Movement of Granular Simazine by Wind Erosion

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Abstract. An early spring wind storm 8 days after application of granular simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] to sandy loam soil reduced the amount of simazine in the treated area to 57% of that applied. The herbicide was deposited up to 2.1 m downwind of the area of application at concentrations phytotoxic to susceptible crops. These results and observations made in other years suggest that herbicide loss by wind erosion may be more significant than loss by water erosion.

Simazine is a selective herbicide for broadleaf and grass weed control in field crops, orchards, vineyards, woody nursery stock and non-cropped areas. In southwestern Ontario the granular formulation is recommended for weed control in established fruit trees (4) and its extension to newly-planted orchards is being considered. Simazine is herbicidally active through the root with limited foliar activity. Many vegetable crops are very sensitive to simazine and movement of herbicide by wind or water from the point of application to these crops is a concern.

The movement of herbicides by water is well documented (1, 2, 6, 8) but few reports are concerned with wind transport. Herbicide injury to susceptible crops downwind of areas treated with volatile chemicals has been reported (9). In many parts of Canada and especially in southwestern Ontario strong winds in the spring cause considerable soil movement. Herbicide injury has been observed on susceptible weeds and crops in experiments downwind of herbicide applied to Fox sandy loam soil following high winds but the extent of herbicide loss has not been quantified. The present study was conducted to quantify the extent of granular simazine movement by wind.

The study area was part of a larger experiment on efficacy of selected herbicides for weed control in transplanted peach (Prunus persica (L.) Batsch) which consisted of 16 treatments in plots 2 x 6 m. Treatments were in a completely randomized block design with blocks oriented with the longitudinal axis in a N-S direction. Two of the blocks were located adjacent to each other in the north half and 2 adjacent in the south half of the field. The area was situated downslope of an open area east of the experimental area on Fox sandy loam which contained 1% organic matter. The southwesterly corner of 1 replicate was situated in a depression. Three peach trees had previously been planted in each treatment.

One treatment in each replicate received 4 kg a.i./ha granular simazine applied with a hand applicator on April 26, 1978. The simazine treatments were sampled at application time and again on May 5, the day after a strong north-east wind. Soil samples were collected downwind of the simazine treated area at the distances indicated in Table 1.

Simazine was extracted from 50 g of soil by shaking the sample for 2 hr with 100 ml methanol. Samples were filtered under suction and the extracts reduced to dryness at 40°C on a flash evaporator. The residue was dissolved in ethyl acetate for analysis by gas chromatography. The 0.5 m x 3 mm i.d. glass column was packed with 5% OV-17 on 60-80 mesh Gas Chrom Q. Injector, column and detector temperatures were 180, 180, and 230°C, respectively. Air, hydrogen and carrier (He) gas flow rates were 200, 6 and 30 ml/min respectively. Simazine was detected on a N thermionic sensitive detector.

In this study, wind erosion was not maximized because of the location of the treatments in the field, the wind direction and topography of the land. Hence, the results do not reflect the maximum movement of herbicide which could be expected had the treatments been located further upslope and the wind perpendicular to the treated area. The wind speed on May 4, the day of the storm, was 21 km/hr with gusts to 59 km/hr. No precipitation fell from April 26 to May 3. On May 4 and 5, 11 mm of precipitation fell.

The initial amount of simazine applied to the soil average 4.4 ± 0.8 kg/ha. After the wind storm the amount of simazine which remained in the treated area averaged 2.5 ± 0.3 kg/ha with the rest deposited up to 2.1 m downwind of the treatments (Table 1). The loss of simazine from the treatments was attributed to wind removal since volatile losses of simazine added to soil as the wettable powder are negligible (3). Simazine availability from the granule is less than from the wettable powder formulation (5). Air temperature averaged 8°C and soil moisture content dropped from 12 to 7% (w/w) over the week before the wind storm, thus, biological and chemical degradation of simazine in the soil would be insignificant (7).

About 43% of the simazine was removed from the treated area by wind erosion. This is considerably greater than soil losses by water erosion which range from 0–5% of that applied (8). The simazine was deposited 2.1 m downwind of the treatments at quantities sufficiently high to be phytotoxic to susceptible crops or to impair the quality of adjacent irrigation ponds or waterways. In past years we have observed herbicide transport by wind erosion of wettable powder or emulsifiable concentrate formulations of other herbicides.

<table>
<thead>
<tr>
<th>Distance downwind (m)</th>
<th>Simazine amount (kg/ha)</th>
<th>Range</th>
<th>Mean ± SE</th>
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</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.0 ± 0.3</td>
<td></td>
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<tr>
<td>0.25</td>
<td>0.2 ± 0.1</td>
<td>1.0 ± 0.8</td>
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<tr>
<td>0.50</td>
<td>0.4 ± 0.3</td>
<td>1.2 ± 0.7</td>
<td></td>
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<tr>
<td>0.75</td>
<td>0.1 ± 0.7</td>
<td>0.4 ± 0.3</td>
<td></td>
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<tr>
<td>1.00</td>
<td>0.2 ± 0.8</td>
<td>0.5 ± 0.3</td>
<td></td>
</tr>
<tr>
<td>1.50</td>
<td>0.3 ± 0.2</td>
<td>0.3 ± 0.3</td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>0.1 ± 0.6</td>
<td>0.2 ± 0.3</td>
<td></td>
</tr>
<tr>
<td>2.50</td>
<td>&lt;0.1 ± 0.2</td>
<td>&lt;0.1 ± 0.1</td>
<td></td>
</tr>
</tbody>
</table>

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Dissipation of herbicides from the soil is a multifactor process. Several physical and chemical soil properties including pH, clay minerals, organic matter, leaching, microbial activity, chemical decomposition, volatilization, photodecomposition and plant metabolism are involved (1).

A porous growing medium which requires frequent irrigation, is used for the production of container grown nursery plants. Consequently, large volumes of irrigation water percolate through the medium. Leaching is an important factor affecting herbicidal activity in this situation.

Herbicides recommended for container grown ornamental plants are mainly applied preemergence to the weed (4). Daily irrigation leaches all but the least soluble compounds (1). Leaching dilutes the herbicide in the zone of seed germination and can concentrate it in the root zone of the crop which might cause injury.

This study was initiated to evaluate the effects of irrigation on herbicide leaching in a nursery container medium. Slow release herbicide tablets and granular formulations of alachlor, EPTC and metolachlor were compared. The commercial formulations of alachlor 15G and EPTC 10G were used as well as an experimental formulation of metolachlor 15G.

Nursery containers were constructed from flexible polyvinyl chloride pipe; 10.1 cm diameter x 15.2 cm long. Sections of pipe were cut in half lengthwise, then re-assembled with tape. A 4-ply square section of cheesecloth was secured to one end, which functioned as the container bottom. Containers were filled to within 2.5 cm from the top with 4 sphagnum peat moss:1 sand (v/v).

Herbicide tablets were prepared using the technique developed by Verma and Smith (3, 5) by mixing plaster of paris with each technical grade herbicide. Rates were calculated on a weight to weight basis to deliver 10 and 40 kg/ha of herbicide when using 3 tablets per container. The mixtures were then uniformly wetted with water, cast in 1.3 cm diameter x 0.8 cm thick mold and air dried.

Herbicide treatments consisted of 10 and 40 kg/ha rate of alachlor, EPTC, or metolachlor. Both the slow release plaster of paris tablet and commercially prepared granular formulations were evaluated. Tablet treatments were applied by evenly spacing 3 tablets of the desired herbicide and rate on the medium surface. The granular formulations were applied by using a shaker can which evenly distributed the granules. This study was carried out in a greenhouse at Columbus, Ohio during December to February. Plants grew under a natural daylength and a day/night temperature of 22/18°C. Containers were irrigated with 2.5 cm of water per day. This allowed a considerable amount of water to move through the medium. At 4, 7 and 10 weeks, 3 containers from each treatment were randomly selected and split into 2 longitudinal halves. A bioassay was then run on each of the horizontally placed container halves. Annual ryegrass (Lolium multiflorum L.) seeds were sown in 4 bands running the length of the container (12.5 cm) at a rate of 0.5 g per band. Evaluations were conducted 2 weeks after seeding. At this time the container halves were divided into 5 regions, each 2.5 cm wide. These regions represented contiguous 2.5 cm depth sections of medium starting at the medium surface and extending downward, when the column was standing. Vegetative tissue was harvested from each region, oven dried at 70°C for 48 hr and dry weight determined. Each herbicide tested is toxic to annual ryegrass. Relative concentrations of the herbicides could then be determined at various depths by a reduction in tissue dry weight of the bioassay test plant. This would indicate how deep the herbicide had leached during the 4, 7, or 10 weeks of irrigation. The study was a completely randomized design with 3 replications per treatment and 2 observations per replication.

**Literature Cited**