Forest Tree Nursery Herbicide Studies in the Northern Great Plains: Herbicide Phytotoxicity Tables[1]

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Abstract.--Eight herbicides (registered for similar uses in the U.S.) were extensively evaluated at 15 forest tree nurseries in Western and Northern United States for weed control on first year seedling nursery beds. Phytotoxicity evaluations of dcpa, napropamide, oxyfluorfen, diphenamid, bifenox, oxadiazon, trifluralin and prometryn on 38 different conifer and hardwood species are presented.

Additional keywords: Enide®, Treflan, Dacthal®, Caparol®, Devrinol®, Modown®, Goal®, and Ronstar®.

INTRODUCTION

The USDA Forest Service developed a number of nursery herbicide projects in the United States out of a recognition of the potential benefits of herbicidal control of weeds in nursery seedbeds. This paper will concentrate on projects conducted at 15 nurseries in the Great Plains, the Lake States and in New York. The forest tree nurseries were part of the following projects. The cooperative western nursery herbicide project, initiated in 1976, was with cooperation among state, private and federal nurseries, Forest Service Research, State and Private Forestry, National Forest Systems, and State University of New York out of Syracuse. Twenty-eight nurseries in 12 states were involved in this effort which was broken down into three segments, each of three-year duration; the Pacific Coast started in 1976 (Stewart 1977, Owston et al. 1980, Owston and Abrahamson 1984), the Intermountain-Great Basin in 1977 (Ryker and Abrahamson 1980), and the Great Plains in 1978 (Abrahamson 1981, Abrahamson and Burns 1979). In 1979 the Northeastern (NE) Area started an eastern nursery herbicide project in five states cooperating with Purdue University and State University of New York (SUNY) at Syracuse (Holt and Abrahamson 1980). In 1981 the NE Area expanded the eastern nursery herbicide project to the Great Lakes area with eight nurseries (state, federal and private) in three Lake States cooperating with SUNY (Abrahamson and Jares 1984). During 1982 Oklahoma State (Abrahamson 1983) also sponsored a nursery herbicide project of their own in cooperation with SUNY to help the nursery expand on the herbicide studies using different herbicides, tree species and sowing times.

What is important in these projects is that all studies have similar objectives and methodologies and that information developed from one region or study project is supportive of that from other regions. In all these studies the objectives were to identify promising herbicides, develop data for product registration, and demonstrate safe and effective weed control practices for nursery seed beds.

METHODS

The nursery herbicide screening and demonstration projects were initiated as part of a three-year study. During the first year of the three-year study up to ten herbicides (eight of which are represented in Table 1) were screened on two to four major species of spring- and/or fall sown conifers and/or hardwoods depending on the nursery involved in the study.

Treatments were applied to three-foot long plots in four-foot wide nursery beds with a one foot untreated buffer between plots. All treatments were installed in a randomized block design with three replications per species. Herbicides were applied with a modified AZ plot pressurized sprayer equipped with check valves and four flat fan 8001 nozzles operated at 20 psi in a water carrier at a volume equivalent to 85 ppa (100 ml/ plot). Granular formulations were ocularly applied from a hand shaker uniformly over the plot.

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Pre-seeding incorporated treatments were applied no more than one day before seeding and incorporated into the top two inches of soil using a garden rake. Post-seeding treatments (Ps) were applied within two days after seeding, except on the fall-sown species which were applied any time after fall seeding but before mulching. Postgermination treatments (Pg) were applied four to six weeks after seedling emergence, except on the fall-sown species which were applied in the spring after mulch was removed and seedlings had emerged.

Herbicidal damage to conifers/hardwoods at the end of the first growing season was evaluated using a ten-point rating scale (0 is complete kill, 10 is no effect) proposed by Anderson (1963). Height of nine randomly selected seedlings and number of seedlings per foot in three randomly selected rows in each plot were also measured to determine chemical effects on germination, seedling growth and survival.

The objectives of the second-year studies were to evaluate the phytotoxicity and weed control effectiveness of three to four herbicides screened from the first-year study to be nonphytotoxic to the species tested and have reasonable weed control of weeds present at that nursery. Phytotoxicity was evaluated by using herbicidal damage ratings (Anderson 1963), seedling survival (number/foot) and height growth (cm). Dosages of 1X, 2X, and 1X + 1X of these herbicides were applied post-seeding and/or post-germination using three-foot long plots in fourfoot wide beds with a one-foot untreated buffer between plots. All treatments were installed using a randomized block design with three replications per species. Herbicide treatments were applied by small pressurized sprayer or hand shaker as was done the first year of these studies.

Weed control effectiveness of the best treatments selected from the second year study were evaluated the third year under operational use using nursery application equipment on 100foot test plots. The herbicides were evaluated for weed control under operational use at the 1X rate of application applied post-seeding alone, or post-seeding and post-germination. Phytotoxicity rating, survival and height measurements were also recorded from these operational plots.

RESULTS AND DISCUSSION

Since each nursery is a study in itself, this paper will only concentrate on studies completed at 15 nurseries in the Great Plains, the Lake States and New York (Abrahamson 1984). Phytotoxicity data from these nurseries is presented in Tables 2-15, listed by herbicides tested under each species. The tables are summaries of all the phytotoxicity studies and indicate; 1) those fall- and/or spring-sown seedlings where the herbicide has been safely applied at rates indicated without stunting or germination reduction (x); 2) herbicides that appear to be promising at rates indicated, but because of possible phytotoxic problems implied in some of our studies, these should be thoroughly tested before using at your nursery (o); 3) herbicides that should not be used at rates indicated because of severe phytotoxic damage (-). One herbicide that should be elaborated on is napropamide. Napropamide is used at the lower rate (1.5 lbs ai per acre) when the nursery soil has below 1 percent organic matter, otherwise the higher rate (3.0 lbs ai per acre) is normally used. Napropamide is safe to use post-seeding on most spring sown conifer species tested, but caused severe stunting when applied post-seeding to fall-sown conifer species in the Lake States study. Napropamide applied post-germination to both spring and fall-sown conifers caused no phytotoxic problems.

Weed control expressed in terms of hand weeding time, or "how much time can herbicides save you versus hand-weeding" is one of the most important aspects of these studies. In the Great Plains study (Abrahamson 1981) on spring sown species the post-seeding applications were as effective as the post-seeding plus postgermination applications for total season weed control. The Norman Nursery in Oklahoma is an example (Abrahamson 1983) of the type of savings in time and money that can be expected from these herbicides when used in forest tree nurseries.

Hand weeding time at the Norman Nursery was reduced by an average of 80 percent for all herbicides applied only in the spring (Ps) while those applied in both the spring and a second application five to six weeks later (Ps + Pg) reduced hand weeding time by an average of 87 percent. Based on minimum wage of $3.35 per hour, this would amount to an average gross saving of $4,600 per acre of seedbed (without figuring in cost of herbicide or application costs) weeded six times with a mean weeding time of 283 man hours per acre untreated seedbeds at Norman (Abrahamson 1983).

SUMMARY

There have been numerous trials, studies and tests of various herbicides at many different nurseries that have demonstrated the safe and effective use of dcpa, napropamide, oxyfluorfen, diphenamid, bifenox, oxadiazon, trifluralin, and prometryn on various conifer and/or hardwood first year seedling nursery beds. These herbicides have reduced the time required to hand-weed nursery beds by 80-87 percent when applied at sowing time alone or with a second application four to six weeks later. Over $4,000-$7,000 per acre of seedbed could be saved by using these herbicides over hand-weeding alone.

However, the safety and effectiveness of any herbicide should be tested at each nursery before operational use. These herbicide trials are urged because there is a strong possibility of differential results from varied interactions of

Table 1. Herbicides, rates, and application timings used in the Nursery Herbicide Studies Conducted by SUNY.

Herbicide	Formulation	Manufacturer	(lb ai/A)	Application Timing[1]		
				Pre-Seeding Incorporation or Post-Seeding	Post-Germination	Post-Seeding Plus Post-Germination
Diphenamid	Enide 50W; 90W	Upjohn	4.0	x	x	x
Trifluralin	Treflan 4EC	Elanco	0.75	x	-	-
DCPA	Dacthal W-75	Diamond-Shamrock	10.5	x	x	x
Prometryn	Caparol 80W	Ciba-Geigy	1.0	x	x	x
Napropamide	Devrinol 50W	Stauffer	1.5/3.0	x	x	x
Bifenox	Modown 80W; 4F	Rhone-Poulenc	3.0	x	x	x
Oxyfluorfen	Goal 2E; 1.6E	Rohm & Haas	0.5	x	x	x
Oxadiazon	Ronstar G	Rhone-Poulenc	1.0	x	x	x
Napropamide & Bifenox	Tank mix		1.0+3.0	x	x	x

[1] Pre-seeding incorporation: incorporated into top 2 inches of soil immediately before seeding.
Post-seeding: broadcast applied to soil immediately after seeding.
Post-germination: broadcast applied to soil 4 to 5 weeks after seedling emergence.
Post-seeding plus post-germination: two separate applications at the full recommended rate.

different mixtures of tree and weed species, soil and climatic factors, and cultural practices at different nurseries. If a particular herbicide has never been used at your nursery, several years of trials are advisable because of variations in effects caused by different weather conditions. Trials should include "double doses" to evaluate the safety limits on crop seedlings and leave an untreated control to properly evaluate the effects of the herbicide.

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TABLE 2: Phytotoxic effects of herbicides tested on first year ponderosa and lodgepole pine nursery beds.

Ponderosa Pine

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
oxyfluorfen	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		x	x	x
oxadiazon	*		x	x	x
trifluralin	*		x		
napropamide & bifenox	*		x	x	x

Lodgepole Pine

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
oxyfluorfen	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		x	x	x
trifluralin	*		o		
napropamide & bifenox	*		o	x	o

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 3: Phytotoxic effects of herbicides tested on first year loblolly and Austrian pine nursery beds.

Loblolly Pine

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
oxyfluorfen	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		o	x	o
trifluralin	*		x		
napropamide & bifenox	*		o	x	o

Austrian Pine

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
oxyfluorfen	*		o	x	o
diphenamid	*		x	x	x
bifenox	*		o	x	o
trifluralin	*		x		
napropamide & bifenox	*		o	x	o

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 4: Phytotoxic effects of herbicides tested on first year white and Scotch pine nursery beds.

White Pine

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*	*	x	x	x
napropamide	*		x	x	x
napropamide		*	-	x	-
oxyfluorfen	*	*	x	x	x
diphenamid	*	*	x	x	x
bifenox	*	*	x	x	x
oxadiazon	*	*	x	x	x
trifluralin	*		x		
prometryn	*	*	x	x	x
napropamide & bifenox		*	o	x	o

Scotch Pine

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
oxyfluorfen	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		x	x	x
oxadiazon	*		x	x	x
trifluralin	*		x		
prometryn	*		x	x	x

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 5: Phytotoxic effects of herbicides tested on first year red and jack pine, and Colorado blue spruce nursery beds.

Red and Jack Pine

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*	*	x	x	x
napropamide	*		x	x	x
napropamide		*	-	x	-
oxyfluorfen	*	*	x	x	x
diphenamid	*	*	x	x	x
bifenox	*	*	x	x	x
oxadiazon	*	*	x	x	x
prometryn	*	*	x	x	x
napropamide & bifenox	*		x	x	x
napropamide & bifenox		*	-	x	-

Colorado Blue Spruce

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		o	x	o
dcpa		*	x	x	x
napropamide	*		x	x	x
napropamide		*	o	x	o
oxyfluorfen	*	*	x	x	x
diphenamid	*		x	x	x
bifenox	*		o	x	o
bifenox		*	x	x	x
oxadiazon	*	*	x	x	x
trifluralin	*		x		
prometryn	*	*	x	x	x
napropamide & bifenox	*	*	o	x	o

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 6: Phytotoxic effects of herbicides tested on first year white and Norway spruce nursery beds.

White Spruce

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*	*	x	x	x
napropamide	*		x	x	x
napropamide		*	o	x	o
oxyfluorfen	*	*	x	x	x
diphenamid	*	*	x	x	x
bifenox	*	*	x	x	x
oxadiazon	*		x	x	x
oxadiazon		*	o	x	o
trifluralin	*		x		
prometryn	*	*	x	x	x
napropamide & bifenox		*	x	x	x

Norway Spruce

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
oxyfluorfen	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		x	x	x
oxadiazon	*		x	x	x
trifluralin	*		x		
prometryn	*		x	x	x

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 7: Phytotoxic effects of herbicides tested on first year Japanese larch, eastern red cedar, and white cedar nursery beds.

Japanese Larch

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		o	x	o
oxyfluorfen	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		x	x	x
oxadiazon	*		x	x	x
trifluralin	*		x		
prometryn	*		x	x	x

Eastern Red Cedar

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
oxyfluorfen	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		o	x	o
oxadiazon	*		x	x	x
trifluralin	*		x		
napropamide & bifenox	*		o	x	o

White Cedar

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		o	x	o
oxyfluorfen	*		-	x	-
diphenamid	*		x	x	x
bifenox	*		-	x	-
oxadiazon	*		x	x	x
trifluralin	*		x		

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 8: Phytotoxic effects of herbicides tested on first year caragana, Russian olive, and black locust nursery beds.

Caragana

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		-	x	-
oxyfluorfen	*		-	x	-
diphenamid	*		x	x	x
bifenox	*		-	x	-
trifluralin	*		o		
napropamide & bifenox	*		-	x	-

Russian Olive

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		-	x	-
trifluralin	*		x		
napropamide & bifenox	*		-	x	-

Black Locust

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*			x	
napropamide	*		x	x	x
oxadiazon	*			x	
trifluralin	*		-		

x = no phytotoxic effects at nurseries teated.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 9: Phytotoxic effects of herbicides tested on first year hard and silver maple, and black walnut nursery beds.

Hard Maple

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*	-	x	-
oxyfluorfen		*	o	-	-
diphenamid		*	x	x	x
bifenox		*	-	x	-
oxadiazon		*	-	x	-
trifluralin		*	o		
prometryn		*	x	-	-
napropamide & bifenox		*	-	x	-

Silver Maple

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		-	x	-
napropamide	*		o	x	o
oxyfluorfen	*		-		-
diphenamid	*		-	o	-
bifenox	*		-		-
oxadiazon	*			x	
napropamide & bifenox	*		-		-

Black Walnut

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*	x	x	x
napropamide		*	o	x	o
oxyfluorfen		*	x	o	o
diphenamid		*	x	x	x
bifenox		*	x	x	x
oxadiazon		*	x	x	x
trifluralin		*	x		

x = no phytotoxic effects at nurseries teated.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 10: Phytotoxic effects of herbicides tested on first year cotoneaster, Siberian elm, and honeysuckle nursery beds.

Cotoneaster

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*	x	x	x
napropamide		*	o	x	o
oxyfluorfen		*	o	-	-
diphenamid		*	x	x	x
bifenox		*	x	o	o
oxadiazon		*		x	
napropamide & bifenox		*	o	o	o

Lacebark Elm

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		o	x	
napropamide	*		-	x	-
oxyfluorfen	*		-		-
diphenamid	*		-	o	-
bifenox	*		-	-	-
oxadiazon	*			x	
trifluralin	*		o		
napropamide & bifenox	*		-		

Honeysuckle

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*	x	-	-
napropamide		*	x	x	x
oxyfluorfen		*	o	-	-
diphenamid		*	o	o	o
bifenox		*	x	o	o
oxadiazon		*		-	-
trifluralin		*	x		
napropamide & bifenox		*	x	o	o

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 11: Phytotoxic effects of herbicides tested on first year white and green ash, and silky dogwood nursery beds.

White Ash

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*	x	x	x
napropamide		*	x	x	x
oxyfluorfen		*	x	-	-
bifenox		*	o	x	o
oxadiazon		*	-	x	-
trifluralin		*	x		
prometryn		*	x	-	-

Green Ash

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		x	x	x
napropamide	*		x	x	x
diphenamid	*		x	x	x
bifenox	*		-	x	-
trifluralin	*		x		
napropamide & bifenox	*		-	x	-

Silky Dogwood

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*	x	-	-
napropamide		*	-	x	-
oxyfluorfen		*	-	-	-
diphenamid		*	x	x	x
bifenox		*	-	-	-
oxadiazon		*	-	-	-
trifluralin		*	x		

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 12: Phytotoxic effects of herbicides tested on first year euonymus, hackberry, sycamore, and choke cherry nursery beds.

Euonymus

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*		x	
napropamide		*		x	
diphenamid		*		o	
oxadiazon		*		x	

Hackberry

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*		-	-
napropamide		*		x	
diphenamid		*	o	x	o
oxadiazon		*		x	

Sycamore

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*		-	o	-
napropamide	*		o	o	o
oxyfluorfen	*		-		-
diphenamid	*		o	x	o
bifenox	*		-		-
oxadiazon	*			o	
napropamide & bifenox	*		-		-

Choke Cherry

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*		-	-
oxyfluorfen		*		-	-

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 13: Phytotoxic effects of herbicides tested on first year yellow birch, American plum, honeylocust, and lilac nursery beds.

Yellow Birch

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*	-	-	-
napropamide		*	-	x	-
oxyfluorfen		*	-	-	-
diphenamid		*	x	x	x
bifenox		*	-	-	-
oxadiazon		*	-	-	-
trifluralin		*	-		
prometryn		*	x	-	-

American Plum

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa		*		o	
oxyfluorfen		*		o	

Honeylocust

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*			x	
oxyfluorfen	*			o	

Lilac

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*			x	
oxyfluorfen	*			-	-

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.

TABLE 14: Phytotoxic effects of herbicides tested on first year redbud and catalpa nursery beds.

Redbud

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*			x	
napropamide	*		-	x	-
diphenamid	*			o	
oxadiazon	*			x	
trifluralin	*		o		

Catalpa

Herbicide	Spring Sown	Fall Sown	Post-Seeding	Post-Germination	Post-Seeding & Germination
dcpa	*			x	
napropamide	*		x	x	x
diphenamid	*			x	
oxadiazon	*			x	
trifluralin	*		-		

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use
- = severe phytotoxic effects, Do Not Use.

TABLE 15: Phytotoxic effects of herbicides tested on first year poplar and willow cutting nursery beds.

Poplar Cuttings

Herbicide	Spring Plant	Fall Plant	Post-Plant	Post-Sprouting	Post-Plant & Sprouting
dcpa	*	x	x	x	
napropamide	*	x	x	x	
oxyfluorfen	*	x	o	o	
diphenamid	*	x	x	x	
bifenox	*	x	o	o	

Willow Cuttings

Herbicide	Spring Plant	Fall Plant	Post-Plant	Post-Sprouting	Post-Plant & Sprouting
dcpa	*	x	x	x	
napropamide	*	o	x	o	
oxyfluorfen	*	x	o	o	
diphenamid	*	x	x	x	
bifenox	*	x	o	o	

x = no phytotoxic effects at nurseries tested.
o = some phytotoxic effects at one or more nurseries where tested, requires additional trials before operational use.
- = severe phytotoxic effects, Do Not Use.