Evaluation of crop-safety of PICKIT system on California-grown processing tomatoes. Matt Fatino, Mohsen Mesgaran, and Brad Hanson. University of California, Davis.

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Broomrape (*Phelipanche* syn. *Orobanche sp.)* are parasitic weeds native to the Middle East. The biology of broomrape makes its control via conventional weed control practices very difficult. Broomrape seeds germinate after receiving a signal from a suitable host plant and quickly attach to the host roots via a specialized structure known as a haustorium. Most of the broomrape lifecycle is spent below the soil surface. The above ground portions of the plant lack chlorophyll and quickly produce a large amount of seed, which are highly persistent in the soil seedbank. Broomrape is not currently common in California, but is an "A-listed" noxious weed and has been detected in several processing tomato fields in recent years.

A study was conducted at the UC Davis Department of Plant Sciences Field Research Facility near Davis, CA to evaluate the crop-safety of the Israeli-developed PICKIT decision support system for control of branched broomrape (*Orobanche ramosa)* in processing tomato. The PICKIT decision support system relies on a thermal time model (Growing Degree Days) to predict broomrape phenological stages. Based on these predictions, ALS inhibitor herbicides are applied at very low rates at times intended to target specific broomrape life stages and attachment to the host crop.

The soil composition at this site was 28.6% loamy alluvial sand and 71.4% Reiff very fine sandy loam. The site did not contain broomrape; this experiment focused on crop safety (0.5X, 1X, 2X rates) of herbicides used in the Israeli system that are not currently registered for use in tomato in the United States. Plots were 40 feet long on 60-inch beds with one plant line in the center of the bed. 'Heinz 1662' processing tomato transplants were spaced at a 12-inch spacing within the row. Each bed had two 5/8-inch drip lines buried 12 inches slightly off-center with 0.16 GPH emitters spaced every 12 inches; one line was ran the full length of the beds and was used for crop irrigation and fertigation, the second line was terminated at the end of each plot and used to apply the chemigation herbicide treatments via an above-ground manifold system. Plots were arranged in a randomized complete block design with four replications.

The PPI application of sulfosulfuron was made on April 22 before transplanting. PPI herbicides were applied using a backpack sprayer and two-nozzle boom delivering 30 GPA with AIXR 1103 nozzles at 28 PSI. PPI treatments were mechanically incorporated to 3 inches after application. Tomatoes were mechanically transplanted with a single-row transplanter on April 22, 2020. Drip herbicide injections were made using CO_2 to push a chemigation mix into the terminated lines in each plot. Treatments were applied to 2 plots at once; replications 1 and 2 were applied together while replications 3 and 4 were applied together. Treatments were applied with 11L of solution over approximately 15 minutes, followed by 20 minutes of water to flush the lines. The PICKIT system's thermal time model is based off growing degree days (GDD), and called for applications at 400, 500, 600, 700, and 800 GDD depending on treatment intensity and began May 13, 2020 (Table 1). Foliar imazapic treatments were made on June 12, 2020 and

21 days later (July 6, 2020) with a 2-nozzle backpack sprayer delivering 30 GPA with AIXR 1103 nozzles at 28 PSI. Phytotoxicity data (percent affected plants) were taken every two weeks. Plant heights were taken in the middle of the growing season. One-meter square sections of row will be harvested at commercial maturity in late August 2020 (Tables 2,3, and data not shown).

Table 1. Growing Degree Day targets and actual application dates.

Growing Degree Day Target	Application Date
PPI	4/22/2020
400	5/13/2020
500	5/21/2020
600	5/27/2020
700	6/1/2020
800	6/3/2020
Foliar	6/12/2020
Foliar 21 Days POST	7/6/2020

*. Cumulative Growing Degree Days (GDD) were calculated after planting date by using the formula $GDD = \sum(\bar{T} - T_b)$, where $\bar{T}$ is mean daily temperature and T_b is the base temperature set at 10 ℃ (50 degrees Fahrenheit). Both experiments use the same plot randomization.

There was no observed phytotoxicity on processing tomato in any of the treatment plots. This follows a trend from 2019, in which there were no significant difference in phytotoxicity across treatments in two previous runs of this experimental protocol (see report for IS00330-19-CA01). There were no significant differences in tomato plant heights across treatments (Table 2). Heights ranged from 20 to 22 inches. This too follows a trend in no differences in tomato height across treatments in 2019 trials. Yield data were not available as of the writing of this interim report but will be added once available.

After two calendar seasons, and three field trials, the PICKIT decision support system seems to have high crop safety in California processing tomato systems. An efficacy trial was conducted in an infested field in 2020, as well as a 2019-2020 rotational crop safety study examining the residual effects of the 2019 PICKIT herbicides on commonly rotated crops during the 2020 season; tomato crop safety was adequate in both of these experiments as well.

Table 2. **Mean phytotoxicity percentages by treatment. Mean tomato plant heights by treatment. Numbers with the same letter are not significantly different.**

2020 UC Davis Crop Safety Field Experiment						Percent Phytotoxicity					Height (in)	Yield Kg/m row
Trt. No	**Treatment**	**Rate**	**Rate**	**Application**	**GDD Appl.**	**6/3/20**	**6/12/20**	**6/26/20**	**7/7/20**	**7/21/20**		-**
1	Untreated Check					0.0a	0.0a	0.0a	0.0a	0.0a	20.9a	-
2	Treflan	2.57 pt/a		PRE		0.0a	0.0a	0.0a	0.0a	0.0a	21.1a	-
	Matrix	1 oz wt/a		POST								
3	Sulfosulfuron (Outrider)	0.535 oz ai/a	4.8 g ai/ha	PPI	400, 500,	0.0a	0.0a	0.0a	0.0a	0.0a	21.0a	-
	Imazapic (Cadre)	0.0685 oz ai/a	4.8 g ai/ha	CHEM x5	600, 700, 800							
4	Sulfosulfuron (Outrider)	0.535 oz ai/a	37.5 g ai/ha	PPI	400,600	0.0a	0.0a	0.0a	0.0a	0.0a	20.8a	-
	Imazapic (Cadre)	0.0685 oz ai/a	4.8 g ai/ha	CHEM x2								
5	Imazapic (Cadre)	0.0343 oz ai/a	2.4 g ai/ha	POST		0.0a	0.0a	0.0a	0.0a	0.0a	20.5a	-
6	Sulfosulfuron (Outrider)	1 oz ai/a	70 g ai/ha	PPI	400, 500,	0.0a	0.0a	0.0a	0.0a	0.0a	21.8a	-
	Imazapic (Cadre)	0.137 oz ai/a	9.6 g ai/ha	CHEM x5	600,700,800							
7	Sulfosulfuron (Outrider)	1 oz ai/a	70 g ai/ha	PPI	400, 600	0.0a	0.0a	0.0a	0.0a	0.0a	22.2a	-
	Imazapic (Cadre)	0.137 oz ai/a	9.6 g ai/ha	CHEM x2								
8	Imazapic (Cadre)	0.0685 oz ai/a	4.8 g ai/ha	POST		0.0a	0.0a	0.0a	0.0a	0.0a	20.9a	-

* Means were analyzed using ANOVA and Tukey-HSD tests (P-value=0.05); means with the same letter show no significant difference. PPI: preplant incorporated, POST: post emergent, CHEM: chemigation.

** tomato fruit yield will be determined in late August 2020 and this interim report updated (8/5/20 Hanson)