

Developing a Weed Control Strategy in Transplanted Bell Peppers with Preemergence Herbicides for California



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Weed Control Challenges

field grown peppers without plastic mulch

- Peppers compete poorly with weeds for the first 40 to 60 days following transplanting.
- Peppers may be subject to weed pressure by both winter and summer annual weeds.



Issues with weed control in California field grown peppers

- Several perennial weeds are problematic.
- Registered preemergent herbicides have gaps in spectrum of weeds controlled.
- Very few post-emergent herbicides registered.

2007

**As a result of these challenges
weed management is a significant
cost of production.**

**Growers can easily spend
\$400/Acre**

**On herbicide application,
mechanical cultivation,
and hand hoeing.**

Field Research Objectives

To develop a “weed control strategy” for peppers with preemergence herbicides applied

- At PLANTING

and/or

- At LAYBY

that provide weed control throughout the growing season.

2004 - 2009

CA Weed Control Trials in Peppers

- **Field Trials**

- **Central Coast** (Santa Clara and Monterey Counties)
- **San Joaquin Valley** (Fresno County)

- **Materials evaluated included:**

- **Dual Magnum** (S-metolachlor)
- **Chateau** (flumioxazin)
- **Goal Tender** (oxyfluorfen)
- **Outlook** (dimethenamid)
- **Prowl H₂O**
- **Devrinol** (napropamide) **or Dacthal** (DCPA) – **Standards**

Bell Pepper Herbicide Studies



Methods

Fresno

Monterey

Preplant Goal Tender:

March 15

April 15

Transplant Peppers:

April 15

May 15

Variety:

Jupiter or Indra

Baron

Plot size:

2(40'') x 70'

40'' bed x 25'

Water volume:

30 gal/A

74 gal/A

Layby herbicides:

May 30 – mid June

June 16

Irrigation:

Sprinkler to furrow

Sprinkler to drip

Soil type:

Panoche clay loam

Pacheco silt loam

Harvest:

Aug 1-15

Aug 19







Plot size: Two 40-inch beds x 70' row
4 replications



2007



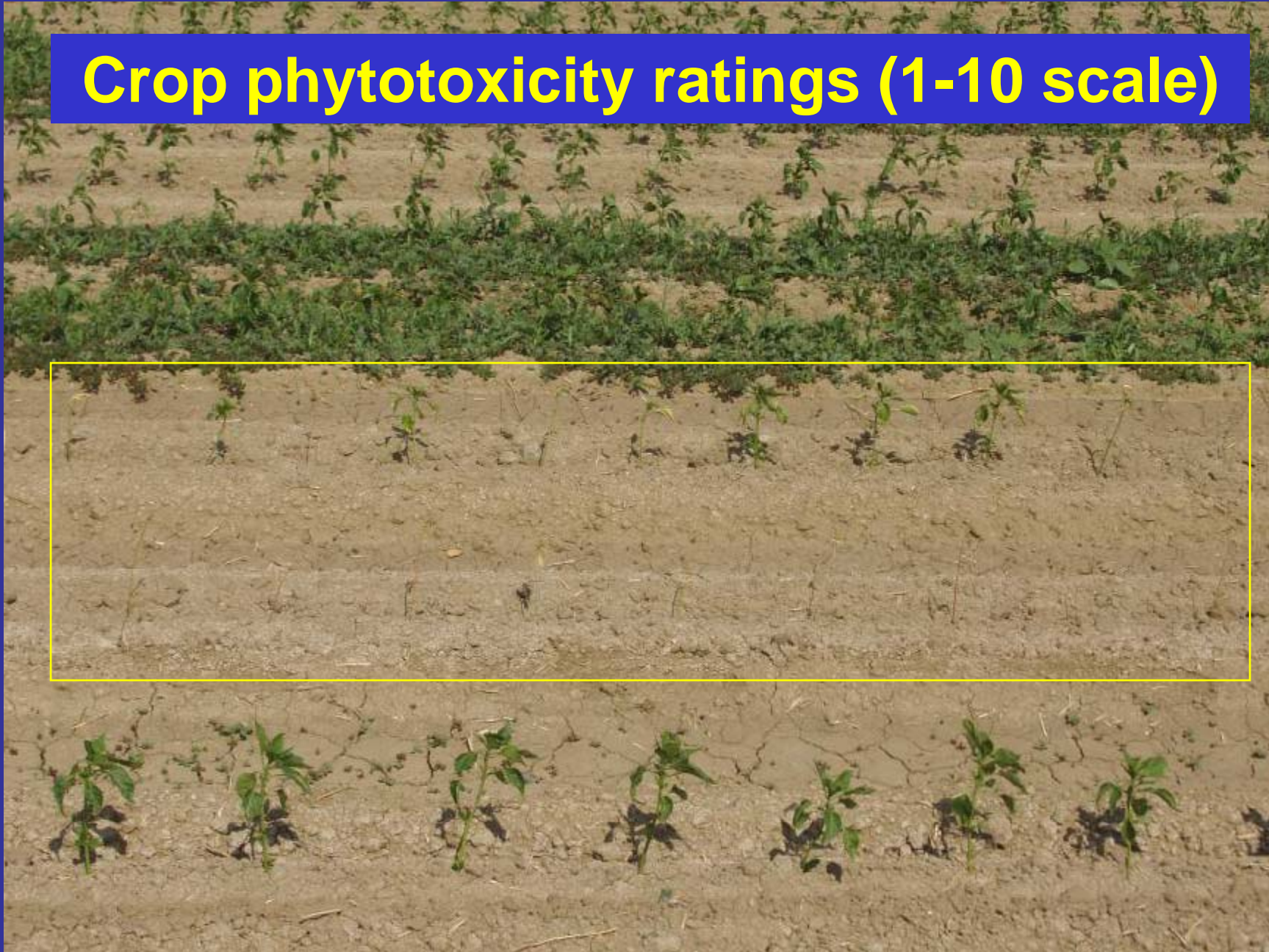
UNTREATED

2007



Weed control ratings (1-10 scale)

Crop phytotoxicity ratings (1-10 scale)



Difficult to control weeds in Peppers



UC Statewide IPM Project
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**Hairy Nightshade
(*Solanum sarrachoides*)**

**Also cutleaf nightshade
and groundcherry.**

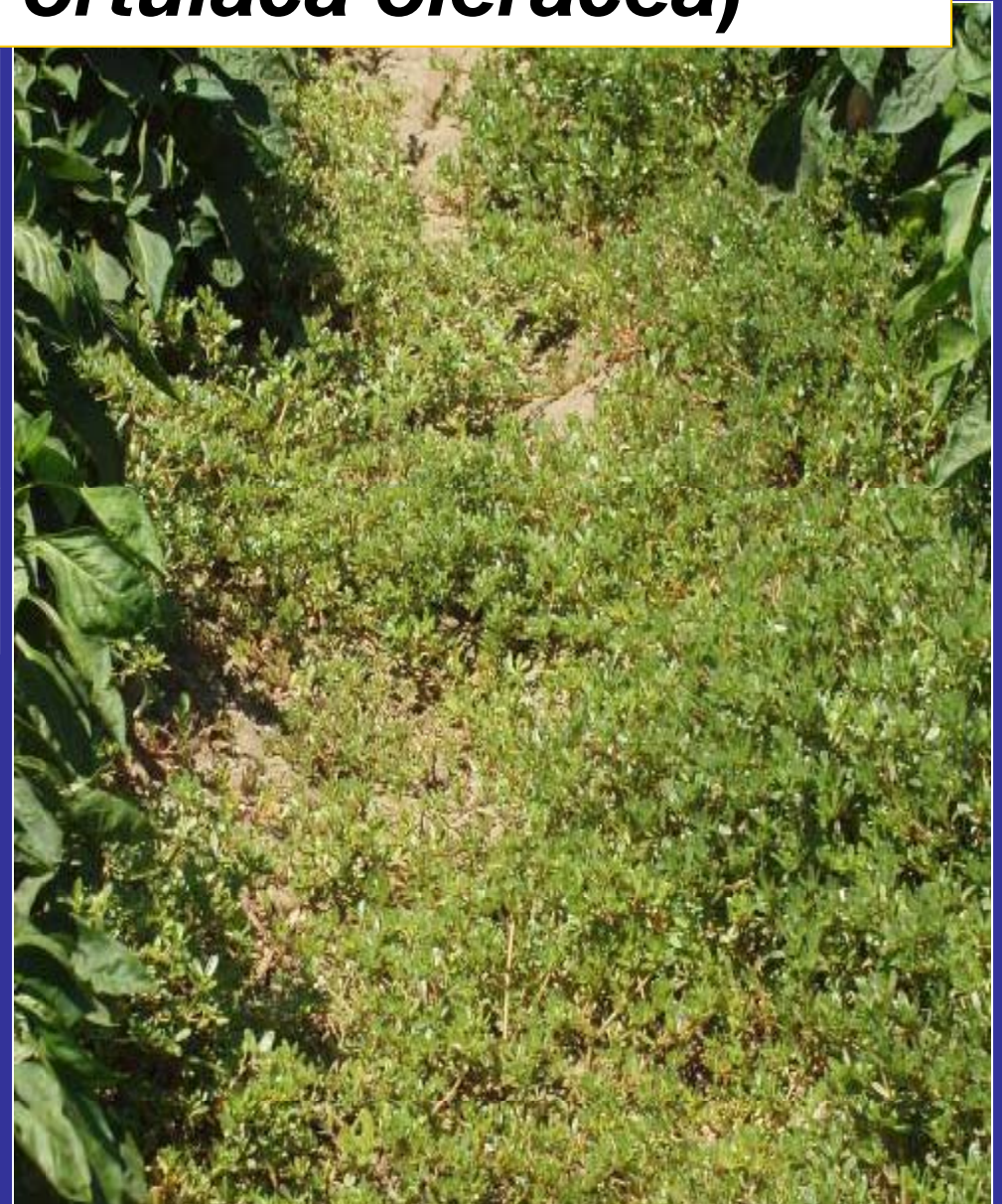
**Black Nightshade
(*Solanum nigrum*)**



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Dual Magnum & Goal Tender work.

Common purslane (*Portulaca oleracea*)



Many herbicides work.

Pigweeds (*Amaranthus* spp.)

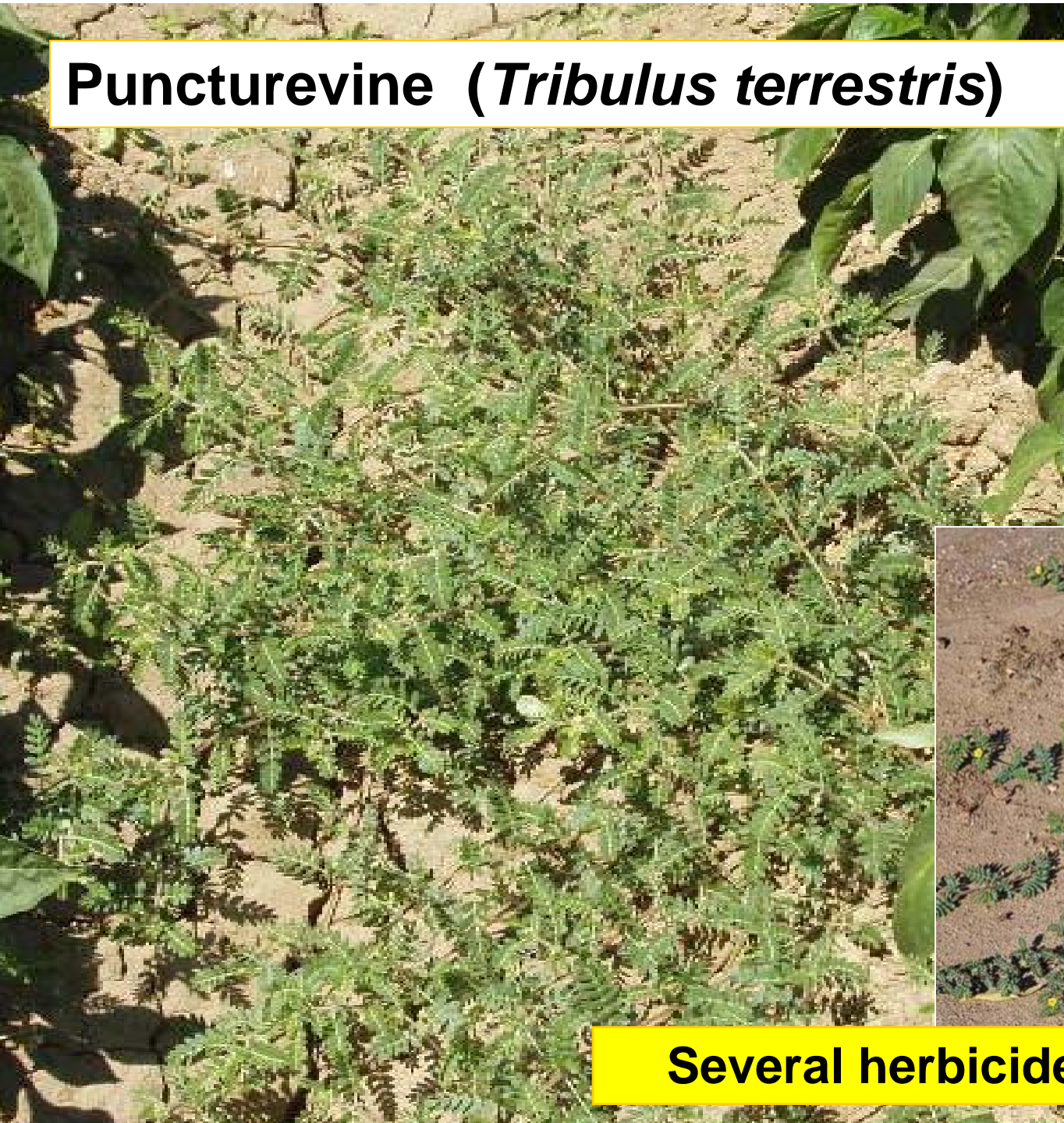
Tumble pigweed

Redroot pigweed

Also Prostrate pigweed

Many herbicides work.

Puncturevine (*Tribulus terrestris*)



Several herbicides offer partial control.

Difficult to control perennial weeds in CA

Yellow nutsedge (*Cyperus esculentus*)



Purple nutsedge (*Cyperus purpurea*)



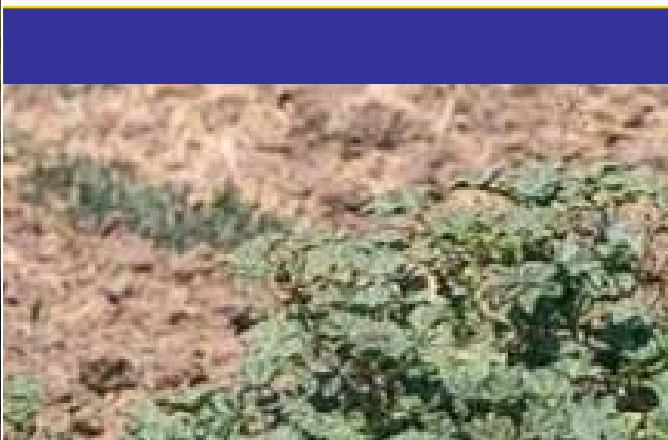
Dual Magnum effective against yellow nutsedge.



Field bindweed
(*Convolvulus arvensis*)

Treflan is the only layby herbicide effective on field bindweed.

**Little Mallow (*Malva parviflora*) –
Annual/biennial**



No currently registered layby herbicide is effective against little mallow. (Goal Tender works, but you cannot use it at layby).

Weed Control Materials Registered for Transplanted Peppers in California

- **Preplant**
 - **Paraquat**
 - **Roundup**
 - **Metam Sodium**
 - **Shark** (carfentrazone)
 - **Scythe** (pelargonic acid)
- **Preplant - Preemergence**
 - **Treflan & Prowl H₂O**
 - **Dual Magnum (24c)**
 - **Goal Tender^{1,2}**
- **Post Transplant**
 - **Devrinol**
- **Layby**
 - **Dacthal**
 - **Prowl H₂O**
 - **Dual Magnum (24c)***
- **Postemergence**
 - **Poast**
 - **Select Max** (clethodim)
 - **Sandea**

1- Preformed beds up to 30 days prior to transplanting, must work beds

2- Applied to shaped beds and tarped (approved in 2004) * indemnified label

UC Weed Susceptibility Chart

BROADLEAF	Prefar	Dacthal	Devrinol	Dual Magnum	Goal Tender	Prowl H2O	Treflan	Chateau	Outlook
FLEABANE, HAIRY	N	N	N	N	P	N	N	C	
GOOSEFOOT	P	C	C	P	C	C	C	C	
GROUNDCHERRY	N	C	N	C	C	N	N	-	
GROUNDSEL, COMMON	N	N	C	N	C	N	N	C	
HORSEWEED	N	N	N	N	P	N	N	C	
KNOTWEED	C	P	C	N	P	C	C	-	
LAMBSQUARTERS	C	C	C	P	C	C	C	C	
MALVA	N	P	P	P	C	P	N	C	
MORNINGGLORY, ANNUAL	N	N	P	N	C	N	N	C	
NIGHTSHADE, BLACK	N	P	N	C	C	N	N	C	
NIGHTSHADE, HAIRY	N	P	N	C	C	N	N	C	
NUTSEDGE, PURPLE	N	N	N	N	N	N	N	N	
NUTSEDGE, YELLOW	N	N	N	P	N	N	N	P	
PIGWEEED	C	C	C	C	C	C	C	-	
PUNCTURE VINE	N	P	P	-	P	P	P	-	
PURSLANE	C	C	C	C	C	C	C	C	
RUSSIAN THISTLE	N	C	C	P	P	P	P	-	
SOWTHISTLE	N	P	C	P	C	N	N	C	
SUNFLOWER	N	P	P	N	C	N	N	-	
VELVETLEAF	N	N	-	P	-	N	N	-	



Goal Tender (Dow Agro Sciences)

- Goal Tender applied to shaped beds 30 days prior to transplanting.
- Goal Tender less tendency to lift off the soil and damage young pepper plants.



Goal 2XL
2 lb/gal

Goal Tender
4 lb/gal
Registered



Dual Magnum (Syngenta)

- Dual Magnum was registered in 2002, but the label was very restrictive to only bell type peppers and at-planting applications
- It was registered for a 60 day PHI, but we felt it would be an important tool as a layby application.
- In 2008 the label an indemnified label was created that clearly states that Dual Magnum is registered for use at layby in peppers.



Dual Magnum (Syngenta)

- Now available is an INDEMNIFIED 24c label for Dual Magnum in peppers, onions, celery, and spinach.
- Growers can only obtain this label by going to the Syngenta sponsored website and registering as a user. <http://farmassist.com>
- This agreement affords Syngenta protection from unreasonable liability.



Prowl H2O (BASF)

- Registered for use in peppers in 2008.
- Greatly expanded the weed spectrum controlled.
- Controls many broadleaf weeds such as lambsquarters, goosefoot, mustards.
- NOT effective on nightshades or yellow nutsedge.



Outlook (BASF)

- Currently this product is not registered for use in peppers. We are working with BASF to determine application method (over the top versus directed spray), timing, and application rate.
- We have noticed excellent weed control, but crop phytotoxicity may be a problem.

CHATEAU
HERBICIDE

Chateau, Broadstar (flumioxazin) **(Valent)**

- This product provided excellent weed control. BUT Crop PHYTOTOXICITY is a PROBLEM.
- We worked with Valent Corp. to determine application method (spray versus granule), timing, and application rate for a couple of years.
- We stopped testing it but then resumed last year in conjunction with water repellent adjuvants to increase selectivity.

Transplant Application	Lbs a.i./A	Layby Application	Lbs a.i./A
Dual Magnum 7.62	1.43	Dual Magnum 7.62	1.43
Dual Magnum 7.62	1.43	Outlook 6.0	0.60
Dual Magnum 7.62	1.43	Dacthal 75W	7.00
Goal Tender 4F ¹	0.50	Dual Magnum 7.62	1.43
Goal Tender 4F ¹	0.50	Outlook 6.0	0.60
Goal Tender 4F ¹	0.50	Dacthal 75W	7.00
Outlook 6.0	0.60	Dual Magnum 7.62	1.43
Outlook 6.0	0.60	Outlook 6.0	0.60
Outlook 6.0	0.60	Dacthal 75W	7.00
Chateau - Broadstar 0.125 lb ai/A per 250 lbs	0.094	Dual Magnum 7.62	1.43
Chateau - Broadstar	0.094	Outlook 6.0	0.60
Chateau - Broadstar	0.094	Dacthal 75W	7.00
Devrinol (standard)	1.50	Dacthal 75W	7.00
Untreated	---	---	---

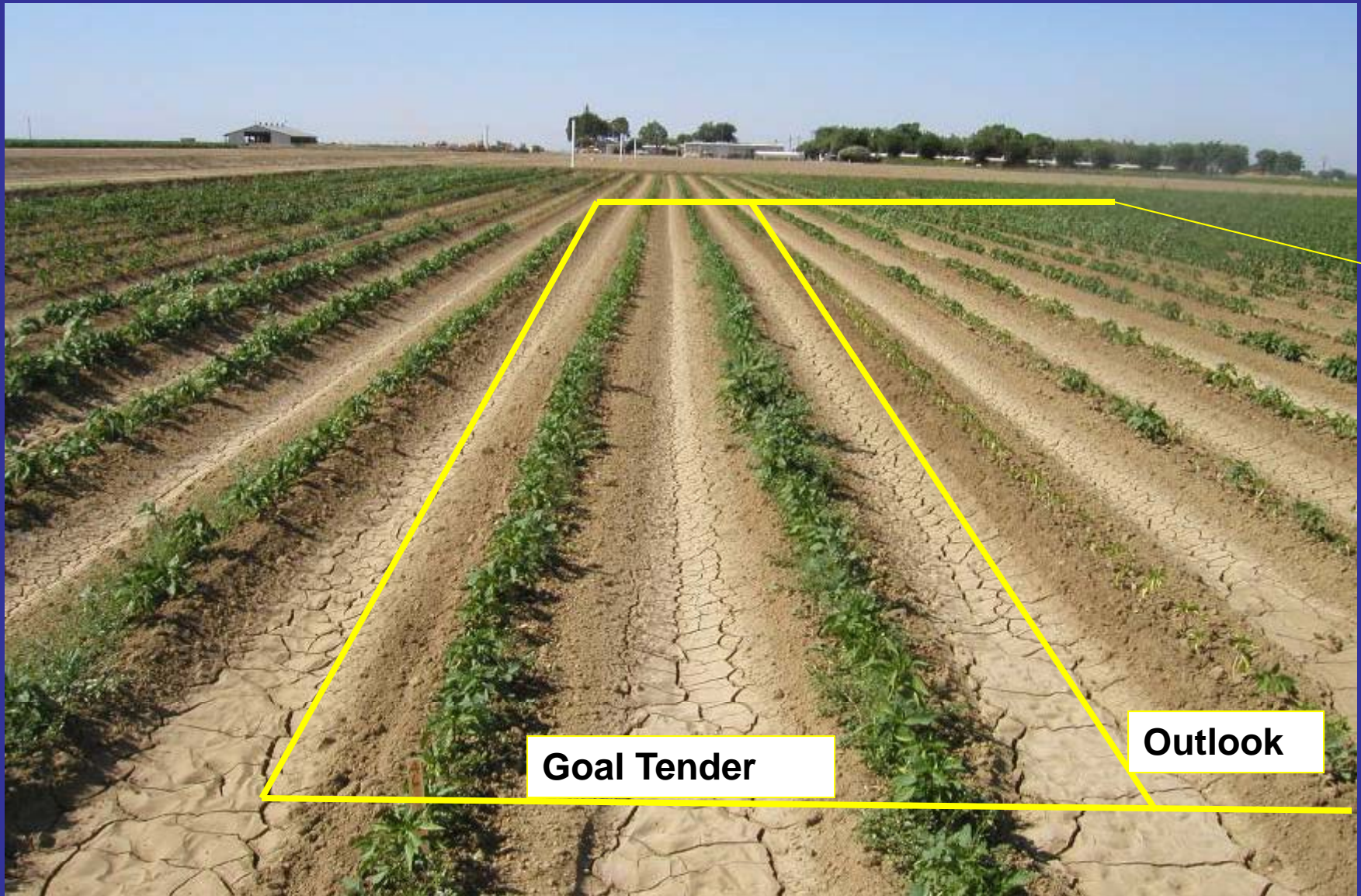


**Goal Tender Worked! Fresno
– June 1, 2005**

Concerns with Goal Treated Beds without Incorporation



Leaf crinkling
but can cause
necrotic spotting
and leaf death
as well



Goal Tender

Outlook

Fresno - July 13, 2005



Dual Magnum

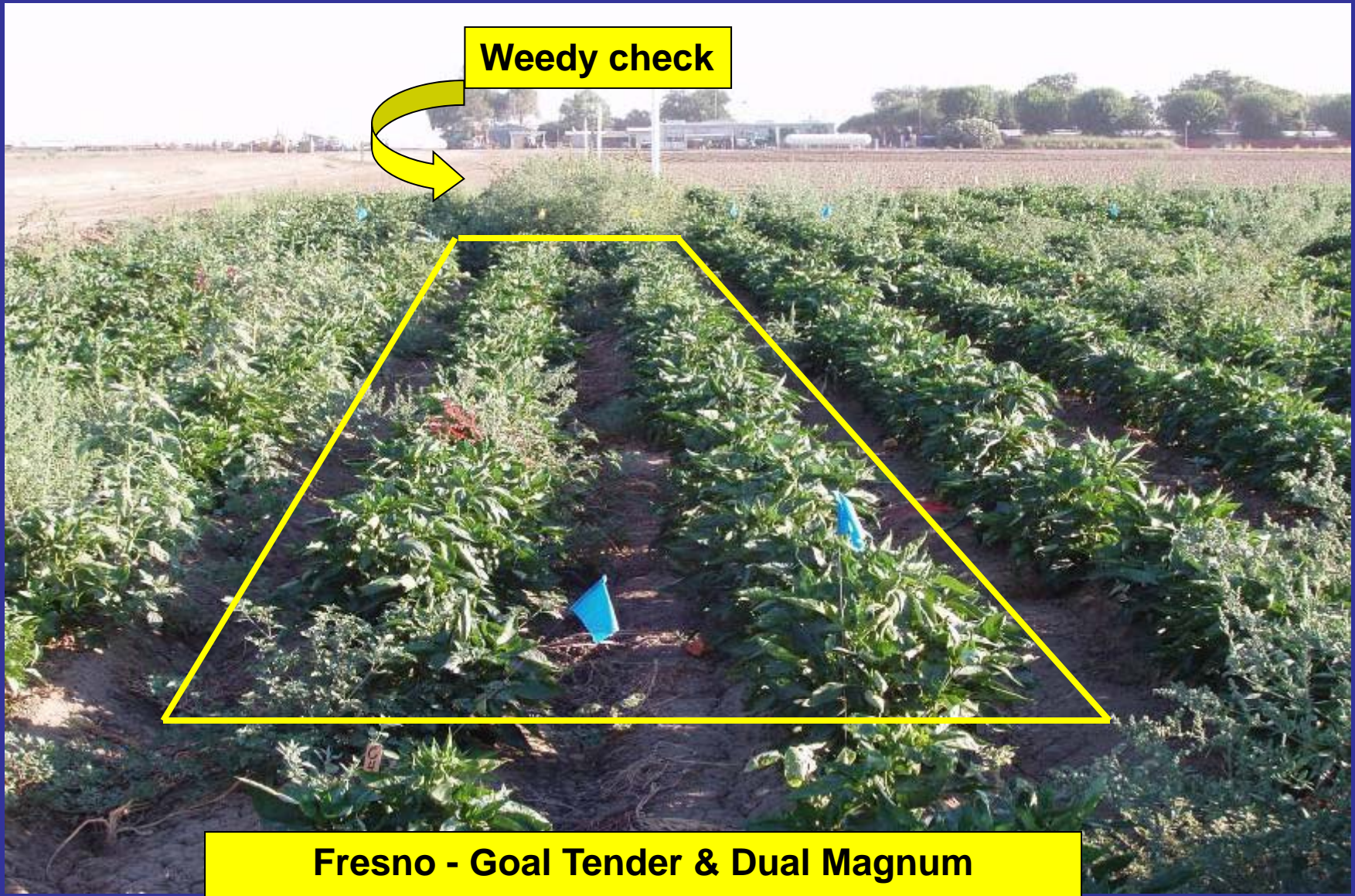


Goal Tender





Fresno: Outlook stunting persisted to harvest – August 23, 2005



Weedy check

**Fresno - Goal Tender & Dual Magnum
August 23, 2005**

Treatments	a.i./ Acre	24 DAT	67 DAT
Dual Magnum 7.62 <i>Fb Dual Magnum</i>	1.43 1.43	9.8	9.6
Dual Magnum <i>Fb Outlook</i>	1.43 0.60	10.0	8.5
Dual Magnum <i>Fb Dacthal</i>	1.43 7.00	10.0	9.7
Goal Tender 4F ¹ <i>Fb Dual Magnum</i>	0.50 1.43	1.3	8.7
Goal Tender ¹ <i>Fb Outlook</i>	0.50 0.60	1.5	9.3
Goal Tender ¹ <i>Fb Dacthal</i>	0.50 7.00	1.0	8.8
Outlook 6.0 <i>Fb Dual Magnum</i>	0.60 1.43	10.0	8.3
Outlook <i>Fb Outlook</i>	0.60 0.60	10.0	8.5
Outlook <i>Fb Dacthal</i>	0.60 7.00	9.7	7.0
Flumioxazin impregnated on fertilizer <i>Fb Dual Magnum</i>	0.094 1.43	7.7	9.0
Flumioxazin <i>Fb Outlook</i>	0.094 0.60	9.7	8.8
Flumioxazin <i>Fb Dacthal</i>	0.094 7.00	8.2	8.8
Untreated - weeded	-- --	0.7	6.7
Untreated - weedy	-- --	1.0	0.7

Weed Control Ratings

Yield of Peppers Lbs/plot

Treatments	a.i./A	Marketable	Total Fruit
Dual Magnum 7.62 <i>Fb Dual Magnum</i>	1.43 1.43	77.6	112.2
Dual Magnum <i>Fb Outlook</i>	1.43 0.60	71.3	103.5
Dual Magnum <i>Fb Dacthal</i>	1.43 7.00	61.0	89.5
Goal Tender 4F ¹ <i>Fb Dual Magnum</i>	0.50 1.43	62.6	97.6
Goal Tender ¹ <i>Fb Outlook</i>	0.50 0.60	91.6	116.0
Goal Tender ¹ <i>Fb Dacthal</i>	0.50 7.00	66.0	89.1
Outlook 6.0 <i>Fb Dual Magnum</i>	0.60 1.43	47.2	65.5
Outlook <i>Fb Outlook</i>	0.60 0.60	41.8	66.2
Outlook <i>Fb Dacthal</i>	0.60 7.00	21.0	31.9
Flumioxazin impregnated on fertilizer <i>Fb Dual Magnum</i>	0.094 1.43	57.5	84.4
Flumioxazin <i>Fb Outlook</i>	0.094 0.60	79.4	112.3
Flumioxazin <i>Fb Dacthal</i>	0.094 7.00	65.3	89.0
Untreated – weeded	-- --	78.4	107.5
Untreated – weedy	-- --	20.9	31.5

Peppers
never
recovered



2007

2008 Fresno Pepper Trial

2008 Bell Pepper X Preemergence Herbicides

April 18 - At Planting application - applied post transplant, over the top
Pepper Variety - INDRA 10.5 inch spacing

		lbs ai/A	rate/A	6 plots
1	untreated			
2	handweeded			
3	Dual Magnum	1.4	1.5 pt	43 ml
4	Outlook Lo	0.5	10.7 oz	19 ml
5	Outlook Hi	1.0	21.4 oz	38 ml
6	Prowl H ₂ O Lo	0.75	1.5 pt	45 ml
7	Prowl H ₂ O Hi	1.5	3.0 pt	90 ml
8	Dacthal	7.0	9.3 lb	254 gr
9	Dual Magnum	1.4	1.5 pt	43 ml
10	Dual Magnum	1.4	1.5 pt	43 ml
11	Dual Magnum	1.4	1.5 pt	43 ml
12	Dual Magnum	1.4	1.5 pt	43 ml
13	Dual Magnum	1.4	1.5 pt	43 ml
14	Dual Magnum	1.4	1.5 pt	43 ml
15	Outlook Lo	0.5	10.7 oz	19 ml
16	Outlook Hi	1.0	21.4 oz	38 ml
17	Outlook Lo	0.5	10.7 oz	19 ml
18	Outlook Lo & Prowl H ₂ O Lo	0.5 & 0.75	10.7 oz & 1.5 pt	19 ml & 45 ml
19	Outlook Hi & Prowl H ₂ O Lo	1.0 & 0.75	21.4 oz & 1.5 pt	38 ml & 45 ml
20	Outlook Lo & Prowl H ₂ O Lo	0.5 & 0.75	10.7 oz & 1.5 pt	19 ml & 45 ml
21	Outlook Hi & Prowl H ₂ O Lo	1.0 & 0.75	21.4 oz & 1.5 pt	38 ml & 45 ml
22	Outlook Lo	0.5	10.7 oz	19 ml
23	Outlook Hi	1.0	21.4 oz	38 ml
24	Outlook Lo	0.5	10.7 oz	19 ml
25	Outlook Hi	1.0	21.4 oz	38 ml

2008 Bell Pepper X Preemergence Herbicides

Layby application - Directed spray

		lbs ai/A	rate/A	6 plots
1	untreated			
2	handweeded			
3	-----			
4	-----			
5	-----			
6	-----			
7	-----			
8	-----			
9	Dual Magnum	1.4	1.5 pt	43 ml
10	Outlook Lo	0.5	10.7 oz	19 ml
11	Outlook Hi	1.0	21.4 oz	38 ml
12	Prowl H ₂ O Lo	0.75	1.5 pt	45 ml
13	Prowl H ₂ O Hi	1.5	3.0 pt	90 ml
14	Dacthal	7.0	9.3 lb	254 gr
15	Outlook Lo	0.5	10.7 oz	19 ml
16	Outlook Lo	0.5	10.7 oz	19 ml
17	Outlook Hi	1.0	21.4 oz	38 ml
18	-----			
19	-----			
20	Outlook Lo & Prowl H ₂ O Lo	0.5 & 0.75	10.7 oz & 1.5 pt	19 ml & 45 ml
21	Outlook Hi & Prowl H ₂ O Lo	1.0 & 0.75	21.4 oz & 1.5 pt	38 ml & 45 ml
22	Dual Magnum	1.4	1.5 pt	43 ml
23	Dual Magnum	1.4	1.5 pt	43 ml
24	Dacthal	7.0	9.3 lb	254 gr
25	Dacthal	7.0	9.3 lb	254 gr

Transplanted April 18, 2008

Photo on June 3





June 19, 2008





July 10, 2008

August 4, 2008



August 4, 2008

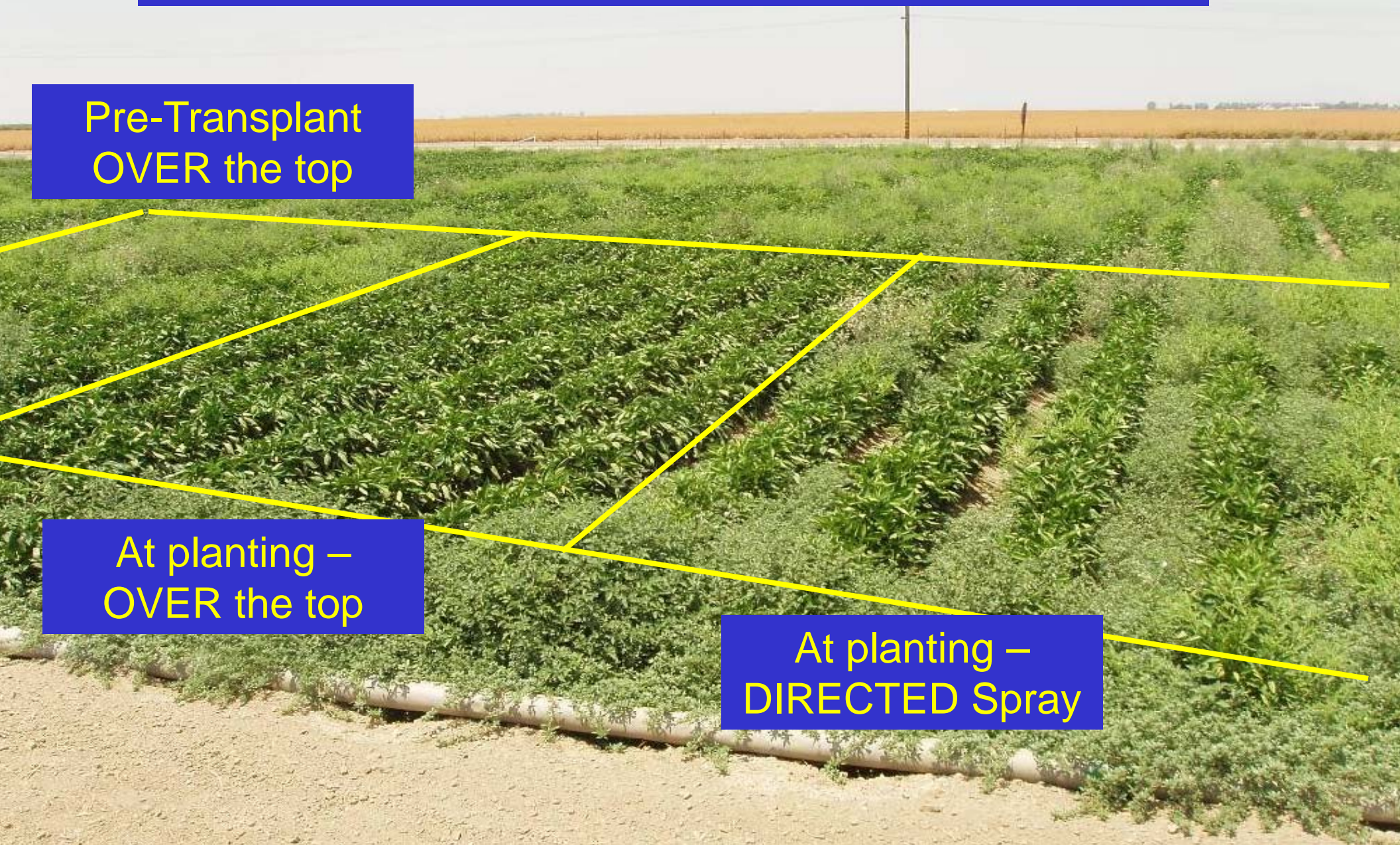


OUTLOOK - Method of Application - 2008

Pre-Transplant
OVER the top

At planting –
OVER the top

At planting –
DIRECTED Spray



A work in progress ... Research Continues in 2010

***Developing* a Weed Control Strategy in
Transplanted Bell Peppers
with Preemergence Herbicides for California**

... Thank you

Acknowledgements

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California Pepper Commission

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