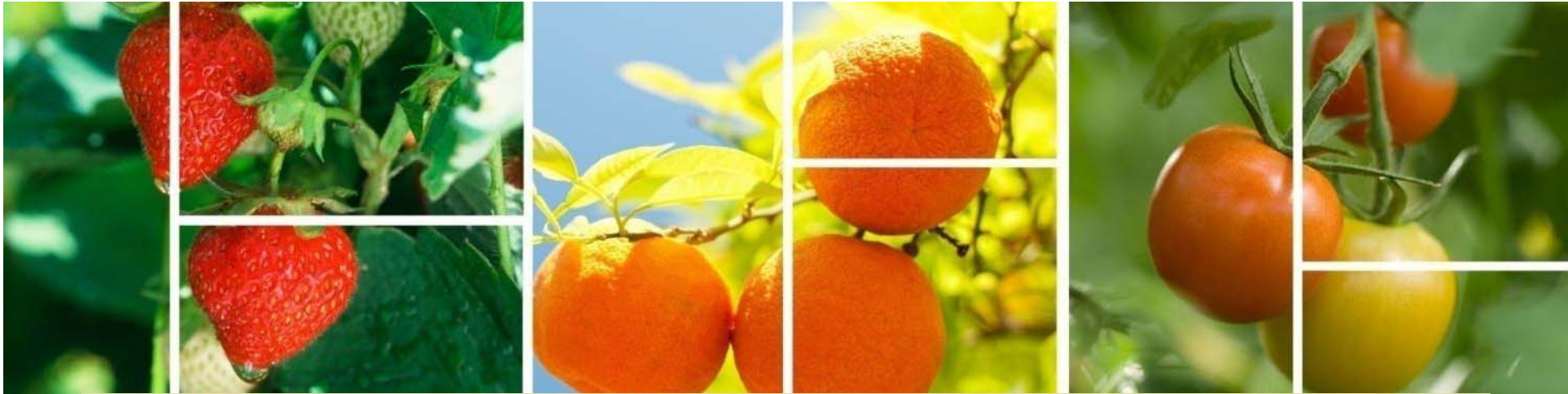




Curtis Sandberg
Product Development Manager
FMC Corporation





Zeus Herbicide

Sulfentrazone Introduction to California





Sulfentrazone History

- ❑ **Discovered in 1985 by FMC**
- ❑ **First compound in a new class of herbicides called aryl triazolinones**
- ❑ **Soybeans were the first registration in the US in 1997**
- ❑ **Recently registered in CA for Vegetables**
- ❑ **Plan to begin Sales in Spring of 2012**



Sulfentrazone Mode of Action

- ❑ Sulfentrazone inhibits Protoporphyrinogen Oxidase IX (PPO IX) required for the formation of chlorophyll
- ❑ Inhibition of PPO IX releases singlet oxygen which disrupts lipid cell membranes causing leakage.
- ❑ The reaction is light dependent
- ❑ WSSA Class 14



Sulfentrazone Mode of Action

- ❑ **Following soil applications, the product is taken up through the roots.**
- ❑ **Sulfentrazone has limited foliar activity but, at high rates, has some burndown capability.**



Sulfentrazone Mode of Action

- ❑ Resistance has not been observed with sulfentrazone.
- ❑ Sulfentrazone causes susceptible plants to turn necrotic and die shortly after exposure to light.



Sulfentrazone Activity



Mottled Chlorosis on Leaves

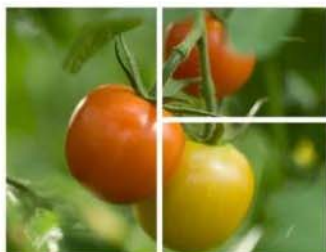


Necrosis

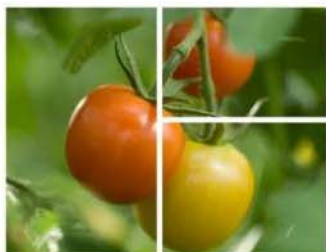


Sulfentrazone Physical Properties

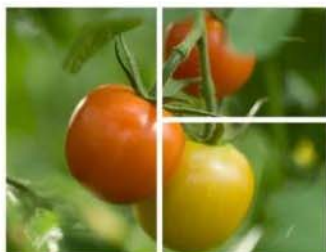
- ❑ **Stable in soil to photolysis**
- ❑ **Has a low potential for field residue binding.**
- ❑ **Stable in lab tests at pH 5 to 9**
- ❑ **Field half life**
 - ❑ **121 days in sandy soil**
 - ❑ **302 days in clay soil**
- ❑ **Low vapor pressure (not volatile)**



- **California Registered Crops**
 - Sunflower
 - Asparagus
 - Cabbage (transplants)
 - Horseradish
 - Mint
- **Registrations anticipated in 2012**
 - Tomato (transplants)
 - Strawberries



- **Product Information**
 - CAUTION signal word
 - 4 lb/gal flowable formulation
- **PPE**
 - Long-sleeved shirt
 - Long pants
 - Shoes plus socks
 - Chemical resistant gloves.
- **REI = 12 hours**



- ✓ Soil Characteristics are important
- ✓ Crop Injury greatest Potential

pH	> 7.5
%OM	Low OM
Texture	Course Soils





Soil Texture Chart



SOIL CLASSIFICATION CHART

<u>COARSE</u>	<u>MEDIUM</u>	<u>FINE</u>
Sand	Sandy clay loam	Silty clay loam
Loamy sand	Sandy clay	Silty clay
Sandy loam	Loam	Clay loam
	Silt loam	Clay
	Silt	

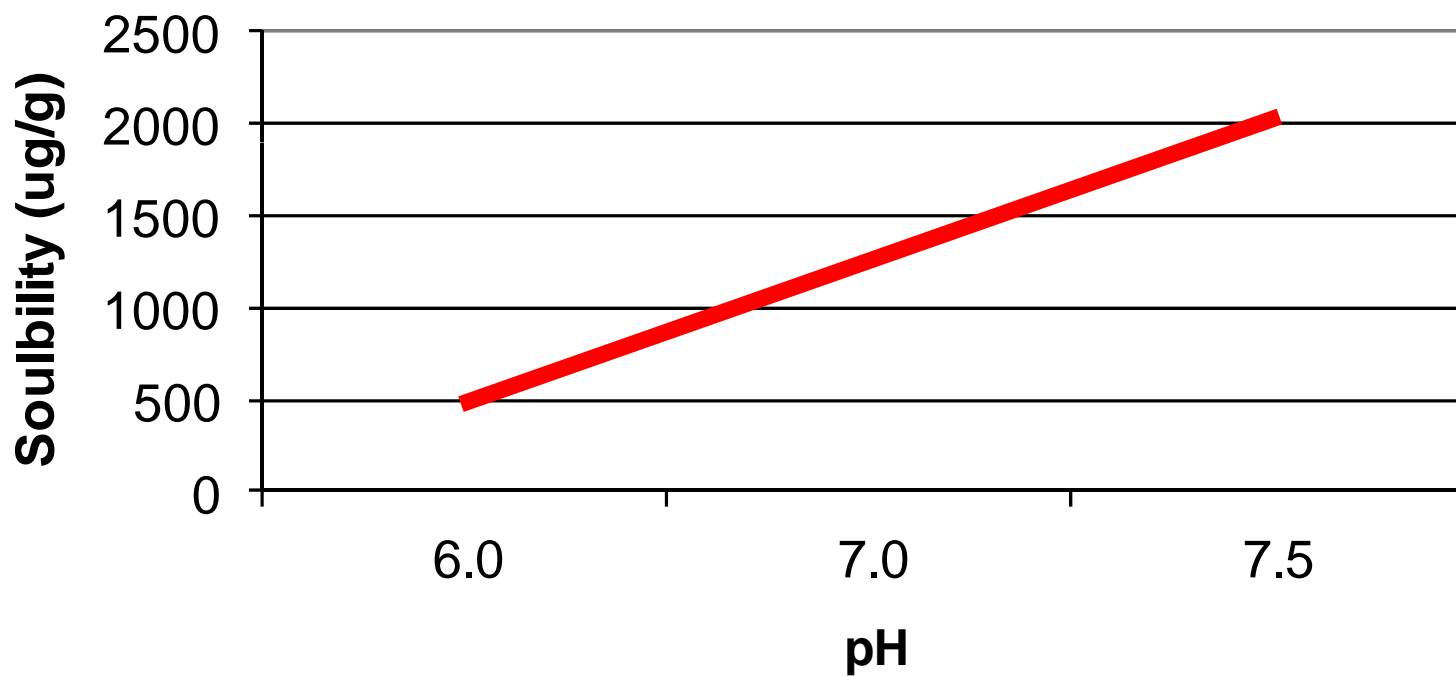
Do not use on coarse soils classified as sand, which have less than 1% organic matter.



Soil pH



INFLUENCE OF PH ON SULFENTRAZONE SOLUBILITY





pH Advisories



Soil pH exerts a dramatic affect on sulfentrazone availability in the soil solution. As soil pH increases, sulfentrazone availability increases. Accurate soil pH will be needed.

It is important to note that irrigation with highly alkaline water (high pH) following a Zeus soil application can also significantly increase the amount of sulfentrazone available in the soil solution. Irrigation with water having a pH greater than 7.5 could result in adverse crop response.



Sample Rate Chart



Spartan 4F Herbicide Use Rate Table TOMATO (Transplanted Only) Preplant Applications

Broadcast Rate	Fluid Ounces Spartan 4F Herbicide per acre		
	Soil Texture		
% Organic Matter	<u>Coarse</u>	<u>Medium</u>	<u>Fine</u>
<1.5%	2.25 – 3.0	3.0 – 4.5	3.0 – 6.0
1.5 – 3.0 %	3.0 – 6.0	6.0	6.0 – 8.0
>3.0 %	6.0 – 8.0	8.0	8.0

Refer to the previous information on soil types under the COARSE, MEDIUM, and FINE categories.

Use higher rates for soils of pH less than 7.0 and lowest rate for pH greater than 7.0 within the rate range.



Moisture is Required to Activate

- **Sulfentrazone can remain on the soil surface for 10-14 days (and longer) but requires rainfall, irrigation, or tillage to move below the surface and activate the herbicide**
- **Weed control may decline if sulfentrazone is not activated in a timely manner**



Moisture is Required to Activate

- **The amount of moisture for activation depends on:**
 - **Soil moisture at application**
 - **Soil type**
 - **Organic matter**
 - **Soil tilth**



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Rotation Intervals

12 months for all other crops not listed below



Crop	Interval (Months)	Crop	Interval (Months)
Alfalfa	12	Mint	Anytime
Asparagus	Anytime	Peanuts	Anytime
Barley	4	Potatoes	Anytime
Brassica, Head and Stem	Anytime	Rice	10
Brassica, Leafy Greens	Anytime	Rye	4
Cabbage	Anytime	Sorghum	10 *
Canola	24	Sugar Beets	36
Cereal Grains (Buckwheat, Oats, Pearl Millet, Proso Millet, Teosinte, Wild Rice)	12	Succulent Peas & Beans	Anytime
Corn, Field	10	Soybeans	Anytime
Corn, Pop	18	Sugarcane	Anytime
Corn, Sweet	18	Sunflowers	Anytime
Cotton	18	Sweet Potatoes	12
Dry Shell Peas and Beans	Anytime	Triticale	4
Flax	Anytime	Tobacco	Anytime
Fruting Vegetables (except cucurbits)	Anytime	Turf	Anytime
Horseradish	Anytime	Wheat	4
Limas	Anytime		
Melons	Anytime		



Rotational Crops

Will not have to do EPA Rotational Crop Trials to reduce the plant back time less than 365 days

- ✓ Tomatoes
- ✓ Broccoli
- ✓ Melons



Rotational Crops

Will need to do EPA Rotational Crop Trials to reduce Plant back interval to be less than 365 day

- ✓ Lettuce
- ✓ Spinach
- ✓ Carrot
- ✓ Onion
- ✓ Cotton



Zeus Tomato – Lanini 2011

Untreated

Zeus Pre @ 3.2 fl oz / acre



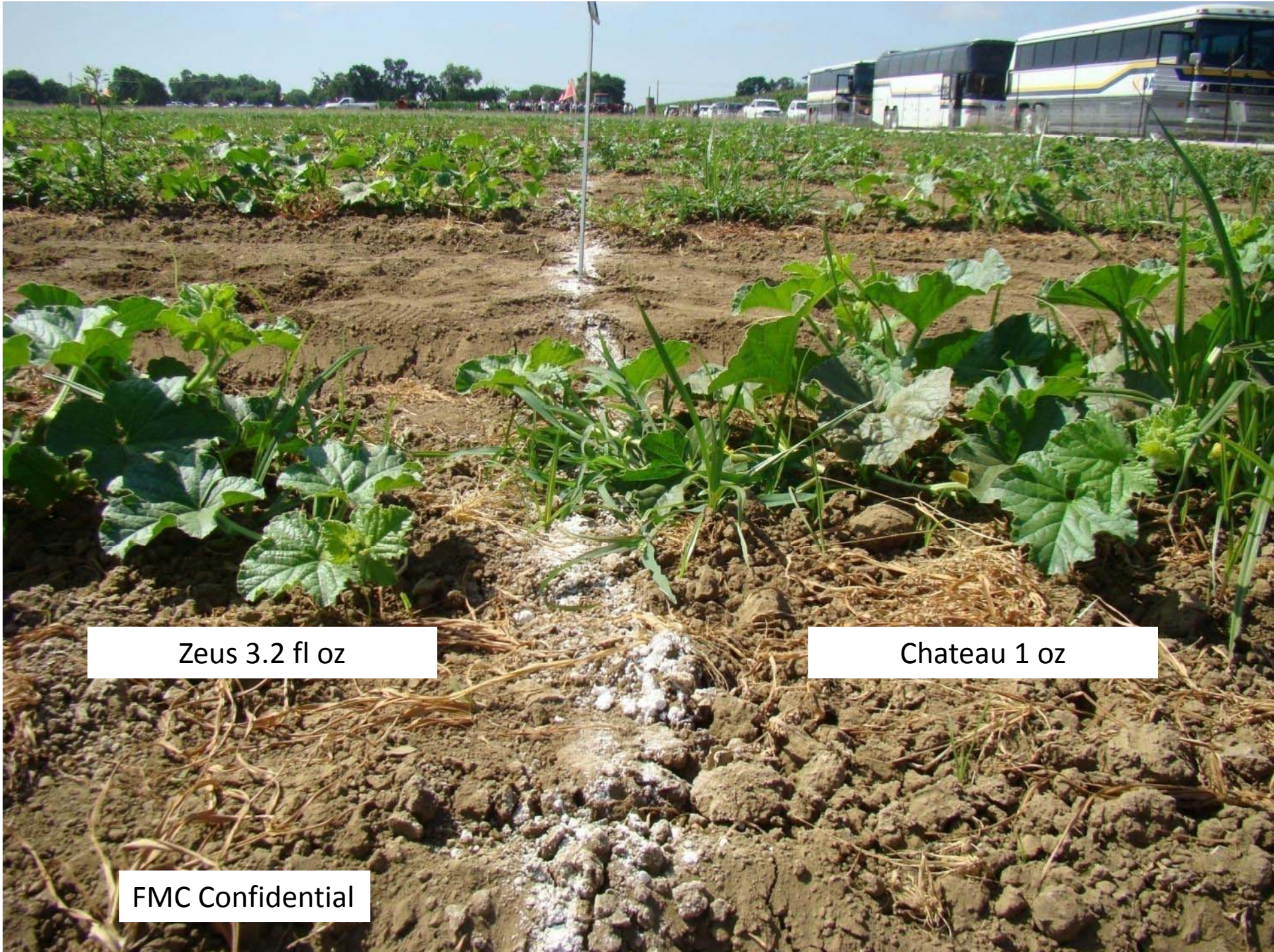


Zeus Tomato Demo – Dixon, CA

Commercial Application – Photo 6/16/2011



Zeus @ 4.5 fl oz /
acre applied to bed
tops. Furrows are
untreated



Zeus 3.2 fl oz

Chateau 1 oz

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Zeus symptoms on Nutsedge



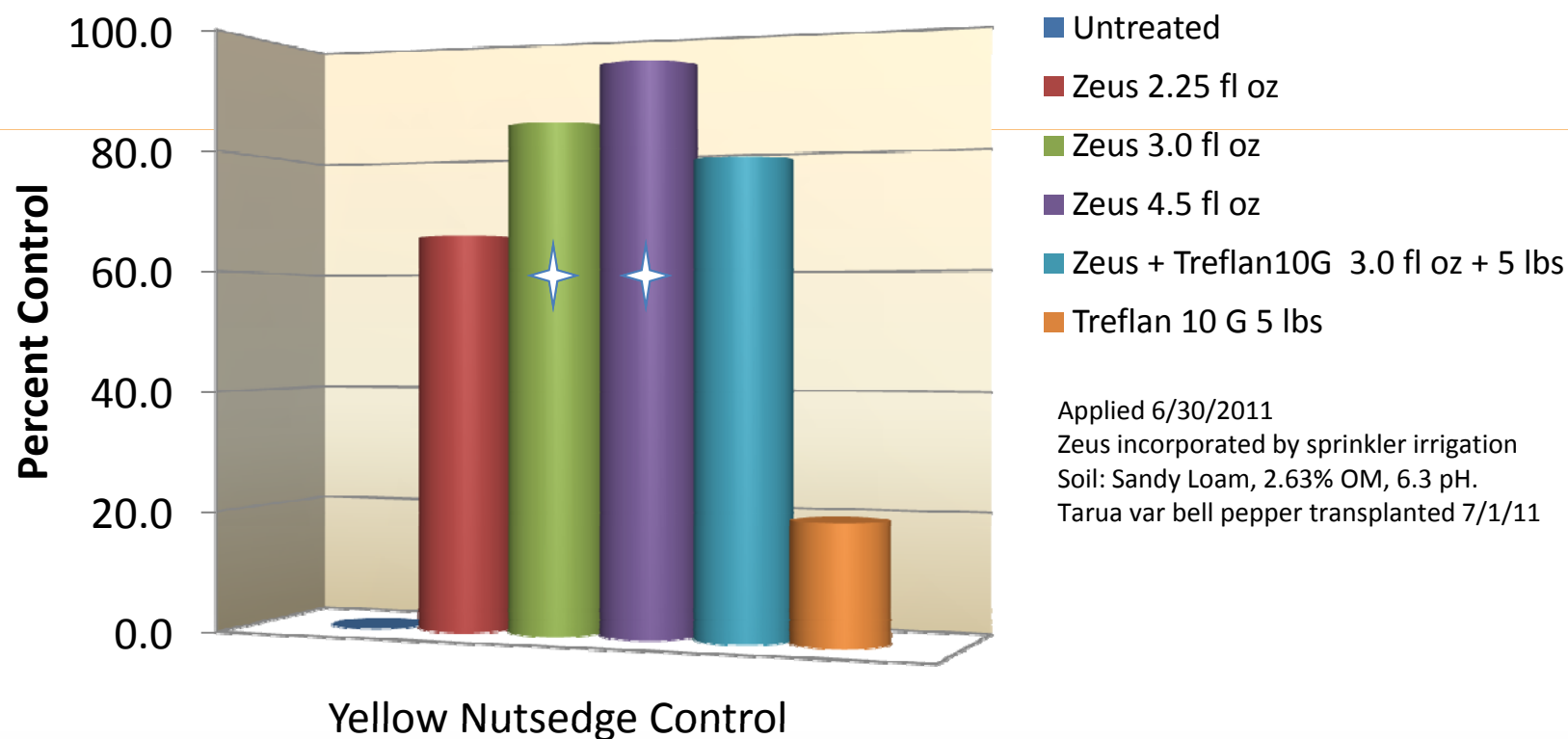


Zeus Bell Pepper

Bio-Research 2011 Fresno, CA



21 Days After Treatment





2010 Zeus Tomato

Tom Lanini, UC Davis, Davis, CA



	Field Bindweed Control		
	Seedling		Established
Treatment (Pre emerge)	6/23	7/2	7/2
Untreated	0	0	0
Zeus 3.2 fl oz	76	88	35
Dual Magnum 1.6 pt	32	81	15
Prowl H2O 2 pt	22	48	22
Matrix 2 oz	50	88	74
LSD 0.05	33	38	42

Trial contained 20 treatments

Applied 6/9/ 10; Transplanted 6/11/10 & Sprinkler irrigated



Zeus Tomato – Lanini 2010

7-15-2010

Zeus 4.8 fl oz / acre

Untreated





2010 Zeus Tomato Wilbur-Ellis Dixon, CA



% Weed Control 24 DAT (6/28/2010)						
Treatment	Nightshade	Velvetleaf	Lambsqtr	Malva	Purslane	Bindweed
Zeus 4.5 oz	90.0	90.0	90.0	95.0	93.3	60.0
Zeus 6.0 oz	90.0	90.0	95.0	95.0	95.0	60.0
Zeus 4.5 oz + Dual 24 fo	95.0	95.0	95.0	95.0	95.0	60.0
Dual 24 fo + Tref 20 fo	40.0	70.0	95.0	93.3	95.0	60.0
Zeus 4.5 oz + Tref 20 fo	13.3	85.0	95.0	95.0	95.0	60.0
Brawl 32 fo + Trifl 24 fo + Metri 16 fo	75.0	86.7	95.0	95.0	95.0	60.0

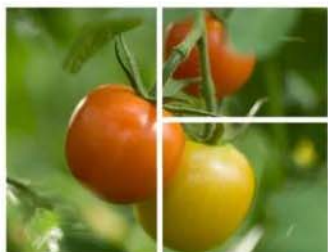
Applied 6/4/2010 (All plots treated with Matrix @ 4 oz/a 6/30/10 for black nightshade and velvetleaf.

H9780 Processing Tomatoes transplanted on 6/10/2010.

Single plots 15 x 130 ft.

No crop injury with any treatment.

Silty Clay Loam 1.5% OM 7.3 pH

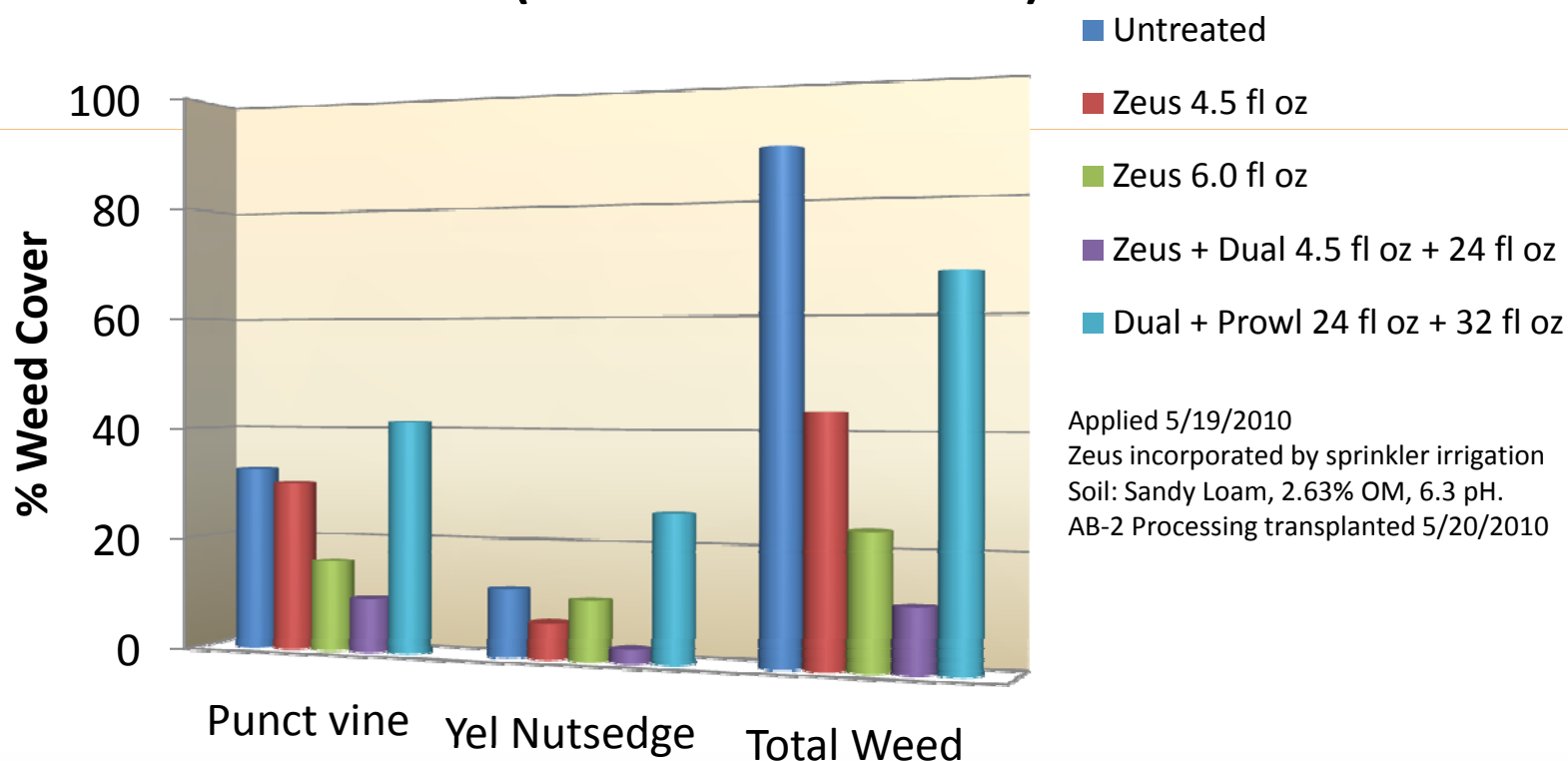


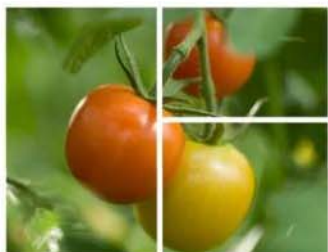
Zeus Tomato

Bio-Research 2010 Fresno, CA



21 Days After Treatment
(Short bars are better)



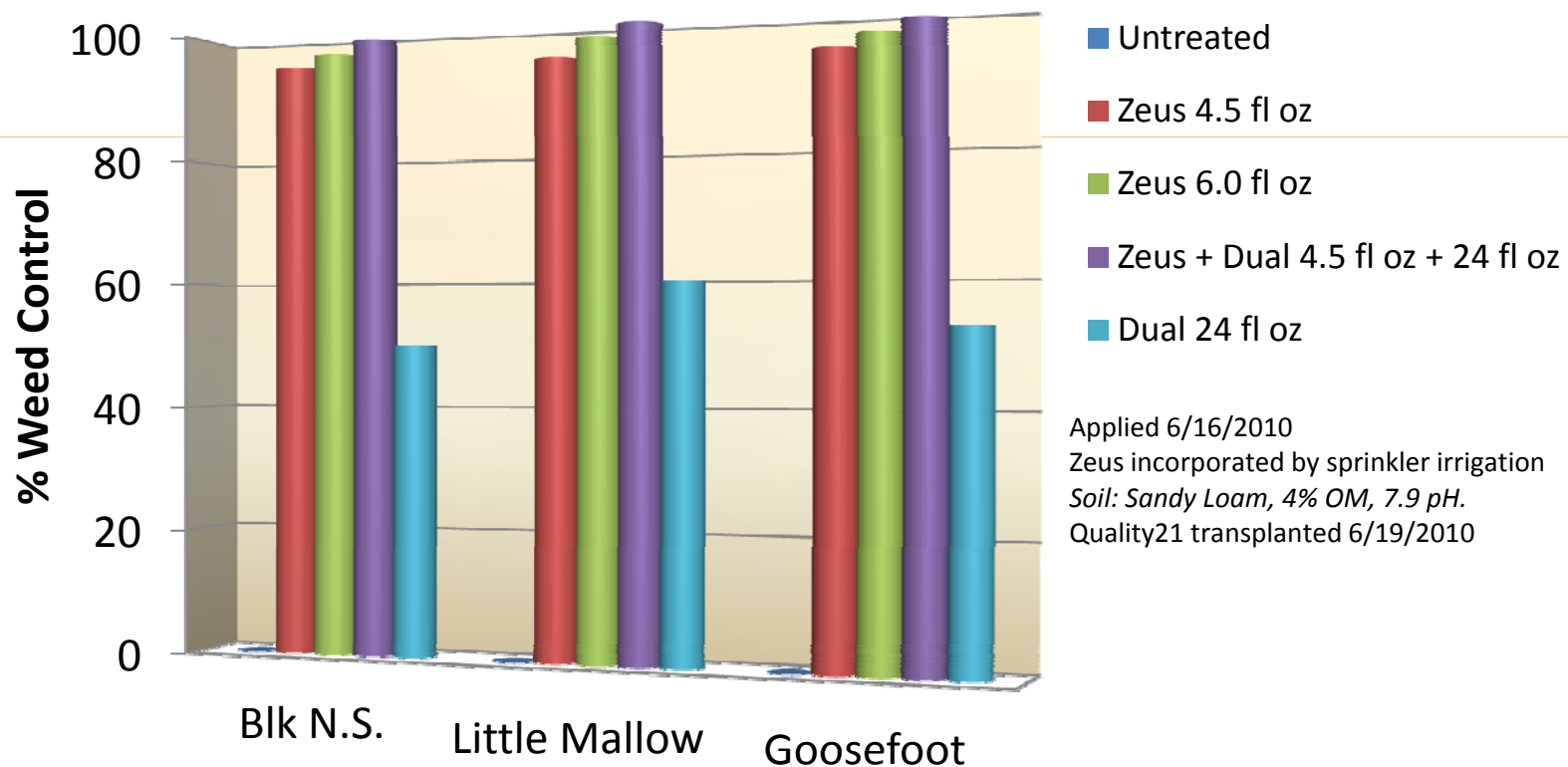


Zeus Tomato

Zaccaria 2010 Guadalupe, CA



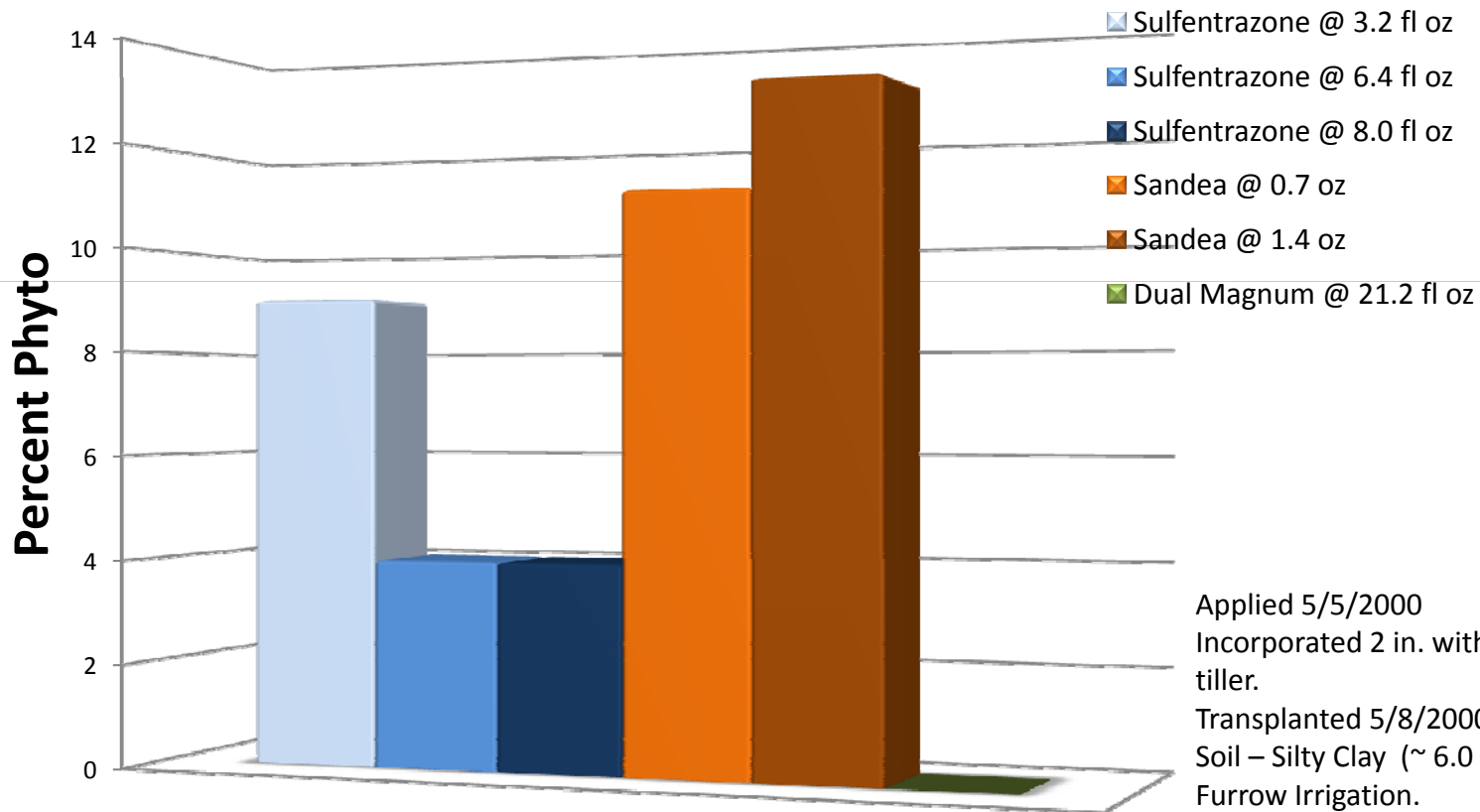
28 Days After Treatment





2000 Tomato Transplants

Tracy (Mullen, UCCE San Joaquin)



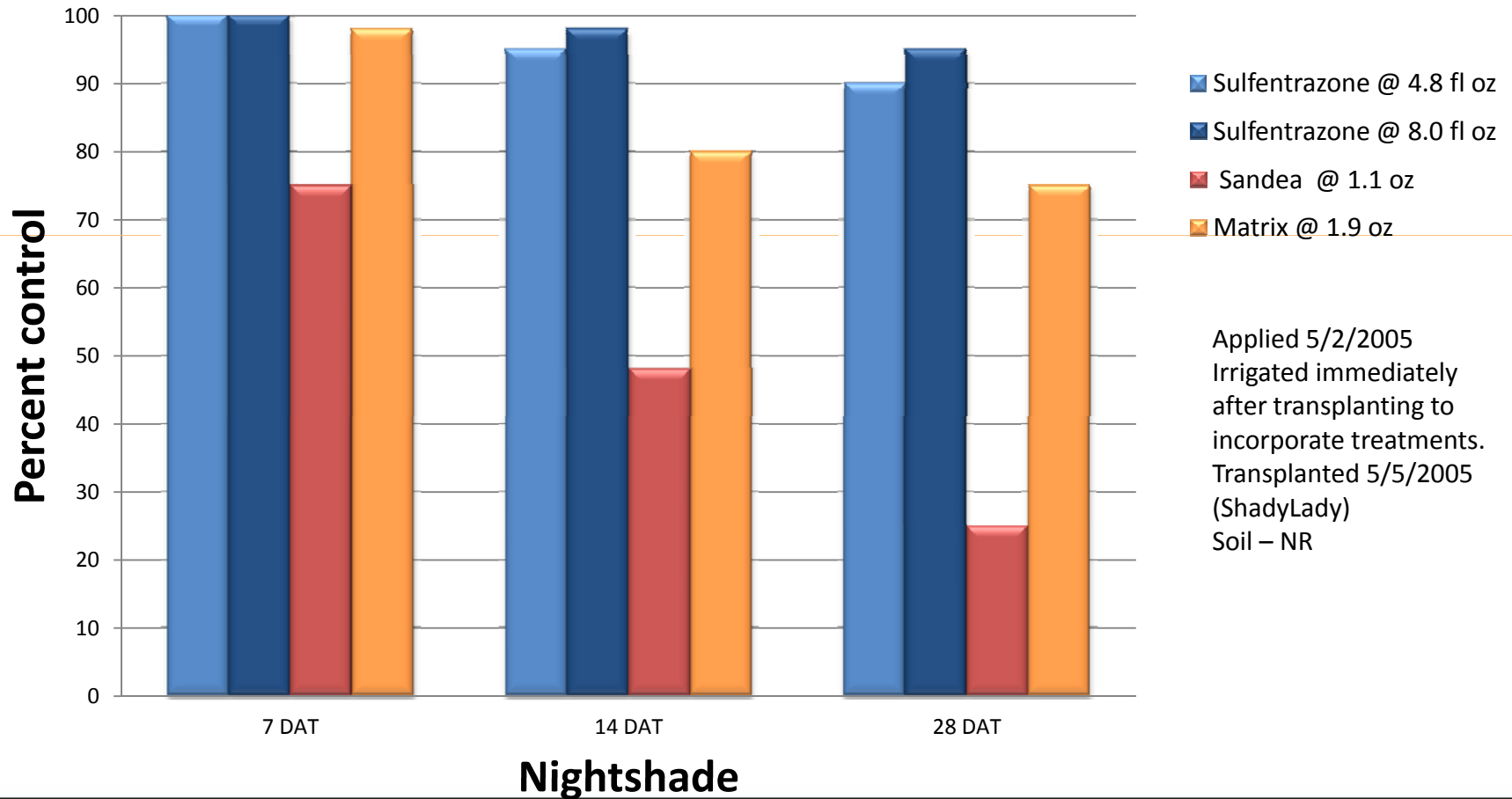
Applied 5/5/2000
Incorporated 2 in. with rotary tiller.
Transplanted 5/8/2000 (H-9775)
Soil – Silty Clay (~ 6.0 fl oz Zeus)
Furrow Irrigation.

Crop Injury 41 DAT



2005 South Coast REC

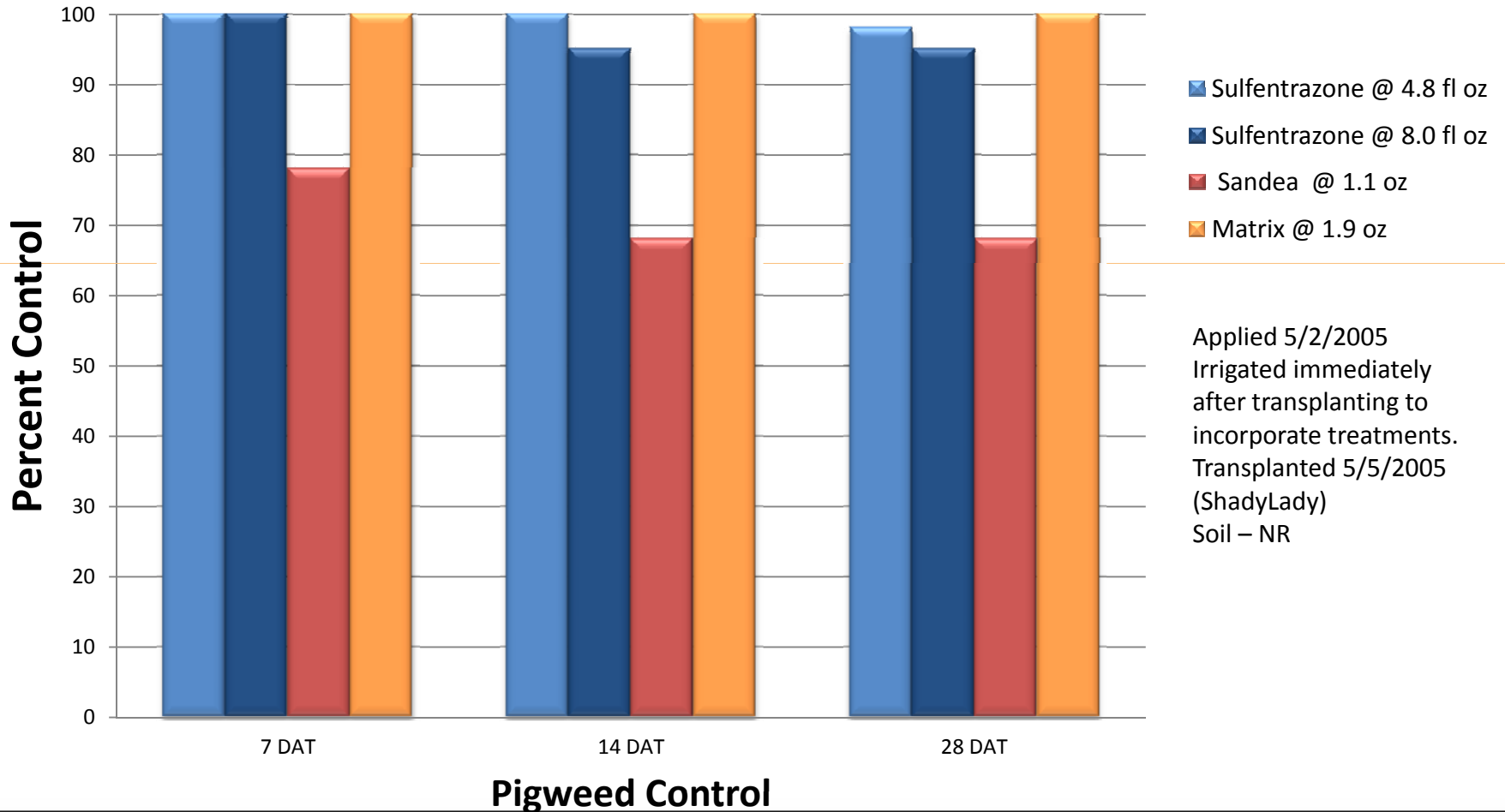
Tom Lanini UC





2005 South Coast REC

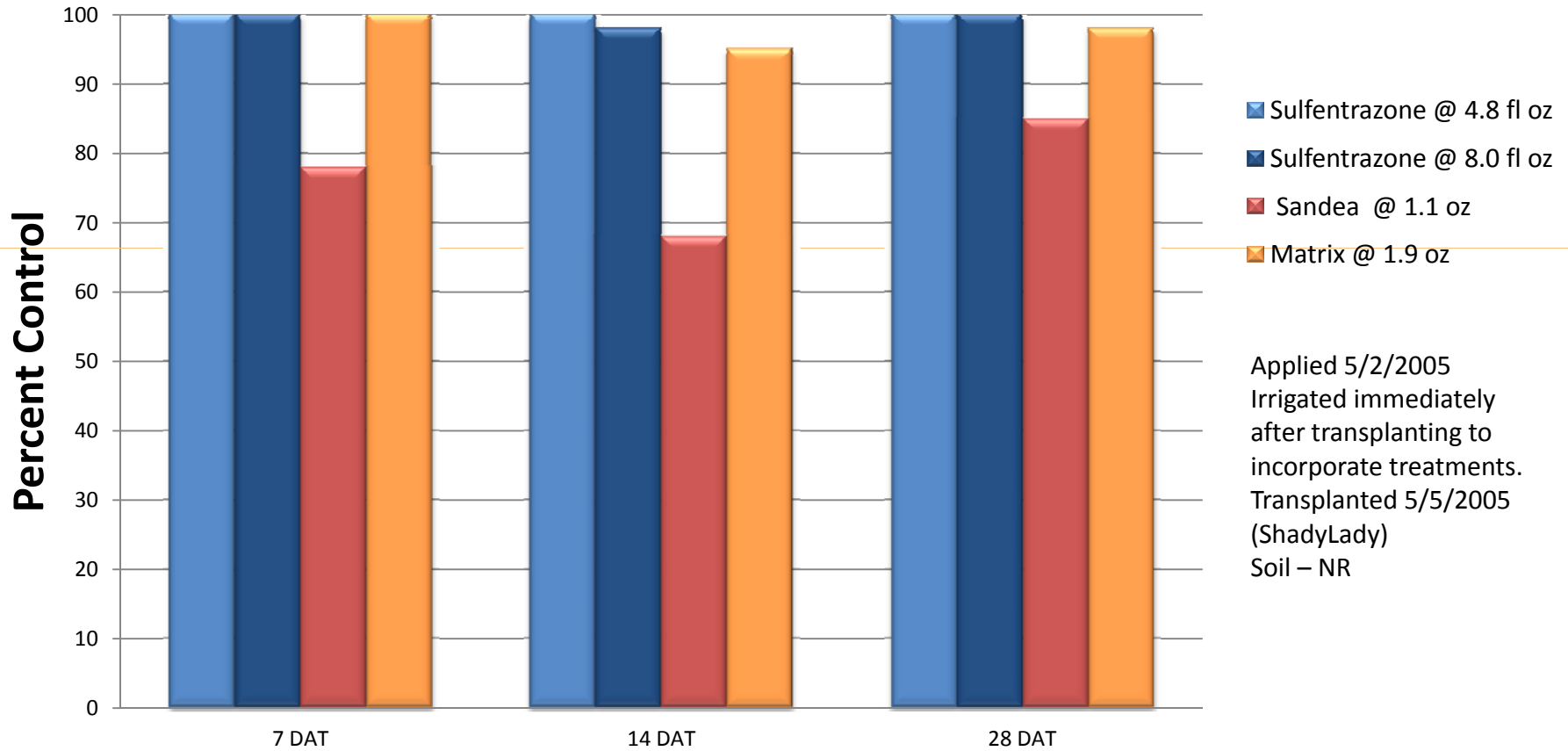
Tom Lanini UC





2005 South Coast REC

Tom Lanin UC



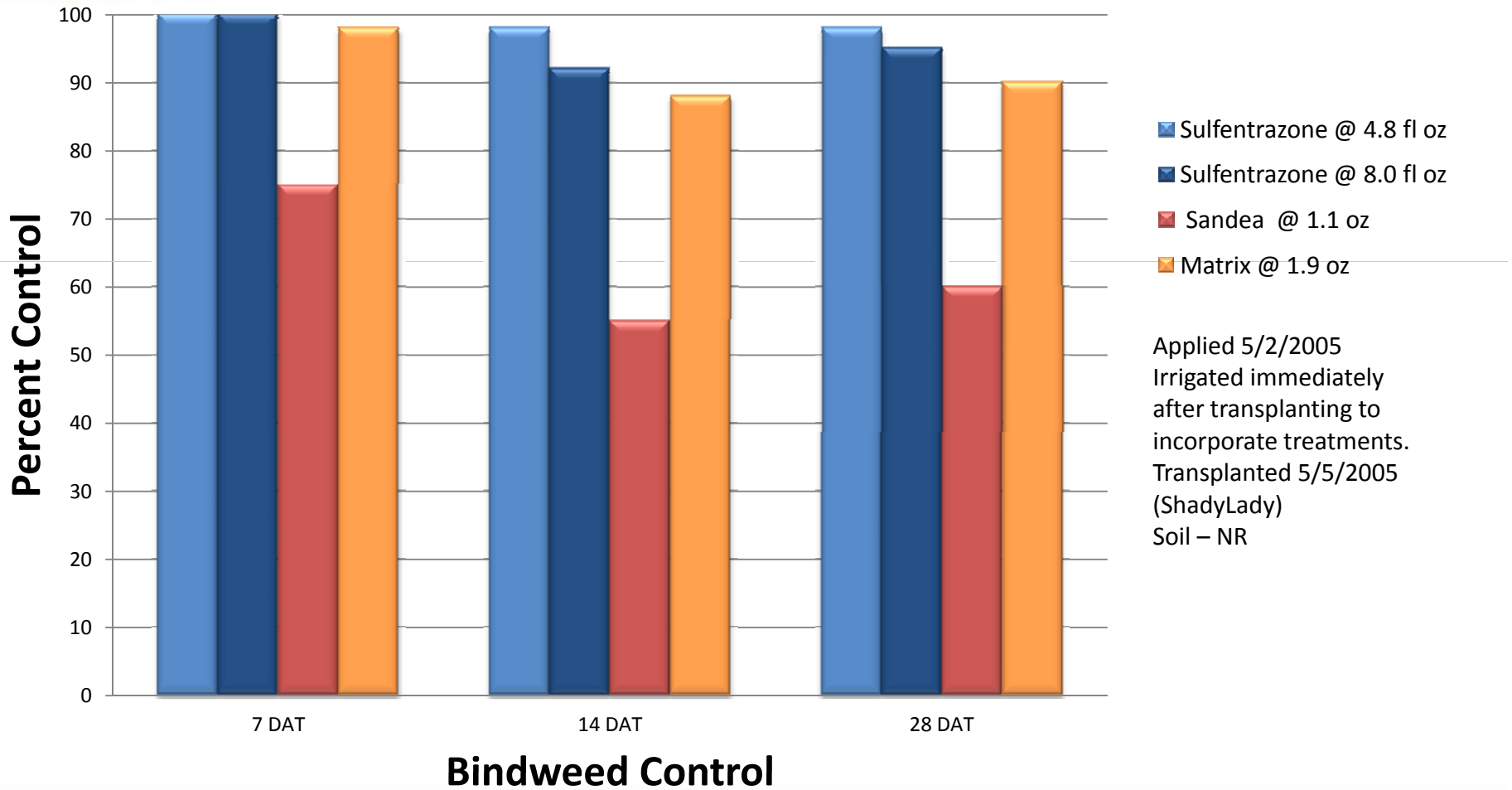
Applied 5/2/2005
Irrigated immediately
after transplanting to
incorporate treatments.
Transplanted 5/5/2005
(ShadyLady)
Soil – NR

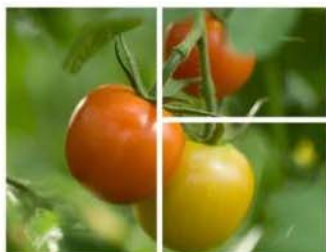
Lambsquarters Control



2005 South Coast REC

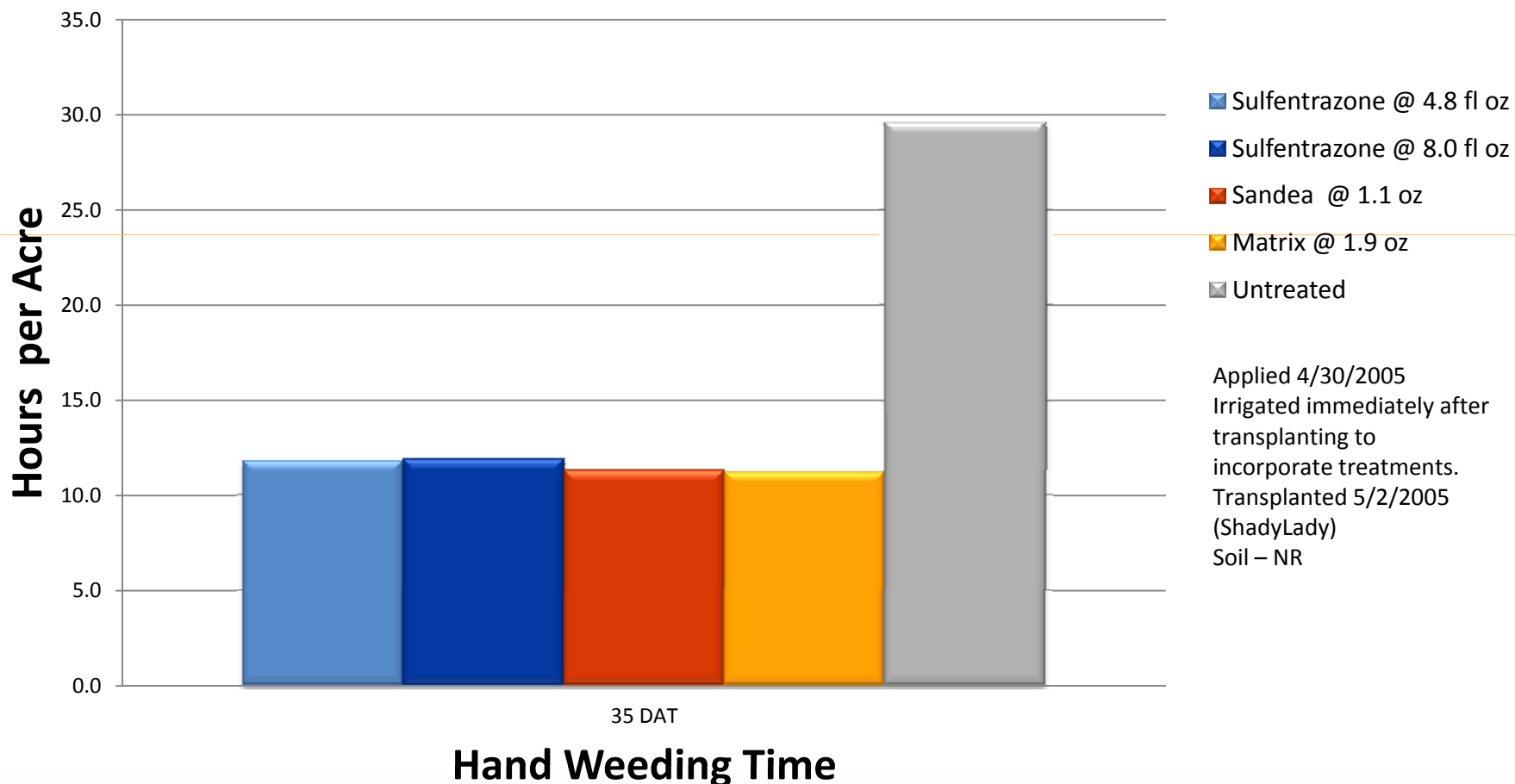
Tom Lanini UC





2005 U.C. Davis

Tom Lanini UC





Zeus Strawberries



- Spartan currently has Section 3 registration on strawberries
- Spartan has been used for several years without incident in strawberries under Section 18's
- Current Spartan strawberry label does not fully address CA conditions.
 - Does not permit treatment of wheel rows.
 - Max seasonal use rate is 12 fl oz
 - Max rate per application is 8 fl oz (depending on soil type)
 - No treatment to transplant interval



• Questions