eg., metribuzin[4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5 (4H)-one] and trifluralin (α, α, α-trifluoro-2,6-dinitro-N,N-dipropyl-*p*-toluidine) and greater distances of movement than that reported here has occurred from areas more exposed than those in the present study. In these cases, growth of susceptible weeds downwind of the treated areas was prevented but the amount of herbicide in the soil was not quantified. These observations suggest that herbicide losses by wind transport may be independent of formulation which is not the case for losses by water erosion (8). Factors affecting erosional losses by water include formulation, slope, storm intensity, and proximity of storm to application date, whereas losses by wind transport would include type of crop cover, topography, surface roughness, storm intensity, and proximity to application date and soil erodibility.

These data show that significant amounts of herbicide in exposed areas can be lost from sandy soils by wind erosion. Horticultural crops or open waters near newly-planted orchards, which have received herbicide application, should be protected from herbicide movement by wind erosion.

Literature Cited

1. Gaynor, J. D. and V. V. Volk. 1981. Runoff losses of atrazine and terbutryn from unlimed and limed soil. Environ. Sci. Technol. 15:440–443.
2. Hall, J. K. and N. L. Hartwig. 1978. Atrazine mobility in two soils under conventional tillage. J. Environ. Qual. 7:63–58.
3. Kearney, P. C., T. J. Sheets, and J. W. Smith. 1964. Volatility of seven *s*-triazines. Weeds 12:83–87.
4. Ministry of Agriculture and Food. 1980. Fruit production recommendations. Publ. 360. Toronto, Ontario, Canada.
5. Sheets, T. J. 1970. Persistence of triazine herbicides and related problems. Residue Rev. 32:287–310.
6. Triplett, Jr., G. B., B. J. Conner, and W. M. Edwards. 1978. Transport of atrazine and simazine in runoff from conventional and no-tillage corn. J. Environ. Qual. 7:77–84.
7. Walker, A. 1978. Simulation of the persistence of eight soil-applied herbicides. Weed Res. 18:305–313.
8. Wauchope, R. D. 1978. The pesticide content of surface water draining from agricultural fields — a review. J. Environ. Qual. 7:459–472.
9. White, Jr., A.W., L. A. Harper, R. A. Conrad, and J. W. Turnbull. 1977. Trifluralin volatilization losses from a soybean field. J. Environ. Qual. 6:105–110.

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Leaching of EPTC, Alachlor, and Metolachlor through a Nursery Medium as Influenced by Herbicide Formulations[1]

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Additional index words. slow release, weed control

Abstract. **Granular and tablet formulations of EPTC (*S*-ethyl dipropylthiocarbamate), alachlor (2-chloro-2′,6′-diethyl-*N*-(methoxymethyl)acetanilide) and metolachlor (2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide) were evaluated for leaching characteristics in nursery containers. The tablet formulations generally controlled the release rate of the herbicides so leaching was not a major problem. Granular formulations of the same herbicides readily leached through the medium. EPTC did not release at a favorable rate from the tablet formulation.**

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 plastic polyvinyl chloride pipe; 10.1 cm diameter × 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 a 1.3 cm diameter × 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 glasshouse 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* Lam.) 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.

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Table 1. Effect of formulation of herbicides on leaching as reflected in growth of annual ryegrass. Containers received 2.5 cm irrigation per day for 4, 7, or 10 weeks before the bioassay was conducted.

			Dry wt of annual ryegrass (g)[z]														
			4 weeks of irrigation					7 weeks of irrigation					10 weeks of irrigation				
			Medium depth					Medium depth					Medium depth				
Treatment	Formulation	Rate (Kg/ha)	0–2.5 cm	2.5–5.0 cm	5.0–7.5 cm	7.5–10.0 cm	10.0–12.5 cm	0–2.5 cm	2.5–5.0 cm	5.0–7.5 cm	7.5–10.0 cm	10.0–12.5 cm	0–2.5 cm	2.5–5.0 cm	5.0–7.5 cm	7.5–10.0 cm	10.0–12.5 cm
Alachlor	Tablet	10	.1	.2	.3	.3	.4	.2	.3	.4	.4	.4	.2	.2	.2	.2	.0
		40	.0	.1	.3	.3	.4	.0	.2	.4	.4	.4	.0	.2	.2	.2	.4
	Granule	10	.0	.3	.3	.4	.4	.0	.2	.4	.4	.4	.0	.2	.2	.2	.3
		40	.0	.1	.1	.3	.4	.0	.2	.2	.2	.4	.0	.0	.0	.0	.2
EPTC	Tablet	10	.2	.3	.3	.3	.4	.2	.2	.4	.3	.2	.2	.2	.2	.2	.0
		40	.2	.3	.3	.4	.4	.0	.0	.2	.2	.2	.2	.2	.2	.0	.0
	Granule	10	.0	.0	.1	.3	.4	.0	.0	.0	.0	.2	.2	.0	.0	.0	.0
		40	.0	.0	.0	.1	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Metolachlor	Tablet	10	.0	.1	.3	.3	.4	.0	.2	.2	.4	.4	.0	.2	.2	.3	.4
		40	.0	.1	.1	.3	.4	.0	.0	.0	.4	.4	.0	.0	.1	.2	.2
	Granule	10	.1	.3	.3	.3	.4	.0	.2	.2	.4	.4	.0	.0	.2	.2	.2
		40	.0	.0	.1	.1	.4	.0	.0	.2	.2	.2	.0	.0	.0	.0	.0
Control	-----	0	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4

[z]All means are directly comparable, LSD 5% = 0.1.

After 4 weeks of irrigation, growth of annual ryegrass was reduced at depths of 0 to 10 cm (Table 1). Results varied but in general the 40 kg/ha treatments with the plaster of paris tablets did not leach to as great a depth as the 40 kg/ha granular formulations. These results were further amplified when 10 and 40 kg/ha rates of EPTC were examined.

Seven weeks of irrigation showed similar trends (Table 1). As indicated by ryegrass toxicity, tablet treatments again did not leach as far as the granular formulations. EPTC leached considerably more than either alachlor or metolachlor.

Results were similar after 10 weeks of irrigation (Table 1). Alachlor and metolachlor did not leach as far at the higher rate when the tablet formulation was used. The 40 kg/ha tablet formulation of alachlor and metolachlor maintained complete annual ryegrass control in the upper regions of the medium profile. Some growth reduction was noted at the lower depths. The higher rate of herbicide leached to greater depths when the granular formulations were applied. From these results it is possible to hypothesize that the plaster of paris tablet is governing the herbicide release rate. If less herbicide is available at any given time then leaching would undoubtedly be reduced. The 10 kg/ha rate is generally too low to clearly show these results, however, similar trends for EPTC and metolachlor are apparent.

EPTC did not perform as alachlor and metolachlor did and was generally found in the lower regions of the nursery container. Alachlor and metolachlor concentrations were usually highest in the upper regions of the container. Exceptions were: 1) 40 kg/ha metolachlor granules which were present at all depths at phytotoxic levels and 2) 10 kg/ha alachlor tablets. EPTC is considerably more volatile than the other herbicides which may be a factor in these results. Also EPTC might be more tightly bound to plaster of paris and not be released as rapidly. However, the solubility of EPTC (375 ppm) does not indicate this.

Results with the plaster of paris tablet formulation of alachlor and metolachlor indicate a potential use as a slow release formulation (2). Weed seeds typically germinate in the 0–0.5 cm layer of soil. By retaining the herbicide in this area, a longer period of weed control can be expected with less herbicide in the root zone of the crop plants.

Literature Cited

1. Anderson, W. P. 1977. Herbicides and the soil. Weed science principles. West Publ., New York. p. 171–200.
2. Koncal, J. J., S. F. Gorske, and T. A. Fretz. 1981. Slow release herbicide formulation for weed control in container grown plants. HortScience 16:83–84.
3. Smith, A. E. and B. P. Verma. 1977. Weed control in nursery stock by controlled release of alachlor. Weed Sci. 25:175–177.
4. Smith, E. M. and T. A. Fretz. 1980. Chemical weed control recommendations for commercial nursery and landscape plantings. Ohio Coop. Ext. Serv. Bul. MM 297.
5. Verma, B. P. and A. E. Smith. 1978. Slow release herbicide tablets for container nursery. Trans Amer. Soc. Agr. Eng. 21:1054–1059.

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In Vitro Propagation of *Alnus glutinosa* Gaertn[1]

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Additional index words. alder, micropropagation, tissue culture

Abstract. **Rapid clonal propagation of *Alnus glutinosa* was achieved *in vitro* using lateral buds excised from greenhouse grown, juvenile stock plants. Multiple shoot development occurred in 50% of the cultures after the first subculture (7–8 weeks after initial explanting) using a low salt, woody plant medium containing 1 μM 6-benzylaminopurine (BA). Microshoots were removed from proliferating tissues and rooted in a conventional potting medium under high humidity prior to establishment in the greenhouse.**

Alnus species have been identified as potential woody bioenergy crops for plantations on marginal agricultural land in Minnesota (2). Vegetative propagation of A. glutinosa by cuttings has been difficult and of limited success (3). This paper describes a micropropagation technique for the rapid production of selected *A. glutinosa* clones.

Seedlings of *A. glutinosa* 'Saaksmaki' and 'Tuusla' were grown in a greenhouse under natural photoperiod. In early September, following 2 months of growth, plants were cut 2.5 cm above the potting medium. After removal of the leaves, the stems were surface disinfested by washing for 20 min in 0.5% sodium hypochlorite solution containing 2 drops per liter of Tween 20, then rinsed 3 times in autoclaved distilled water. Under aspectic conditions, nodal cross-sections of the stems, which contained a lateral bud, were cut and placed onto 15 ml of medium in 2.5 × 9.5 cm culture vials. The medium used was a woody plant medium (WPM) (4) containing 1 μM BA with pH adjusted to 5.75 ± 0.02 prior to the addition of 7g liter^{-1} agar and subsequent autoclaving at 121°C for 20 min. Cultures were incubated at 22° ± 1°C under a 16 hr photoperiod of Cool White fluorescent

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