Devrinol (Napropamide) Effect on Newly Transplanted Tomato

Andrea Frost and H. G. Taber, Department of Horticulture
Iowa State University, Ames, IA 50011
taber@iastate.edu

Fresh market tomato production is a $5 billion a year industry. Tomatoes are a warm season vegetable crop with large acreages grown in warm climates such as Florida and California. Tomatoes are also grown in numerous northern states earning premium prices for early production in cooler climates. Tomato production often employs plasticulture, such as the use of plastic mulches, for earliness and improved fruit quality. Plastic mulches offer many advantages including improved and less costly weed control, improved soil moisture retention, less soil compaction, cleaner fruit, and increased maturity as a result of warmer spring soil temperatures.

Other warm season crops, such as muskmelon, also employ the use of plastic mulches for weed control. The resultant growth vigor in muskmelon due to enhanced soil temperatures allows the melon vine to cover the plastic mulch rapidly denying any sunlight to transplant holes, and therefore to any potential germinating weed seeds. For staked tomato plants, however, the slower, mostly upright growth allows light to reach the transplant holes and therefore supply energy (necessary for photosynthesis) to potential weed seeds.

Weed control herbicides are typically broadcast over the entire acreage prior to laying the plastic mulch. The alternative of hand pulling weeds one to three times a season is labor intensive and not cost effective. The amount of herbicide, and therefore cost, could be greatly reduced if the herbicide was applied only to the transplant area. Crop rotation can also be utilized to reduce weed growth.

Trifluralin (treflan) and napropamide (devrinol) are two major herbicides registered for tomato use. Both require soil incorporation and control most grasses, but differ in broadleaf control. Trifluralin is known to stunt tomato growth under cool spring growing conditions. In a study comparing pre and post treatment of napropamide, a rate of 2.2 kg/ha (ai) (Devrinol 50DF at 4 lbs/acre) showed the best over-all weed control and the highest number of fruit, regardless of application time. The pretreatment yielded the greatest weight and number of tomatoes (Ferretti and Grenoble, 1982).

In another study, napropamide produced a growth stimulation resulting in increased height and foliar growth. The increased growth was not evident by harvest or in resultant yield (data not presented) (Gorske, 1983).

The objective of this study was to determine if napropamide herbicide could effectively control weed competition by its inclusion in the transplant water without reducing tomato growth. Specifically, to find the upper rate of napropamide without detriment to plant growth.
Methods and Materials

Preliminary experiments were conducted in the greenhouse in the fall of 2002 with tomato seedlings (*Lycopersicon esculentum*, cv. Mountain Spring) grown in soilless mix to determine growth response to napropamide (Devrinol 50DF) concentration. Three rate studies were conducted to determine the upper limit of napropamide that could be applied before shoot growth declined.

Tomato seedlings were germinated in a soilless germinating mix and transplanted at the 3\textsuperscript{rd} true leaf stage to 5 inch round, plastic pots. The soilless greenhouse mix contained 70-80% peat moss, perlite, dolomitic limestone, gypsum, starter nutrient charge, and a wetting agent. The appropriate napropamide amount, as active ingredient (a.i.), was dissolved in tap water to give a final concentration of 0, 7.5, 15, 30, 60, 120, 240, and 480 mg/L. At transplanting, 250 ml (8.6 oz.) of the solution was applied to the seedling. The seedlings were grown under controlled environmental conditions of 22 C (± 3 C) under high intensity lights with a 16 hour photoperiod. They were watered and fertilized as needed. There were four or five replications of each application rate and plants were harvested after one to three weeks of growth. The tomatoes were cut at the cotyledons and leaf number and shoot dry weight determined.

From the preliminary experiment information napropamide rates were selected for greenhouse experiments with field soil. The soil was a loam (Clarion loam classified as fine-loamy, mixed, mesic Typic Hapudolls) with a pH of 6.7 and an organic matter content of 3.3%. Peppers (*Capsicum annuum*, cv. Brigadier) were germinated in soilless mix and transplanted at the 2\textsuperscript{nd} true leaf stage of growth on 11 Nov 2002 to 5-inch round, plastic pots containing field soil. Eight napropamide rates, from 0 to 480 mg/L, with 5 replications were established at transplanting by applying 250 mls of the appropriate napropamide solution to each transplant. Weed counts were determined for both grasses (mainly foxtail) and broadleaves (lambsquarters, smartweed, buckwheat). Seedlings were cut at the cotyledons on 4 Dec 2002 and dry weight determined. A similar greenhouse field soil study was conducted with tomatoes (cv. Mountain Spring) transplanted 20 Dec 2002 and harvested 22 Jan 2003.

In the summer of 2003 a field study was initiated at the Horticulture Station using Mtn. Spring cultivar. The culture system was composed of black plastic mulch, trickle irrigation, pruned to 1\textsuperscript{st} flower cluster, staked and tied according to the Florida stake and weave system. The tomato seedlings were grown for 5 weeks in a soilless mix described above. At the time of transplanting, May 19, five devrinol rates were included in the transplanting water: none, 11.2, 15, 30, and 60 mg devrinol 50 DF/L. Once cup or 8 oz. of solution was applied per transplant. Normal culture and pest management practices were followed. There were 4 harvests: August 1, 8, 15, and 22. Fruit were separated into marketable and unmarketable categories and fruit number and weight determined for each.

Data were analyzed by analysis of variance and regression techniques using the routines of SAS (SAS Institute, Inc., Cary, NC).
Results and Discussion

Preliminary greenhouse experiments indicated tomato seedlings could tolerate up to 60 mg napropamide/L in the transplant water. This is equivalent to 15 mg per plant (or 30 mg Devrinol). A subsequent study expanded napropamide rates to 480 mg/L (Fig. 1). There was evidence of a growth promoter effect on shoot dry weight at the first rate, compared with the control. The 7.5 mg/L level gave a significant (P=.05) shoot increase of 123 mg. Rates above 30 mg/L resulted in a linear decline in shoot dry weight (P < .001, r = + .97). Leaf number was not reduced until a rate of 240 mg/L (data not presented).

Applying similar rates to tomato transplants in field soil resulted in weak evidence of napropamide effect on plant growth (Fig. 2). First, there was no evidence of a growth stimulation as seen with the soilless mix; and, second, shoot growth was not reduced up to a rate of 60 mg/L. Weeds were essentially eliminated at a rate > 5.6 mg/L (P= < .01) (Fig. 3). There were very few broadleaves with most of the grass weed count being foxtail. The control or check rate contained > 50 weeds per pot. Interestingly, another soil study showed that rates > 7.5 mg/L enhanced the soil Phythium/Phytophthora complex resulting in death of the tomato seedling.

Sweet bell peppers were grown in field soil similar to the tomato experiment. As with tomato, there was no effect of napropamide rate up to 60 mg/L on pepper shoot dry weight after 3 weeks of growth (Fig. 4). However, there was weak evidence (P = .046) of a growth stimulation effect at the 1st rate, 7.5 mg/L. The shoot increase was 97 mg or 49.2% over the control plants, 295 mg vs 198 mg, respectively. Ninety-six percent reduction of weed growth occurred with the first napropamide rate increment (Fig. 3).

The Mtn. Spring field trial in the 2003 growing season showed no detrimental effect of any devrinol rate (Table 1). An early indication of devrinol was assessed July 10 by counting the number of set fruit per plant. There was no significant differences. Also, there was no affect of devrinol rate on early harvest (August 1st picking date) or total marketable yield.

Conclusions

Tomato seedlings proved to be resilient to high napropamide levels, not showing growth reduction, as measured by shoot leaf number and dry weight accumulation, until > 30 mg/L. When tomato and bell pepper were transplanted into loam soil with selected napropamide rates growth enhancement occurred up to 7.5 mg/L. This rate also gave 96% control of the measured weed species of foxtail, buckwheat, and lambsquarters in both transplanted crops. In one tomato soil experiment, napropamide rates > 7.5 mg/L enhanced the Phythium/Phytophthora disease complex resulting in seedling death. A summer 2003 tomato field trial showed no deleterious effects from 30 mg devrinol/L in transplanting water.

Literature Cited


Fig. 1. Effect of napropamide level in transplanting water on shoot dry weight of tomato seedlings, cv. Mtn. Spring, grown for 2 weeks in a greenhouse soilless media of peat and perlite, fall 2002.
Fig. 2. Effect of napropamide in transplant water on shoot growth of tomato seedlings, cv. Mtn. Spring, grown for 4 weeks in a loam soil in the greenhouse, January 2003.

![Graph showing the effect of napropamide on tomato and pepper growth.]

Fig. 3. Effect of napropamide level in the transplant water for tomato (cv. Mtn. Spring) and bell pepper (cv. Brigadier) on weed growth reduction, compared to the control, in loam soil.

![Graph showing the effect of napropamide on weed growth reduction.]
Fig. 4. Effect of napropamide level in transplant water on shoot growth of pepper seedlings, cv. Brigadier, grown for 3 weeks in a loam soil in the greenhouse, fall 2003.

Table 1. The effect of devrinol 50 DF on yield and fruit size of field grown Mtn. Spring tomatoes, 2003, Horticulture Station, Ames, IA.

<table>
<thead>
<tr>
<th>Devrinol rate, mg/L</th>
<th>Fruit/plant</th>
<th>July 10th</th>
<th>Marketable</th>
<th>Total Yield</th>
<th>Fruit Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>cwt/acre</td>
<td></td>
<td>ounces ea.</td>
</tr>
<tr>
<td>None</td>
<td>13</td>
<td>387</td>
<td>432</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>11.2</td>
<td>14</td>
<td>415</td>
<td>444</td>
<td>10.4</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>13</td>
<td>384</td>
<td>425</td>
<td>10.9</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>12.5</td>
<td>408</td>
<td>445</td>
<td>10.7</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>12.6</td>
<td>379</td>
<td>414</td>
<td>10.3</td>
<td></td>
</tr>
</tbody>
</table>