Idaho germplasm	
Herbicide	Rate lb/A	PRE	POST	PRE	POST
		---------- Injury (0 = safe, 10 = dead) ----------			
Matrix	0.031	9.4 a	6.3 b	8.4 a	5.9 b
Maverick	0.036	9.0 a	5.6 bc	1.3 de	4.5 bc
Accent	0.063	8.6 a	4.1 cd	3.0 cd	4.5 bc
Raptor	0.032	0.9 e	3.3 d	0.1 e	0.8 e
Pursuit	0.063	1.3 e	1.9 e	0.0 e	1.0 e
Enfield	0.029	9.9 a	6.6 b	5.3 b	4.6 bc
Upbeet	0.031	4.3 cd	4.5 cd	0.0 e	2.3 de
Sandea	0.032	9.5 a	5.4 bc	5.6 b	4.9 bc
Kerb	1.2	1.0 e		0.0 e	
Untreated	0.0	0.1 e		0.0 e	

[1] Data within a lettuce variety sharing the same letter(s) were not different at P = 0.05

Table 4. Crop injury ratings Oct. 10, 2003 on standard 'Boston' and Idaho germplasm treated with IMI and SU herbicides.

		Standard lettuce [1]		Idaho germplasm	
Herbicide	Rate lb/A	PRE	POST	PRE	POST
		---------- Injury (0 = safe, 10 = dead) ----------			
Matrix	0.031	9.8 a	10.0 a	8.4 a	9.1 a
Maverick	0.036	9.4 ab	8.1 c	0.3 c	2.0 c
Accent	0.063	8.5 bc	9.8 a	0.9 c	5.8 b
Raptor	0.032	0.4 d	0.9 d	0.1 c	0.5 c
Pursuit	0.063	0.9 d	0.5 a	0.3 c	0.3 c
Enfield	0.029	10.0 a	10.0 a	2.3 c	4.6 b
Upbeet	0.031	0.8 d	8.6 bc	0.0 c	1.0 c
Sandea	0.032	9.9 a	9.1 ab	2.1 c	5.1 b
Kerb	1.2	0.4 d		0.0 c	
Untreated	0.0	0.0 d		0.0 c	

[1] Data within a lettuce variety sharing the same letter(s) were not different at P = 0.05

Table 5. Number of total plants at Oct. 29, 2003 harvest on standard 'Boston' and Idaho germplasm treated with IMI and SU herbicides.

		Standard lettuce [1]		Idaho germplasm	
Herbicide	Rate lb/A	PRE	POST	PRE	POST
		---------- 1000. plants/A ----------			
Matrix	0.031	5.0 d	0.0 d	25.5 cd	11.5 e
Maverick	0.036	30.7 a	25.9 a	31.4 abc	32.7 ab
Accent	0.063	27.8 a	0.0 d	31.1 abc	22.0 d
Raptor	0.032	31.8 a	32.7 a	34.6 a	34.0 a
Pursuit	0.063	32.4 a	30.5 a	32.7 ab	32.7 ab
Enfield	0.029	0.0 d	0.0 d	30.5 abc	29.4 abc
Upbeet	0.031	31.8 a	18.9 b	35.3 a	28.8 abc
Sandea	0.032	0.0 d	12.2 c	26.8 bcd	28.8 abc
Kerb	1.2	32.0 a		35.0 a	
Untreated	0.0	31.4 a		34.0 a	

[1] Data within a lettuce variety sharing the same letter(s) were not different at P = 0.05

Table 6. Fresh weight lettuce yields at Oct. 29, 2003 in standard 'Boston' and Idaho germplasm treated with IMI and SU herbicides.

		Standard lettuce [1]		Idaho germplasm	
Herbicide	Rate lb/A	PRE	POST	PRE	POST
		---------- 1000. lbs/A ----------			
Matrix	0.031	0.0 d	0.0 d	1.1 i	0.5 i
Maverick	0.036	0.1 d	2.1 d	16.4 abc	10.9 de
Accent	0.063	1.3 d	0.0 d	13.5 cd	4.1 h
Raptor	0.032	21.5 ab	17.3 c	18.4 ab	16.5 abc
Pursuit	0.063	16.5 c	18.8 bc	15.4 bc	15.4 bc
Enfield	0.029	0.0 d	0.0 d	8.2 efg	7.5 fg
Upbeet	0.031	16.2 c	1.9 d	19.6 a	13.1 cd
Sandea	0.032	0.0 d	0.6 d	10.0 ef	5.5 gh
Kerb	1.2	19.1 bc		19.0 ab	
Untreated	0.0	23.6 a		18.5 ab	

[1] Data within a lettuce variety sharing the same letter(s) were not different at P = 0.05

B. Evaluate improved nutsedge management systems for lettuce.

A study was initiated near Indio, CA in June 2003 to determine if treatment with metam sodium or Telone C35 can improve the performance of the Eptam fallow land nutsedge control program. Metam sodium was applied by water run injection through sprinklers at 40 gallons per acre and Telone C35 by shank injection at 28 gallons per acre on June 19, 2003, and then Eptam at 7 pints per acre was applied and disk incorporated on July 1, 2003. Lettuce was planted on October 17, 2003 and the nutsedge densities were measured on November 2, 2003. The results indicate that Telone C35 followed by Eptam provided very good nutsedge control (Table 7), but the treatments had no effect on marketable yields January 26, 2004. The incidence of lettuce drop was too low to rate (data not shown).

Table 7. Nutsedge control at Desert Mist Farms, Indio, CA.

Herbicide [1]	Rate	Nutsedge density (no./A) [2]	Marketable heads (1000 heads/A)
Eptam 7 E	7 pts	1,287 a	26.9
Metam sodium fb Eptam 7 E	40 GPA fb 7 pts	1,023 ab	27.3
Telone C35 fb Eptam 7 E	28 GPA fb 7 pts	46 b	27.3

[1] Followed by (fb) means a sequential application.
[2] Data within a column sharing the same letter(s) were not different at P = 0.05

C. Magnesium salt effect on Kerb soil mobility.

It has already been well established in Yuma, AZ and other places that high levels of irrigation move Kerb below the weed germination zone, resulting in poor weed control. There have been reports in the literature that Kerb provided poor weed control where soil magnesium levels were high. We wanted to know if higher concentrations of magnesium in irrigation water may enhance Kerb mobility and result in poor weed control. We conducted a series of studies with soil columns to determine if magnesium increases Kerb soil mobility. We evaluated the soil mobility of surface-applied Kerb at 1.5 lb ai/A and irrigated with 2.5 inches of water over 8 hours. The water used to irrigate the 10-inch soil columns contained a range of $MgSO_4$ concentrations at an electrical conductivity of 0, 100, 500, 1,000 and 2,500 µS (µmhos cm^{-1}). We measured the concentration of Kerb in the leachate with a spectrophotometer at 255 nm. After 8 hours of leaching with $MgSO_4$ solutions, Kerb concentration was higher in the leachate at 2500 µS than at 100 or 500 µS (Table 8). After the columns drained overnight, we sectioned the 10-

inch columns into four 2.5-inch sections from top to bottom, and planted perennial ryegrass (*Lolium perenne*) in soil from each depth to detect the presence of Kerb. Perennial ryegrass is known to be very sensitive to Kerb residues in the soil. The ryegrass was grown for 4 weeks and then dry weights were determined (Table 9). The effect of magnesium on Kerb soil mobility does not appear to be large, as indicated by the ryegrass bioassays.

Table 8. Effect of magnesium on Kerb mobility: Kerb concentration in soil water after 8 hours of leaching.

$MgSO_4$ conductivity	Adsorption	Kerb concentration [1]
------- µS m^{-1}--------	------ 255 nm ------	-------- µg/ml --------
100	0.177	1.14 b
500	0.177	1.14 b
1000	0.274	1.76 ab
1500	0.219	1.41 ab
2500	0.360	2.31 a

[1] Data within a column sharing the same letter(s) were not different at P = 0.05

Table 9. Effect of magnesium concentration on Kerb mobility. Perennial ryegrass was used to test for the presence of Kerb residues in the soil columns by depth. The effect of magnesium was not significant.

Depth	---------- Magnesium concentration (µS) ----------					
inches	0	100	500	1000	1500	2500
	---------- Dry weight /plant (mg) ----------					
0-2.5	0.0	0.0	0.0	0.0	0.0	0.0
2.5-5	3.2	5.7	0.3	2.3	3.3	4.4
5-7.5	11.9	6.9	5.4	8.0	7.6	4.0
7.5-10	14.3	7.4	5.0	3.9	7.6	9.2

D. Evaluate the crop safety of Treflan on lettuce.

Treflan has a food tolerance for lettuce, but is not labeled for use on lettuce. We initiated a test plot at Hartnell farm near Salinas, CA August 25, 2003 to determine if we should pursue a label to allow Treflan use on lettuce. Visual injury estimates and pre-thinning stand counts suggest that Treflan, applied post plant preemergence and activated with sprinkler irrigation (same as Kerb), was safe on lettuce (Table 10). Yields from November 10, 2003 indicate that Treflan at 1 pint/A was as safe on lettuce as Kerb.

Table 10. Lettuce tolerance to Treflan: injury ratings, stand and yields.

Herbicide	Rate	Injury	Stand	No. heads [1]	Fresh weights
	Pints/A	Injury (0 to 10)	No. 20 ft. row	1000 / A	1000 lbs./A
Treflan	1	0.0 b	150.8	24.5 ab	45.2
Treflan	1.5	0.4 b	158.5	21.5 ab	40.8
Treflan	2.0	0.9 a	150.8	17.2 b	29.1
Kerb	2.4 lbs product	0.0 b	164.8	26.3 a	45.2
Untreated	0.0	0.0 b	163.8	22.4 ab	40.0

[1] Data within a column sharing the same letter(s) were not different at P = 0.05

(reprinted from California Lettuce Research Board Annual Report 2003-2004)

Marketing Alternatives and Niches

The University of California Cooperative Extension (UCCE) in Riverside and San Bernardino Counties and the California State University San Bernardino (CSUSB) in partnership through the Inland Empire Center for Entrepreneurship (IECE) recently offered seminars in Riverside and in the Coachella Valley on **Marketing Alternatives and Niches.**

The seminars provided alternative marketing ideas and venues for minimizing marketing costs and maximizing returns. Topics included:

- Government Produce Purchasers
- Using Cooperatives to Market
- Understanding the Food Safety Issues in Producing and Marketing

The seminars were for those growers seeking new marketing ideas. Larry Montoya presented information on produce buying procedures for the Department of Defense. DOD is a huge buyer of produce and they expressed an interest in supporting California farmers and California's Small Farmers in particular. Shermain Hardesty presented information on how cooperatives are an effective way to market crops. There are over 47,000 cooperatives in the United States, they serve 100 million people (40%) of the population. Linda Harris spoke on the importance of implementing food safety programs. Dr. Harris also spoke on the main microorganisms involved in foodborne illnesses and presented Good Agricultural Practices with a focus on prevention of contamination of produce.

Please read Desert Ag-Notes for future program notices.

Seminars Organizers:

If you would like more information on these and future programs, please contact:
Eta Takele (951-683-6491 Ext. 243)
UCCE Area Farm Advisor
Peggy Mauk
UCCE Riverside County Director
Jose Aguiar (760-863-7949)
UCCE Farm Advisor
Joe Elizondo (760-398-4827)
IECE Director

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Jose Aguiar, Farm Advisor JA/ws/09-01-2004/450

U.C. COOPERATIVE EXTENSION
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Moreno Valley, California, CA 92557-8718

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