Reviews

Innovative Herbicide Application Methods and Their Potential for Use in the Nursery and Landscape Industries

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Additional index words. controlled release, landscape fabrics, herbicide application

Summary. Chemical weed control is an important weed management option in nursery crop production and landscape maintenance. Improved methods of herbicide delivery can increase efficacy of chemical control and minimize off-site movement, applicator exposure, and incorrect herbicide application. Certain innovative technologies show potential for addressing these issues in the nursery industry. Slow-release herbicide tablets have shown promise in container production. Horticultural collars, treated paper, and treated mulch are potential ways of applying herbicides in container crop production and / or landscape maintenance. Horticultural collars contain herbicides between two layers of a carrier such as a landscape fabric. A rapidly degradable paper can be pretreated with an herbicide for a precise application rate. Mulch can be treated with a herbicide prior to use in the landscape for improved weed control. Herbicides applied through the clip-cut pruning system could control weeds selectively in nurseries and landscapes. Each of these methods may address one or more concerns about off-site movement, calibration, and applicator exposure to pesticides.

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Weed control is an important practice in both nursery crop production and landscape maintenance. There are differences in the major weed problems and weed management practices between these distinct areas of the nursery industry (Derr, 1993, 1994).

Chemical control of weeds is used extensively in both nursery crop production and maintenance. As with other crops, there are concerns in the nursery industry about off-site movement of pesticides through herbicide leaching, runoff, and spray drift. Current research is addressing the off-site movement of herbicides from container nurseries (Gilliam et al., 1991; Keese et al., 1991; Mahnken et al., 1993). Additional concerns about pesticide use include applicator exposure and accurate calibration.

Public- and private-sector scientists have been researching novel methods of herbicide application that may have applications to the nursery and landscape industries. These new methods include slow-release herbicide formulations, herbicide collars, herbicide-treated paper, herbicide-treated mulch, and herbicides applied with pruning shears. These techniques can influence off-site movement and other concerns about herbicide use in container production, field production, and / or landscape maintenance.

Slow-release herbicide formulations

Nursery crops often are grown for several years. In container production, a plant may grow in the same pot for 1 to 3 years. In field production, even longer periods of time are often required. Plants in landscapes may be maintained for many years. Hence, weed control must be maintained for a longer period of time in the nursery industry than with annual crops. Herbicides used in the nursery industry, however, are ones that generally were developed initially for use in agronomic crops. With annual crops, the required length of weed control may be as short as 1 or 2 months. To obtain season-long weed control in container production, preemergence herbicides are applied every 2 to 3 months. Multiple applications of preemergence herbicides per year also are made in field production and landscape maintenance.

Herbicides with long soil residual activity can pose a carryover problem when used in annual crops (Hagood et al., 1994). However, long-residual herbicides can be advantageous in perennial crops. Increasing the herbicide rate is one way to increase the length of soil residual for a given herbicide. However, this could increase the potential for crop damage, as well as concerns about off-site movement. Use of slow-release herbicides are an alternative way to increase soil residual (Verma and Smith, 1981).

Problems associated with herbicide use in container production include proper calibration, concerns about herbicide runoff from plastic or gravel (especially for chemicals that fall between containers), and the need for multiple applications. One type of slow-release formulation that addresses these concerns is herbicide tablets applied directly to containers (Verma and Smith, 1978).

Slow-release tablets. Slow-release tablets are a porous pellet containing an inert material such as plaster of paris or dicalcium phosphate, plus a preemergence herbicide (Koncal et al., 1981a, 1981b; Ruizzo et al., 1983; Smith and Verma, 1977; Smith and Treater, 1987; Verma and Smith, 1978, 1981). As these tablets are wetted by irrigation, small amounts of the herbicide are gradually released over an extended period of time. The rate of herbicide release can be increased by increasing the herbicide concentration, or by changing the size or porosity of the tablet (Smith and Verma, 1977; Verma and Smith, 1978, 1981). When alachlor [2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide] was applied at 10, 20, 40, and 80 lb / acre (11.2, 22.4, 44.8, and 89.6 kg·ha^{-1}) in tablet form, weed control generally increased with increasing rate at 51, 83, and 118 days after treatment (Verma and Smith, 1978). In that study, weed control with the tablet formulation was almost always better than with the liquid formulation of alachlor. Excellent weed control for 2.5 months was noted with both tablet and granular formulations of alachlor (Verma and Smith, 1981). However, by 4 months after application, weed control with granular alachlor dropped markedly (<20% weed control), while slow-release tablet formulations provided >90% control. Weed control with the slow-release tablets decreased to ≈60% at 5 months and gradually decreased to 10% control by 14 months after application. Smith and Verma (1977) evaluated various sizes of tablets containing 0.5%, 1%, 2%, or 4% alachlor by weight. A single application of two small, 4% alachlor in plaster of paris tablets per container of 27 square inches (177 cm^2) surface area, at 40 lb / acre (45 kg·ha^{-1}) active ingredient, controlled large crabgrass [*Digitaria sanguinalis* (L.) Scop.] and Italian ryegrass (*Lolium multiflorum* Lam.) for up to 7.5 months. Use of dicalcium phosphate or dicalcium phosphate plus gypsum as the inert ingredient resulted in tablets that did not deform upon wetting, whereas those containing plaster of paris did crack upon wetting (Verma and Smith, 1981). Cracks developing in a tablet could accelerate the herbicide release rate by increasing the surface area. Tablets made with 4% metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methoxy-1-methylethyl)acetamide] in dicalcium phosphate controlled Italian ryegrass for up to 14 months in 1-gal containers (Verma and Smith, 1981).

Plaster of paris tablets were applied to 4-inch- (10-cm-) diameter pots and compared to granular formulations (Koncal et al., 1981a). At 36 lb / acre (40 kg·ha^{-1}), greater leaching of metolachlor occurred with the granular formulation than with the tablets. Based on a bioassay, metolachlor granules at 36 lb / acre (40 kg·ha^{-1}) leached to a depth of 4 to 5 inches (10–12.5 cm), while metolachlor at the same rate in slow-release tablet form was present primarily in the 0- to 3-inch (0- to 7.5-cm) depth. By retaining a herbicide in the top 0.5 inch (1.2 cm) of medium in a container, a longer period of weed control with less leaching should result. This reduction in leaching reduces the potential for root uptake and subsequent crop damage, along with reducing the amount of chemical that could leach out the bottom of the container.

Tablets containing metolachlor at 36 lb / acre (40 kg·ha^{-1}) controlled annual ryegrass better and caused less injury to ‘Cranberry’ cotoneaster (*Cotoneaster apiculatus* Rhed. & E.H. Wils) than the same rate applied in granular form (Koncal et al., 1981b). At 150 days after application, the tablet formulation reduced annual ryegrass growth by 80%, while the granular formulation of metolachlor reduced shoot weight by only 10%. At that rate, no injury to contoneaster was observed with the tablet formulation, while the granular formulation caused 50% injury. Alachlor, chloramben (3-amino-2,5-dichlorobenzoic acid), naptalam [2-[(1-naphalenylamino)car-bonyl]-benzoic acid], and propachlor [2-chloro-N-(1-methylethyl)-N-phenylacetamide] incorporated into dicalcium phosphate tablets controlled weeds for 16 weeks with no significant injury to four nursery species (*Cotoneaster dammeri* C. K. Schneid, *Euonymous fortunei* (Tarcz.) Hand Mazz., *Ligustrum* x *vicaryi*, and *Forsythia* x *intermedia* Zab) (Ruizzo et al., 1983). A metolachor-containing tablet at 36 lb / acre (40 kg·ha^{-1}) completely controlled weeds in a 2.8- to 3.1-inch (7- to 8-cm) radius. A 0.5-inch- (12-mm-) diameter tablet containing metolachlor released the chemical for 28 weeks based on a cucumber root bioassay. Root length went from 45% of the untreated plants at 0 weeks to 100% of the control at 28 weeks, while a 0.2-inch- (6-mm-) diameter tablet released the chemical for 11 weeks, based on a linear increase in root length from 45% of control at 0 weeks to 100% of control at 11 weeks (Gorski et al., 1989). Release rate appeared to be a function of the surface area and volume of the tablet. Italian ryegrass was controlled within a 2- to 2.8-inch- (5- to 7-cm-) diameter circle around the 0.5-inch (12-mm) tablet. Metolachlor tablets at 9 and 18 lb / acre (10 and 20 kg·ha^{-1}) controlled weeds for more than 6 weeks, but not for 10 weeks (Smith and Treater, 1987). Cyanazine- ([2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl] amino]-2-methylpropanenitrile]) and terbacil- [5-chloro-3-(1,1-dimethyl-ethyl)-6-methyl-2,4-(1H, 3H)-pyrimidinedione]-containing tablets at 9 and 18 lb / acre controlled weeds for 10 weeks, but injured cotoneaster, forsythia, and azalea (*Rhododendron obtusum* Planch.).

Other slow-release herbicide formulations. There have been other types of slow-release formulations evaluated, some with implications for nursery use. Other controlled-release formulations have used starch xanthide, pine kraft lignin, and various polymers to control the herbicide release rate (Baur, 1980; Mehltretter et al., 1974; Raboy and Hopen, 1982; Riggle and Penner, 1987, 1988; Schreiber et al., 1988; Sasha et al., 1976; White and Schreiber, 1984). Nursery operators currently use slow-release fertilizers in production, and, according to Allan (1989), the currently available technology allows for the development of controlled-release herbicides.

An ester formulation of picloram (4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid) in a starch xanthide slow-release product had a three to five times slower release rate than a salt xanthide formulation (Baur, 1980). Release rate of 2,4-D [(2,4-di-chlorophenoxy)acetic acid] over a 90-day period varied across various starch ester formulations (Mehltretter et al., 1974). A pine kraft lignin controlled the release of chloramben, metribuzen [4-amino-6-(1,1-dimethylethyl)-3-(methylthio)1,2,4-triazin-5(4H)-one] and alachlor as measured by water leaching in soil columns (Riggle and Penner, 1988). An emulsifiable concentrate formulation of chloramben ester moved rapidly through soil columns, leaching out after 50 ml of effluent, while a starch xanthide slow-release formulation reduced initial release and still released sufficient herbicide for phytotoxic effects after 550 ml of effluent (Raboy and Hopen, 1982). Starch-encapsulated formulations of trifluralin released the herbicide throughout the growing season and provided higher residual activity than the emulsifiable formulation of trifluralin, with ≈0.9 kg·ha^{-1} trifluralin available 119 days after surface application of the starch-encapsulated formulation, compared to no trifluralin present at 19 days with the emulsifiable concentrate formulation (White and Schreiber, 1984).

Potential advantages of slow-release formulations. Overall herbicide rates could be reduced using a controlled-release material compared to a granular or sprayable formulation. A minimum threshold concentration needed for weed control could be maintained over an extended period using slow-release technology. For currently available herbicide formulations, an initial high concentration of chemical occurs in the medium surface due to rapid release from the carrier, followed by a decline in herbicide concentration over time. Therefore, a rate much higher than the minimum threshold rate must be applied in a quick-release formulation to maintain weed control over time.

Because the active ingredient in controlled-release formulations is released slowly into the growing medium, there should be less potential for herbicide leaching. With direct applications of formulations such as tablets to individual containers, no herbicide is applied directly to the gravel or plastic beneath the containers. This results in less herbicide used per acre of container stock, along with reducing the potential for herbicide runoff from container production areas. It appears that the major concern about herbicide movement from container production areas is from the chemical that falls between pots during broadcast applications, as opposed to herbicide leaching out the bottom of containers (Gilliam et al., 1991).

For slow-release formulations, less labor is required for herbicide application because fewer treatments would be required per year. For tablet formulations, no calibration would be required if tablet size could be adjusted to container size. For example, an application rate of two tablets for a 1-gal container, four tablets for a 2-gal container, etc., would reduce the potential for over-application, which increases environmental concerns, or under-application, which results in unacceptable weed control. As with granular applications, no mixing or spraying would be required for tablet application, thus reducing applicator exposure and chemical drift.

Difficulties associated with the development of slow-release formulations. Uniform herbicide distribution from a tablet in a container would be required for acceptable weed control. Low-water-soluble chemicals may not be effective (Koncal et al., 1981b) in such formulations because the chemical must move laterally from the tablet to cover the medium surface. The release rate must be sufficient to maintain a minimum threshold concentration needed for weed control over an extended period. Marketing and regulatory hurdles also would have to be addressed in the development of slow-release herbicides.

Herbicide collar

Researchers have attempted to develop physical barriers to control weeds in container production (Appleton and Derr, 1990; Wells et al., 1987). The interest in physical barriers developed from the use of landscape fabrics, which were introduced as a replacement for solid polyethylene (black plastic) for weed control in established plantings. Disks cut out of paper deteriorated over time, allowing weed growth; photodecomposition of geotextiles lacking UV inhibitors also led to weed growth (Appleton and Derr, 1990b). Rolling of the edges of black plastic resulted in weeds germinating along the edge of the material. Physical barriers composed of synthetic or natural fibers may be insufficient to control weeds. Fiberglass disks treated with various herbicides were evaluated in containers (Bing and Sheer, 1972). Liverworts (*Marchantia* spp.) grew, however, on top of the moist fiberglass, and weeds often grew at the pot edge not covered by the disk. Other researchers have investigated herbicide-impregnated cloth (Danielson, 1967) and herbicide-impregnated string (Hamill et al., 1975). For most of the herbicides tested, herbicide-impregnated cloth was as effective as sprayed applications (Danielson, 1967). Simazine (6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine), atrazine [6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine], and diuron [N'-(3,4-dichlorophenyl)-N,N-dimethylurea] effectively controlled weeds in a peach [*Prunus persica* (L.) Batsch] planting when applied impregnated on string (Hamill et al., 1975).

Disks composed of a geotextile with a slow-release formulation of trifluralin [2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)-benzenamine] (Biobarrier, Reemay, Old Hickory, Tenn.) gave complete control of spotted spurge (*Euphorbia maculata* L.) and large crabgrass [*Digitaria sanguinalis* (L.) Scop.] 20 weeks after installation, while weeds were present in the herbicide alone or fabric disk alone treatments (Appleton and Derr, 1990b). Combinations of a landscape fabric with a herbicide may provide improved weed control in container production. Such a product also could be used in field applications and, if covered by mulch, could be used for weed control in landscapes. Appleton and Derr (1990a) evaluated disks composed of two layers of a landscape fabric in which herbicides and slow-release fertilizers were placed between the layers. A slit was cut to allow insertion around plant stems, and the edges of the two fabric layers were sealed, resulting in a horticultural collar that could be placed around container-grown nursery stock after planting. They also evaluated different carrier materials for the collar, including biodegradable peat / paper and jute, and photodegradable plastic. The biodegradable carrier deteriorated over time, removing the physical barrier to weed development. Another problem was that the organic material appeared to immobilize nutrients during decomposition, and may serve as a substrate for weed growth (Derr, unpublished data). Collars containing various herbicides have controlled weeds better and longer than a standard granular herbicide application, or a collar lacking a herbicide (Derr, unpublished data). No weeds were found in pots with a collar containing 2 lb / acre (2.24 kg·ha^{-1}) oxyfluorfen [2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(tri-fluoromethyl)benzene] plus pendi-methalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenbamine] at 1.0 lb / acre (1.12 kg·ha^{-1}) 10 weeks after application, and few weeds (<1 g of weed shoot weight per pot) were present 15 weeks after collar installation. Considerable weed growth was present 15 weeks after treatment in pots receiving a granular application of oxyfluorfen at 2.0 lb / acre plus pendimethalin at 1.0 lb / acre. The only place where weeds were able to grow in the collar-plus-herbicide treatments were in any gaps between the collar and the pot edge or the plant stem.

Advantages of a horticultural collar. The horticultural collar controlled weeds longer and better than standard herbicide applications to container-grown plants. Improved weed control by the collar decreases the labor required for hand-weeding and multiple herbicide applications. Slow-release herbicide formulations could be included in the collar. Because the collar covers the entire medium surface, any nursery herbicide, regardless of water solubility, could be included in the collar. In contrast, the tablets discussed previously require water-soluble herbicides to obtain coverage of the entire medium surface. Fertilizers and other chemicals could be added to the collar, resulting in a multiple chemical delivery system.

Blow-over of plants, especially trees, often occurs in container nurseries. If a herbicide and fertilizer are top-dressed on the medium surface, blow-over causes the chemicals to spill out of the pot. If the chemicals are not replaced, nutrient deficiencies and poor weed control develop later in the growing season. If a pot containing a collar blows over, the collar can be reinstalled with no loss of chemical because the herbicide and fertilizer are contained between the fabric layers.

No mixing, spraying, or calibration is required because the correct dosage would already be present in the collar. Because the chemical is located between two layers of fabric, there would be minimal chemical exposure to the user. In addition, because the herbicide would only be applied directly to the pot, with no chemical applied between pots, lower overall herbicide rates would be required, along with lower potential for herbicide runoff.

Difficulties associated with development of horticultural collars. The collar must be cost-effective compared with standard applications of herbicides and fertilizers in the nursery. Disposal of the fabric collar could be a concern, although the collar could be left in place around the plant when it is installed in the landscape, similar to the use of a landscape fabric. As with other new techniques of pesticide application, marketing and regulatory hurdles would have to be overcome in development of such a product.

Herbicide-treated paper

Several researchers have evaluated the use of a water-soluble paper to deliver herbicides to landscape plantings. One such product has been referred to as a herbisheet (American Cyanamid, Princeton, N.J.). The paper, pretreated with the correct herbicide rate, could be cut to fit the landscape bed to be treated. Irrigation or rainfall dissolves the paper, releasing the herbicide to the soil or mulch surface. A thin layer of mulch could be used to cover the paper.

Neal and Senesac (unpublished data) have observed excellent (>95%) control of horseweed [*Conyza canadensis* (L.) Cronq.], common groundsel (*Senecio vulgaris* L.), and smooth crabgrass [*Digitaria ischaemum* (Schreb. ex Schweig) Schreb. ex Muhl.] with a herbisheet containing oxyfluorfen at 2.0 lb / acre (2.2 $kg \cdot ha^{-1}$) plus pendimethalin at 2.0 lb / acre (2.2 $kg \cdot ha^{-1}$). This herbisheet controlled common groundsel, dandelion (*Taraxacum officinale* Weber in Wiggers), and smooth crabgrass better than a mulch treatment. I (unpublished data) have observed good control of large crabgrass with a herbisheet containing oxyfluorfen at 2.0 lb / acre plus pendimethalin at 1.0 lb / acre in combination with pine bark mulch in both landscapes and containers.

Advantages to herbicide-treated paper. No calibration, mixing, or spraying are required by the user of the herbisheet. Because there is no calibration, over-application is eliminated because the chemical is applied only to the intended area. The application also eliminates the problem of drift, which can occur for sprayed herbicides, and confinement of granules to a given area when broadcast applications are made.

Difficulties with herbicide-treated paper. The applicator would be exposed to the chemical during the cutting and installation process. Cutting the paper to fit an area may be time-consuming. Wind may make installation difficult. Residues of the paper may persist after wetting due to incomplete dissolving of the product, posing an aesthetic problem unless covered by mulch. Variation in irrigation practices or rainfall could affect paper decomposition and the herbicide release rate. Marketing and regulatory concerns would have to be addressed.

Herbicide-treated mulch

Mulching is a common weed control practice in landscape maintenance. Mulching will not control all weeds, and organic mulch may become a growing medium for weeds as it decomposes (Derr and Appleton, 1989). Herbicides often are applied to mulch to improve weed control. An additional possibility is the use of mulch that has been pretreated with preemergence herbicides.

Lanphear (1968) observed equal or better weed control when dichlobenil (2,6-dichlorobenzonitrile) was incorporated into mulch than either mulch or dichlobenil alone. The length of soil residual weed control was increased when dichlobenil was incorporated into mulch, extending weed control into the year after application, while dichlobenil applied alone did not control weeds 1 year after application. Neal and Senesac (unpublished data) observed excellent control of horseweed, common groundsel, dandelion, and smooth crabgrass with a layer of pine bark mulch containing oxyfluorfen plus pendimethalin at 2.0 plus 1.0 lb / acre (2.2 plus 1.1 $kg \cdot ha^{-1}$, respectively). The herbicide-treated mulch controlled common groundsel, dandelion, and smooth crabgrass better than a mulch alone treatment. Similarly, I (unpublished data) observed greater control of annual grasses 1 month after application, and henbit 4.5 months after application, with oxyfluorfen plus pendimethalin-impregnated pine bark mulch than with untreated pine bark at a 2-inch mulch depth. At 2.0 lb / acre (2.2 $kg \cdot ha^{-1}$) oxyfluorfen plus 1.0 lb / acre (1.1 $kg \cdot ha^{-1}$) pendimethalin impregnated on mulch, >90% control of annual grasses and 85% control of henbit was observed, while mulch alone controlled annual grass ≈60% and did not provide any control of henbit.

Composted pine or hardwood bark is a major component of container growing media. Several researchers have used a layer of bark pretreated with preemergence herbicides as a 1-

inch (2.5-cm) layer above untreated medium in a container. Wells et al. (1987) reported a three-fold extension in the retreatment time through use of a 1-inch (2.5-cm) layer of herbicide-treated pine bark. Skroch (unpublished data) observed no injury to eight nursery species [*Rhododendron maximum* L., *Kalmia latifolia* L. 'Bullseye', *Rhododendron calendulaceum* (Michaux) Torrey, *Pinus mugo*, *Leucothoe axillaris* (Lam) D. Don, *Pinus strobus* L., *Kalmia latifolia* L., and *Tsuga canadensis* (L.) Carr.] 16 weeks after applying a 1-inch (2.5–cm) layer of herbicide-treated bark, which resulted in an application rate of 1.0 lb / acre (1.1 $kg \cdot ha^{-1}$) oxyfluorfen plus 0.5 lb / acre (0.6 $kg \cdot ha^{-1}$) pendimethalin. Only slight injury to three species (*Rhododendron maximum*, *Pinus mugo*, and *Tsuga canadensis*) was observed when the herbicide rate was doubled, and significant damage only to one species (*Rhododendron maximum*) when the application rate was increased to 4.0 lb / acre (4.5 $kg \cdot ha^{-1}$) oxyfluorfen and 2.0 lb / acre (2.2 $kg \cdot ha^{-1}$) pendimeth-alin.

Advantages of herbicide-treated mulch. Weed control in landscapes should improve when a herbicide-treated mulch is used, compared to untreated mulch. The only calibration required is a monitoring the mulch depth to ensure the optimum herbicide application rate. No chemical mixing or spraying would be required for application. Herbicide would be applied only to the area intended to be treated. Also, herbicide-treated mulch could be added as a top layer during the filling of pots in assembly-line fashion for container production.

Difficulties associated with herbicide-treated mulch. Overmulching, a common problem in landscapes, would result in excessive herbicide application. Users would be exposed to the herbicides during spreading of the mulch. Additionally, there may be restrictions on use in mixed plantings if herbicide-sensitive ornamentals are present. Herbicide-treated mulch would have to be stored in a different manner than untreated mulch. Studies would be needed to address the length of time herbicide-treated mulch could be stored prior to use. Marketing and regulatory concerns also would have to be addressed.

Herbicide/hand pruners

A common problem with using hand pruners for collecting plant cuttings is maintaining sterile conditions on the blades in order to avoid spread of diseases. Modified hand pruners that have a vial attached that slowly drips a disinfecting solution over the blades was developed to maintain sterile conditions. This is known as the KlipKleen system (KlipKleen Pruning System, Bloomland Special Products, Atlanta, Ga.). An adaptation of this concept would be to substitute a solution containing a postemergence herbicide within the vial. As a weed stem is cut, some of the herbicide-containing solution would be absorbed by the plant stem from the pruner blades. If a systemic chemical were used, the herbicide could translocate to roots and other leaves and stems, resulting in plant death. Such a product could be used to control vines in landscape hedges or to control tall weeds in containers.

Kalmowitz et al. (1989) reported 74% or greater control of poison ivy [*Toxicodendron radicans* (L.) Ktze.] and trumpetcreeper [*Campsis radicans* (L.) Seem. ex Bureau] over 1 year from application of a 50% triclopyr [(3,5,6-trichloro-2-pyridinyl)oxy] acetic acid) solution using the hand-pruner system. Undiluted 2,4-D [(2,4-dichlorophenoxy)acetic acid] and 25% and 50% solutions of clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) completely controlled poison ivy when applied with the hand-pruner system. Glyphosate [N-(phosphonomethyl)glycine] did not control poison ivy or trumpetcreeper acceptably when applied with the hand pruners.

Advantages with use of herbicide/hand pruners. At present, no selective chemical exists that allows broadcast applications to nursery stock for vine control. Using this system, vines in landscape hedges could be controlled selectively. The chemical would be applied only to the intended weed, resulting in minimal herbicide usage. Because no spraying would be involved, concerns about spray drift to desired plants would be eliminated.

Difficulties associated with herbicide/hand pruners. Non-target plants could be injured through dripping of the herbicide solution from the pruners or through root exudation from treated plants. Users could be exposed to the herbicide through use of this system. Regulatory concerns would have to be addressed.

Conclusions

Development of new technologies could address some of the environmental concerns associated with herbicide use in nurseries and landscapes. These innovative methods have potential for improved weed management in such areas. Cooperation among manufacturers, nursery operators, and researchers will be needed to develop these concepts into effective products for the industry.

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