

## Changes to Preemergent Herbicide Use Maintains Weed Control and Reduces Off Site Movement Risk in Citrus

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### Introduction

In the San Joaquin Valley of California, weeds are currently managed with preemergent herbicides in fall and winter seasons to control germinating weeds. At least half of the annual preemergent herbicide is applied during the fall in order to maintain bare soil through the winter because vegetation cover during the winter is thought to lower tree canopy temperature. Clean citrus orchard middles often are compacted and have low water infiltration rates. Low infiltration rates and a smooth soil surface result in a greater potential for surface runoff. Losses of herbicides from soil to surface runoff water result in a decrease in the effectiveness of the soil herbicide and increase the risk of lower water quality. Effectively managing weed problems in citrus orchards while maintaining environmental and human health is an objective of our work.

### Materials and Methods

Two sites were established, one near Clovis in Fresno county and the other near Ivanhoe in Tulare county. The Clovis site was in a mature grove of Navelencia oranges on a soil with 44% sand and 31% clay content. The Ivanhoe site was in an 8 years old grove of Valencia oranges. Studies were conducted from 1996 to 1998. Treatments established in each grove are listed in Table 1&2. The experimental design was a randomized complete block with 4 replications in 1996 - 1997 study and 6 replications in 1997 – 1998 study. Herbicides were applied to the soil surface over the entire orchard floor.

Total weeds by species were counted in April 1997 and May 1998 by sampling the entire area of 4 trees for each plot at both sites. Total weed numbers of each plot was logarithmically transformed before performing analysis of variance. Statistical analyses were performed using general linear model (GLM) procedure in the Statistical Analysis System (SAS, 1985). All statistical tests were performed at  $\alpha = 0.05$  level of significance.

**Table 1. Treatments selected for study at Clovis citrus. Treatment 1 is defined as grower standard**

Trt #	Herbicide	Rate (lb ai /ac)		Season of Application	Additive	Non-chemical
		96 – 97	97 – 98			
1	Simazine, diuron	2.0 2.0		Fall Winter	none	none
2	Simazine, diuron	1.0 1.25		Fall Winter	Silicon Surfactant	none
3	Glyphosate, Simazine, and diuron	1.0	2.0	Fall Winter	none	none
4	Glyphosate, Simazine, diuron	1.0 1.0	1.0 1.0	Fall Winter	Silicon Surfactant	
5	Simazine, diuron	2.0 2.0		Fall Winter	PAM	
6	Untreated				none	none

**Table 2. Treatments selected for study at Ivanhoe citrus. Treatment 1 is defined as grower standard.**

Trt #		Rate (lb ai /ac)		Season of Application	Additive	Non-chemical
		96 – 97	97 – 98			
1	Simazine, diuron	2.0	2.0	Fall Winter	none	none
2	Simazine, diuron	1.0	1.25	Fall Winter	Silicon Surfactant	none
3	Glyphosate, Simazine, diuron	1.0 2.0		Fall Winter	none	none
4	Glyphosate, Simazine, diuron	1.0 1.0	1.0 1.0	Fall Winter	Silicon Surfactant	
5	Simazine, diuron	2.0		Fall Winter	PAM	
6	Simazine, diuron	2.0	2.0	Fall Winter	none	Mech. Incorp.
7	Untreated				none	none

## Results And Discussion

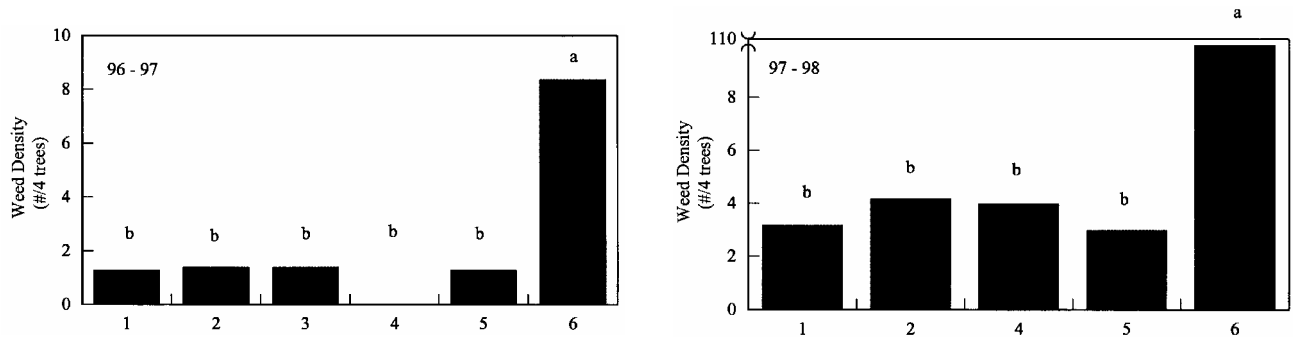
In 1996 – 1997, weed species and density data recorded in early April illustrated the effective control achieved with all treatments at the Clovis site (Fig. 1). Plots with herbicide treatments had significantly fewer weeds than the untreated control. Weed species included: common groundsel, redstem filaree, burr medic, horseweed, annual sowthistle, and purple cudweed. Data at Ivanhoe site showed that postemergent herbicide use in the fall, followed by preemergent herbicide in late winter (treatments 3 and 4 in Table 2) were not significantly different from the untreated control (Fig. 2). All herbicide treatments besides treatment 3 (1.0 lb glyphosate in fall and 2.0 lb/ac simazine + 2.0 diuron in winter) had the same total weed density as the grower standard treatment (treatment 1). Weed species at Ivanhoe included: spotted spurge, common groundsel, horseweed, annual sowthistle and purple cudweed. Spotted spurge and common groundsel consisted of almost 100% total weeds found in the treated plots.

The result obtained in 1997 - 1998 showed that no significant difference in weed density was found between herbicide treatments at the Clovis site (Fig. 1). Plots at the Ivanhoe site had similar results (Fig. 2). All herbicide treatments significantly differed from untreated plots. Weed

species at Ivanhoe site included spotted spurge, common groundsel, annual sowthistle, horseweed and hairy fleabane. Spotted spurge and common groundsel consisted of about 98% total weeds found in the treated plots. Spotted spurge and common groundsel were dominant in younger orchards treated with simazine and diuron application.

Two years' results showed that reduced rates (1.0 lb herbicide  $ac^{-1}$  or 1.25 lb herbicide  $ac^{-1}$ ) were as effective as the standard rate at 2.0 lb herbicide  $ac^{-1}$  at both sites. Data from both sites also showed that weed density in 1997 – 1998 was larger than in 1996 – 1997, especially for the younger grove at Ivanhoe site. Increased weed density most likely resulted from high rainfall in 1997-1998. For example, significant rainfall-runoff events occurred after winter application of herbicide in 1998. However, in 1996- 1997 period, no rain occurred after herbicide application in winter 1997. Rainfall – runoff events could result in herbicide loss and reduce its efficiency on weed control. The Clovis site had much lower weed populations in untreated controls and herbicide treated plots compared to the younger grove at Ivanhoe. A combination of a depleted seed bank from continuous use of herbicides and shading may have contributed to lower weed populations at Clovis site. Movement of herbicides to groundwater is an ongoing problem. Lower application rates reduces the amount of herbicide available for off-site movement while maintaining weed control equivalent to standard farmer application. A fall application of postemergent herbicide followed by preemergent in late winter avoids most of the heavy winter rainfall and reduce the risk of off-site herbicide movement. Modifying how preemergent herbicides are used to control weeds is becoming increasingly important to protect both our environment and our ability to continue use of these important weed control tools.

**Figure 1. Total weed density of each treatment at Clovis site. Treatment numbers along the x-axis refer to the treatments listed in table 1. Means with the same letter are not significantly different to an LSD test at the 0.05 level.**



**Figure 2. Total weed density of each treatment at Ivanhoe site. Treatment numbers along the x-axis refer to the treatments listed in table 2. Means with the same letter are not significantly different to an LSD test at the 0.05 level.**

