Response of Transplanted Tomatoes to Pre-plant Herbicides

Jorge Angeles[1]*, Kurt Hembree[2], and Anil Shrestha[1]
[1]California State University, Fresno
[2]University of California Cooperative Extension, Fresno

ABSTRACT: With the continued use of pre-plant herbicides in new processing tomato systems, the possibility of herbicide persistence affecting crops is of new concern. This study evaluated the above- and below-ground response of transplanted tomato to common pre-plant herbicides. The herbicides were trifluralin, *s*-metolachlor, and pendimethalin at doses of 0, 0.5, 1, 2, 4, and 6 ppm. The results showed that all the herbicides inhibited root growth at a dose of 1 ppm. In 2015, another study was done at reduced doses of 0, 0.03, 0.06, 0.12, 0.25, and 0.5 ppm. All the herbicide high rates reduced the above- and below-ground biomass when compared to untreated plants. Between herbicides, pendimethalin was the safer than the other two herbicides, while *s*-metolachlor had the highest potential to cause injury to tomato plants.

INTRODUCTION: Processing tomato planting in the San Joaquin Valley has transitioned to the use of transplants, buried drip irrigation, and shallow tillage. The use of buried drip tape with shallow tillage on semi-permanent beds has also facilitated the rotation of crops due the 10-12" depth of the tape and its durability. The use of pre-plant herbicides in tomato production were generally safe and caused no negative effects on plant health. However, in recent years, there are reports of dinitroaniline injury symptoms in processing tomato fields that had been treated with common pre-plant herbicides. New growing conditions were also used in these tomato fields. The discovered injury symptoms consisted of stunted plant growth and reduced root development. It is suspected that the breakdown of pre-plant herbicides was facilitated more when deep tillage was done after harvest than under the current grower practices.

OBJECTIVE: To evaluate above- and below-ground response of transplanted tomato to common pre-plant herbicides.

METHODOLOGY: Two greenhouse studies were conducted in Fresno, CA in summers of 2014 and 2015 to assess plant injury to simulated residues of pre-plant herbicides. The experimental design was a two factor (herbicide type and dose) randomized complete block with four replications. Sandy loam soil was collected and mixed with pre-plant herbicides using a cement mixer at different rates. The herbicides were trifluralin (Treflan), *s*-metolachlor (Dual Magnum), and pendimethalin (Prowl H_2O) at doses of 0, 0.5, 1, 2, 4, and 6 ppm in 2014. In 2015, the doses were reduced to 0, 0.03, 0.06, 0.12, 0.25, and 0.5 ppm. After the soil was mixed with the herbicides, it was placed in 3 gallon plastic pots and tomato seedlings were transplanted. The tomato plants were grown for 45 days. Plant height, chlorophyll concentration of leaves, and stomatal conductance were monitored weekly. At 45 days, plants were clipped and separated to determine leaf area and dry biomass. Data was analyzed using ANOVA procedures, and non-linear regression models were used to calculate the dose required to reduce biomass by 50% (GR50%).

RESULTS AND DISCUSSION: From the results in greenhouse study of 2014, it was determined that the pre-plant herbicides inhibited root growth at residual rates of 1 ppm (Fig.1.). The root biomass from the greenhouse study in 2015 showed that the high rates of all the herbicides inhibited root growth when compared to the untreated plants (Fig.3.). Trifluralin and *s*-metolachor resulted in greater reductions in above- and below-ground biomass than pendimethalin. The GR_{50} of trifluralin and *s*-metolachlor was estimated to be 0.45 and 0.48 ppm, respectively for above-ground biomass and 0.5 and 0.22 ppm, respectively for below-ground biomass. Pendimethalin caused some reductions in the above- and below-ground biomass only at the highest dose (Fig.4.). Leaf area and final plant height was also reduced by about 50% and 30% in the *s*-metolachlor (Dual Magnum) treated plants at 0.5 ppm (Fig.4.). Chlorophyll concentration and stomatal conductance of the leaves was generally reduced at the higher doses of all herbicides compared to the untreated control, again the reductions were greater in the trifluralin and *s*-metolachlor treated plants.

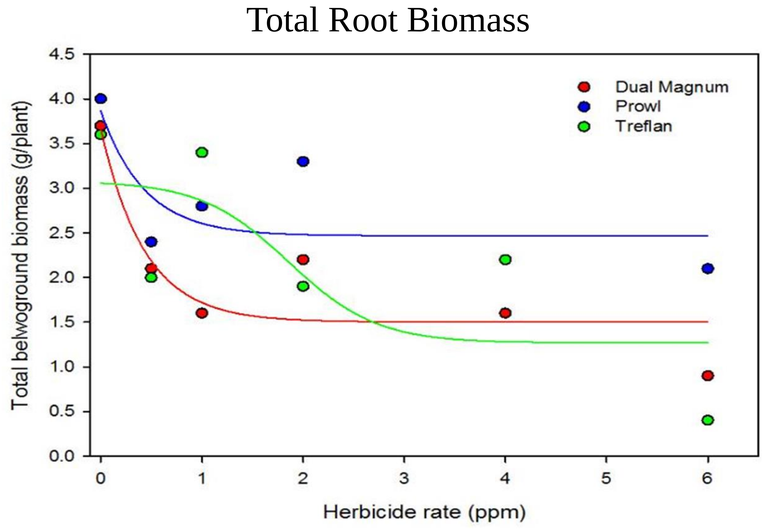

Fig.1. Non- linear regression for root biomass for all treatments in 2014.

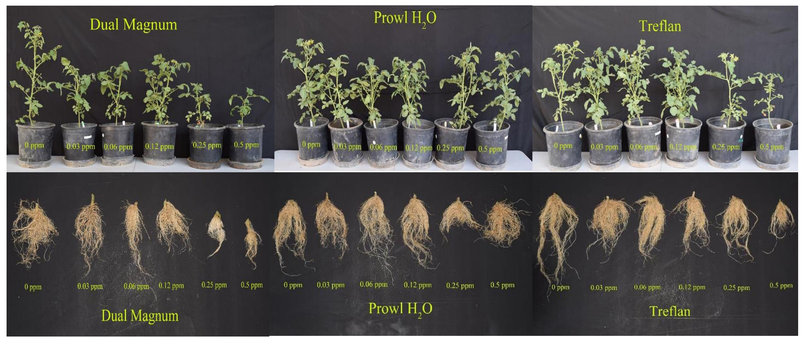

Fig. 2. Plants and roots at 45 days for all herbicides and rates (parts per million)

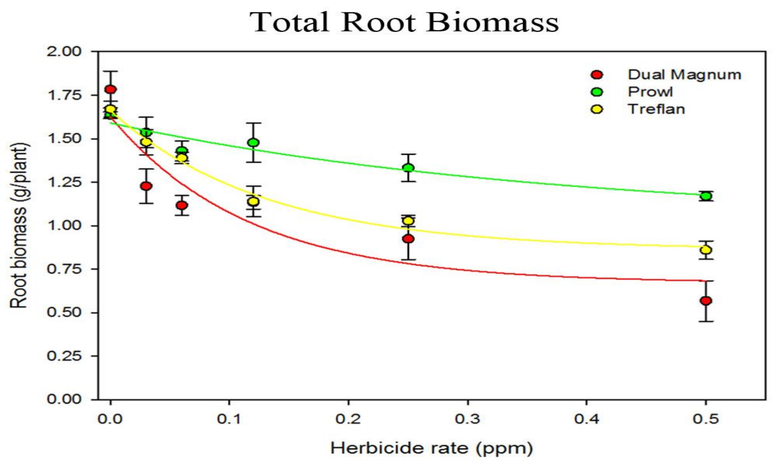

Fig. 3. Non-linear regression for total root biomass for all treatments in 2015.

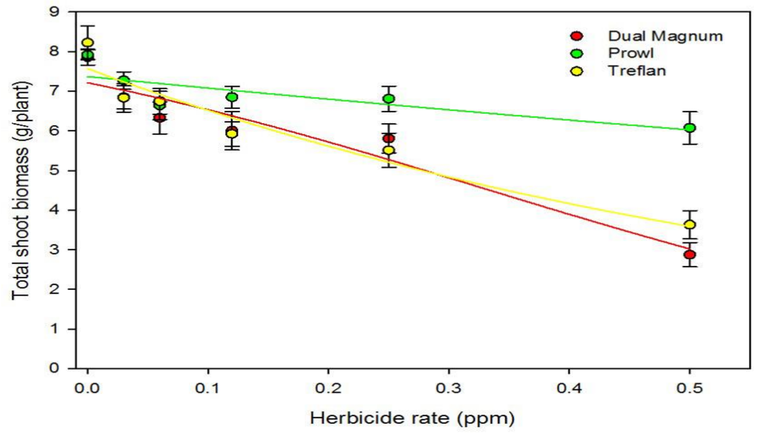

Fig. 4. Non-linear regression for total shoot biomass for all treatments in 2015.

CONCLUSION: The above- and below-ground biomass were differentially affected by herbicide type and doses. All herbicides resulted in some reduction of above- and below-ground biomass of the tomato plants at the higher doses compared to the non-treated plants. Among the herbicides tested, *s*-metolachlor had the greatest potential to cause injury to the tomato plants followed by trifluralin. Although pendimethalin caused some injury at 0.5 ppm, it was generally safer than the other two herbicides.

ACKNOWLEDGMENT: This study was conducted at the greenhouses at Fresno State. All funding for these studies was provided to Kurt Hembree by the CTRI. I would like to acknowledge Dr. Anil Shrestha for his support and guidance. I would also like to acknowledge Dr. Shrestha's Student Research Group and James Shaeffer from the UC Extension Fresno County for all their assistance and help.