CHEMICAL WEED CONTROL IN SHELTERBELTS--A REVIEW

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The major problem in the establishment and maintenance of shelterbelts on the Canadian prairies and on the Great Plains of the United States is control of weeds. It is common knowledge that weed competition, especially in the early stages of a planting, reduces the survival and growth of the tree seedlings, particularly those planted in arid and semiarid areas. Even the weeds left following close cultivation offer deleterious competition. Moreover, weeds in shelterbelts provide a storehouse for weed seeds that are easily dispersed in the surrounding cropland. Since the cost of hand hoeing miles of shelterbelts is prohibitive, control of weeds with herbicides apparently is the most practical means for the successful establishment and weedfree maintenance of shelterbelts.

Chemical weed control in shelterbelts can be divided into three main categories: (1) Weed control in new plantings, (2) weed control in established plantings, and (3) chemical site preparation.

Weed Control in New Plantings

Simazine and diuron are the herbicides that have been most extensively tested on new shelterbelt plantings; the reactions of various species to these herbicides are listed in table 1.

Unfortunately, reports on the degree of tolerance of many species to simazine, when applied at the time of planting or shortly thereafter, have been contradictory. Since none of these species is known to exhibit biochemical selectivity towards simazine, the degree of tolerance probably depends on the type of soil, the amount of soil moisture, the organic content of soil, and any other factor that would determine the leachability of this herbicide in the soil. Unfortunately, none of these reports gives a comprehensive picture of these factors; thus, critical evaluation and comparison is not possible.

On the other hand, applications of diuron to new plantings have given quite consistent results, and the seedlings of some of the species reported to be tolerant have withstood rates of 10 pounds per acre or more without sustaining significant injuries (3).

Several other herbicides, most of which give weed control for only one season or less, have also been tested (17, 20, 28, 33). The most promising are: Casoron, amiben, sesone, DNBP, PCP, and trifluralin. These herbicides will control weeds for 6 weeks to one growing season, and most of the tree species escape injury from applications of these herbicides at rates sufficient to give satisfactory weed control.

In general, most of the shelterbelt species tend to be more tolerant to herbicides on soils that are high in clay and organic matter and are more prone to injury on sandy, calcareous, or saline soils.

Weed Control in Established Plantings

Simazine, because of its long, residual weed control properties, has been tested widely, and most of the species have shown tolerance to this chemical after the seedlings have been established for at least one growing season (table 1). European cotoneaster and Preston lilac are the only species tested that are reportedly susceptible to simazine (22, 23). Due to its effectiveness in controlling weeds for 1 or more years with little or no injury to established plantings, it is recommended for this purpose by a number of extension agencies, both in Canada and the United States (1, 5, 9, 23, 35).

TABLE 1.--Tolerance of shelterbelt tree and shrub species to simazine and diuron

Scientific name	Common name	Simazine, 2 to 4 pounds per acre	Diuron, 2 to 4 pounds per acre	References
Abies balsamea	balsam fir	B	S, A	4, 22
A. concolor	white fir	T, B	B	4, 22
Acer negundo	boxelder	T, B, I	B	6, 16, 18, 19, 22, 29, 31
Caragana arborescens	caragana	T, B, I	T, B	6, 13, 14, 16, 18, 19, 20, 22, 33
Celtis occidentalis	hackberry	T	--	22
Cotoneaster integerrima	European cotoneaster	S	--	22
Elaeagnus angustifolia	Russian olive	T, A	T, B	4, 20, 22
Fraxinus pennsylvanica	green ash	T, B, I	T, B	4, 6, 13, 14, 16, 18, 19, 20, 28
Gleditsia triacanthos	honeylocust	T	--	22, 28
Hippophae rhamnoides	seabuckthorn	T	--	22
Juniperus virginiana	eastern redcedar	T, B	B	4, 22, 28
Picea glauca	white spruce	T	T	22, 28
P. pungens	blue spruce	T, B	B	4, 22, 28
Pinus ponderosa	ponderosa pine	B	B	4, 20
P. resinosa	red pine	B	A	4
P. strobus	white pine	T, B	A	4, 22
P. sylvestris	Scotch pine	T, B	T, A	4, 21, 22, 28
Prunus padus	Mayday tree	T	--	22
Pseudotsuga menziesii	Douglas-fir	T, B, I	B	4, 20
Rosa rugosa	Hansen hedge rose	T, I	--	2, 22
Salix alba	white willow	T	--	22
Syringa prestonae	Preston lilac	S	--	22, 33
Ulmus americana	American elm	T, B	B	2, 13, 14, 18, 19, 20, 22, 28
U. pumila	Siberian elm	T, B, I	B	4, 6, 16, 20, 22

S - Susceptible, established plants and injured or killed by application of the herbicide at the rates given.
T - Tolerant, established plants are not affected by the application of the herbicide at the rates given.
A - Newly planted plants are injured or killed by the treatment.
B - Newly planted plants are unaffected by the treatment.
I - Injury has been reported in some instances.

Of the other herbicides tested, diuron is the most effective (10, 13, 14, 20, 28, 29, 31, 33). However, this herbicide has a shorter residual effect than simazine.

Simazine and diuron are effective only as pre-emergent treatments on weed-free soil. Attempts have been made to control existing weeds, -both annual and perennial, by several post-emergent herbicides (7, 8, 15, 22, 24, 25, 26, 27, 30, 32, 34). Paraquat has proved very effective for controlling top growth of annual broadleaved and grass weeds under deciduous trees (20, 22, 30, 32, 34).

Chemical Site Preparation

New shelterbelt sites must be cleared of existing native vegetation in the year preceding planting. The native vegetation may consist of annual and perennial weeds and various species of native brush and shrubs. To be effective, the herbicide must clear the site of existing vegetation. It must also break down sufficiently in the soil by the following spring, thus enabling the planting of new shelterbelts without any residual toxic effects. Herbicides that may be tested for this purpose are paraquat, dalapon, amitrole, and tordon.

Conclusions

Safe recommendations for the use of herbicides in shelterbelts can be made if their mode of action is known. A herbicide may be safe due to the inherent physiological or/and biochemical selectivity possessed by a certain tree species or just due to restrictions of the movement of the herbicide that prevents it from reaching the root zone of the tree. No tree species is known to possess inherent selectivity for any of the herbicides that have been tested for weed control in shelterbelts. Didario and coworkers (11, 12) have shown that a large number of tree and woody ornamental species are quite tolerant to dacthal. It would be of interest to elucidate the physiological basis of this tolerance.

Since edaphic factors determine, in most cases, the nature of tolerance of tree species to various herbicides, a study of factors

affecting the behaviour of these herbicides in soils is of utmost importance. Adsorption, volatilization, photodecomposition, microbial action, chemical reaction, and perhaps some other processes determine the behaviour of herbicides in soils. These processes, in turn, are dependent to a varying extent on soil type, soil moisture content, soil organic matter, pH of soils, and the nutrient status of soils. It is only after an understanding of most, if not all, of these factors and their interaction that safe and definite herbicide recommendations for weed control in shelterbelts can be made on a scientific basis.

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