North Eastern Christmas Tree Research Alliance

RESEARCH BULLETIN

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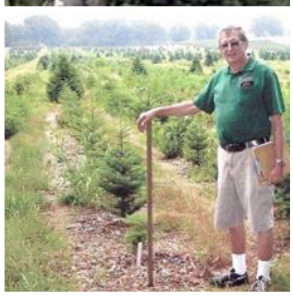

Who We Are

The North Eastern Christmas Tree Research Alliance is a cooperative association composed of invested growers and leading Christmas tree specialists and researchers from the northeastern area of the United States and Canada. Our objective is to facilitate research, enhance dialogue, assist growers and coordinate opportunity and advancement for the Christmas tree industry. We are a registered non-profit society.

We welcome new members and advisors!

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In This Issue

Page 1-2
Letter from the President
Larry Downey

Page 2
Letter from the Vice-President
Ryan Liberty

Page 2-13
Managing Weeds in Christmas Trees
Dr. Jatinder S. Aulakh

Page 14-17
Delphinella Shoot Blight
Julie Marcoux, DTA, and Dominique Choquette, P.Ag. (MAPAQ).

From the President

Throughout my career, I have always been adept in helping the Christmas tree industry. I am a strong supporter of cooperation and shared experience. Over the years, I have been an active board member of the Quebec Association, the Canadian Association and the Promotion Board in the States. I wish to bring the same values I have brought to these Associations over the years. I highly value cooperation, especially shareable knowledge – creating links between universities and producers or sharing knowledge between producers. For me, this Association breaks down politics and borders and creates an environment of cooperation between many provinces and states that has never been seen before. Hopefully this will dawn a new day in Christmas tree support and knowledge. I will do everything in my power to make sure this association excels today and in the future.

Continued…

Managing Weeds in Christmas Trees

Dr. Jatinder S. Aulakh, The Connecticut Agricultural Experiment Station, Valley Laboratory

Introduction

Weeds compete with Christmas trees for essential resources such as water, nutrients, light, and space (**Figure 1**). A failure in weed control, particularly during dry summers, may cause as much as 80% mortality in newly transplanted trees (Kuhns and Harpster 2003). Therefore, effective weed management is vital for sustainable Christmas tree production. Various factors influence the tolerance of Christmas trees to herbicides, including tree species, the age/size of the transplant, its growth stage, the chemistry of the herbicide, and other variables such as the rate, timing, and method of application (Ahrens and Mervosh, 2000; Ahrens and Mervosh 2013; Aulakh 2020, 2022, 2025). For example, young Douglas-fir trees are more sensitive to injury from oryzalin (Surflan) herbicide compared to most true firs, pines, and spruces. In contrast, Christmas trees of various species and ages demonstrate a high tolerance to flumioxazin (Sureguard) when it is applied over-the-top prior to budbreak.

Before deciding on a weed management program, it is crucial to identify the major problem weed species. The diversity and predominance of weed species can vary with the seasons and from farm to farm. Therefore, regular scouting and accurate weed identification are essential for effective weed management in both the current year and subsequent years. Most Christmas tree growers begin with a preemergence herbicide treatment before bud swell during the spring, followed by two or more postemergence herbicide applications in summer to control annual and biennial weeds and suppress perennial weeds such as bindweeds, perennial vetch, and yellow nutsedge. It is followed by a fall clean-up treatment using glyphosate, triclopyr, or their mixture to manage difficult perennial shrubs and woody vines.

1. Spring Preemergence Weed Control (Before budbreak)

Several herbicides are available for preemergence control of annual broadleaf and grassy weeds (**Tables 1 & 2**). Knowledge of the weed species present (from previous weed scouting experience), can help a grower to select an herbicide or combination of herbicides best suited for his weed management requirements. Moreover, a sound understanding of the herbicide mode of action is

From the President Continued

I will achieve this by creating a kind environment in which all members will be prone to give their thoughts and suggestions without judgement. All states and provinces will be represented equally, and the shared knowledge will also be distributed equally. With this in mind, sustainability will be brought to our industry and to our farms.

Larry Downey – NECTRA President

From the Vice-President

When I entered the Christmas tree industry a decade ago, I looked for a trade organization to help me grow and promote my product. The groups that I found were very effective at networking farmers but often focused on broad areas of interest within small geographies. NECTRA's specific focus on the agriscience of our industry fills an important need that will help the farmers of today and the future navigate those challenges.

Ryan Liberty – NECTRA Vice-President

essential for diversifying a chemical control strategy. This knowledge can assist in formulating an herbicide rotation from one year to the next or in choosing prepackaged or tank-mixtures that incorporate different modes-of-action. Utilizing multiple modes-of-action for weed control whenever possible, diminishes the selection pressure that arises from relying on a single mode-of-action, thus decreasing the likelihood of evolution of herbicide resistance in weeds. Herbicides commonly used for preemergence weed control in Christmas trees belong to the following herbicide modes-of-action groups:

1.1. Photosynthesis Inhibitors: This group consists of triazine herbicides such as atrazine, simazine, and hexazinone (Velpar) etc. Atrazine is mainly effective on broadleaf weeds. Simazine has both grass and broadleaf activity. They are absorbed both by roots and foliage. They bind to a protein involved in electron transfer in Photosystem II, thereby inhibit photosynthesis which results in chlorosis (yellowing) followed by tissue necrosis, and eventually death of sensitive weeds. Triazine-resistant common lambsquarters, horseweed, and redroot pigweed are present in several states in the US following repeated use of these herbicides in conifer plantations.

1.2. Root Inhibitors: This group consists of dinitroaniline herbicides such as pendimethalin (Prowl), oryzalin (Surflan), prodiamine (Barricade), pronamide (Kerb 50 WP), and trifluralin (Treflan) etc. Dinitroanilines are largely absorbed by young seedling shoot organs such as the hypocotyl or coleoptile and to some extent by plant root systems. Dinitroaniline herbicides act by inhibiting cell division (mitosis) and kill susceptible plants by inhibiting cell division in root cells which arrests normal root growth. They are very effective on grassy weeds as well as some dicot weeds such as pigweeds and lambsquarters. Other large-seeded dicots such as ragweed and smartweed are not adequately controlled.

1.3. Shoot Inhibitors: This group comprises of chloroacetamides herbicides such as s-metolachlor (Pennant Magnum) and pyroxasulfone (one of the active ingredients in Sureguard Xtra). Shoot inhibitor herbicides are absorbed by germinating seedling shoots prior to or at the time of emergence. They interfere in the formation of long chain fatty acids. S-metolachlor effectively controls many annual grasses, Asiatic dayflower, yellow nutsedge and black nightshade.

1.4. Shoot and Root Inhibitors: This group consists of herbicides such as napropamide (Devrinol). They stop weeds by inhibiting cell division and root growth. They control most annual grasses and many broadleaf weeds. Napropamide is a long residual herbicide labeled for use in conifer seedbeds and transplant beds. It is weak on common ragweed, horseweed, nightshade, spurge, and yellow woodsorrel.

1.5. Cellulose Biosynthesis Inhibitors: This group includes herbicides such as Dichlobenil (Casoron 4G), isoxaben (Gallery, Gemini), and indaziflam (Esplanade, Marengo). These herbicides disrupt cell wall biosynthesis in susceptible weeds and prevent cell division in developing root tips. Seeds of treated plants germinate but they either fail to emerge or emerge as severely stunted seedlings. Dichlobenil controls tough perennial weeds such as Canada thistle, curly dock, mugwort, and horsetail (Equisetum). Dichlobenil is highly volatile. Therefore, it should be applied only in midwinter as a soil surface treatment, preferably before a cold rain or snow to reduce volatility hazard. Use dichlobenil herbicide only around well-established trees. Isoxaben is mainly a broadleaf

herbicide and does not have activity on grassy weeds and sedges. In contrast, indaziflam provides preemergence control of many annual broadleaf weeds, grasses, and sedges.

1.6. Cell Membrane Disruptors: This group comprises herbicides such as oxyfluorfen (Goal XL, Galigan 2E, Goal Tender) and flumioxazin (Sureguard, Sureguard Xtra). These herbicides inhibit the protoporphyrinogen oxidase (PPO) enzyme in the chloroplast to prevent biosynthesis of protoporphyrin IX which is a precursor for the synthesis of both chlorophyll and heme. The inhibition of PPO leads to production of highly reactive molecules that destroy lipids and protein membranes.

1.7. Amino Acid Synthesis Inhibitors/ALS-Inhibitors: This group includes herbicides such as flazasulfuron (Mission/Katana) and sulfometuron (Oust XP, Westar). These herbicides inhibit acetolactate synthase (ALS), a key enzyme in the pathway of biosynthesis of the branched-chain amino acids isoleucine, leucine, and valine. ALS-inhibitor herbicides are readily absorbed by both roots and foliage and translocated in both the xylem and phloem to the site of action at the growing points.

1.8. Pigment Biosynthesis Inhibitors: This group consists of HPPD-Inhibitor herbicides such as topramezone (Frequency). These herbicides inhibit the HPPD enzyme that is essential for the synthesis of carotenoids, which protect chlorophyll in plants. The sensitive weeds suffer oxidative damage and chlorophyll destruction, turn white without deformation, and eventually die.

A standard preemergence herbicide application generally involves a mainly annual broadleaf herbicide such as isoxaben (Gallery), oxyfluorfen (Goal 2XL, Goal Tender), or simazine (Princep) tank mixed with a mainly annual grass weed herbicide such as s-metolachlor (Pennant Magnum), pendimethalin (Prowl H_2O), prodiamine (Barricade, Prodiamine), or oryzalin (Surflan). Prodiamine has been found to be a very safe and effective alternative for oryzalin for preemergence control of annual grassy weeds. Other preemergence herbicides such as flumioxazin (Sureguard), flumioxazin + pyroxasulfone (Suregaurd Xtra), flazasulfuron (Mission, Katana), indaziflam (Marengo SC, Esplanade), or topramezone (Frequency) can control most major broadleaf and grassy weeds found in Christmas tree plantations. Frequency and flazasulfuron offer opportunities for both preemergence and postemergence weed management in Christmas tree plantations. In Connecticut research trials, both Frequency and Mission herbicides demonstrated high weed effectiveness and safety across various tree species when applied according to the label directions. Gemini SC, a prepackaged mixture of isoxaben and prodiamine, is also registered for weed control in Christmas trees. Most preemergence herbicides have very little or no activity on emerged weeds. However, atrazine, flazasulfuron, flumioxazin oxyfluorfen, and topramezone are some examples of herbicides that can control small emerged annual weed seedlings. Besides, it is a common practice to tank-mix glyphosate (Roundup original or equivalent) at 8 to 16 fl.oz/ac with the preemergence herbicide treatment before budbreak to control most of the emerged annual weeds (<3 inches in size).

2. Summer Postemergence Weed Control

2.1. Annual and Biennial Broadleaf Weed Control: Clopyralid (Stinger/Sonora/Spur) may be applied in trees established in the field for at least 1 year. Clopyralid may be applied as a broadcast treatment at a rate of 1/3 to 2/3 pints per acre throughout the year to manage annual broadleaf weeds including horseweed, nightshade, ragweed, thistle (bull-, Canada-, and musk-thistle), smartweed,

and vetch (hairy and perennial) up to the 5-leaf stage. Clopyralid does not affect grasses and sedges. Clopyralid can also be safely used in transplant beds without a significant risk of harm to tree seedlings. However, there have been instances where clopyralid has resulted in minor needle curling or leader twisting if the spray nozzle was inadvertently positioned very close (less than 6 inches) to the new growth. Most true firs and spruces can tolerate clopyralid up to 2/3rd pint/ac/year. In Colorado blue spruce do not exceed ½ pint/ac/year. Clopyralid label does not recommend addition of any surfactants for over-the-top application to Christmas trees else injury may occur.

2.2. Annual Grasses and Broadleaf Weed Control: Topramezone (Frequency) and flazasulfuron (Mission/Katana) herbicides may be used as a directed postemergence application in newly transplanted Christmas trees. They control many broadleaved and grassy weeds up to 4 inches in height. Frequency label lists several species of fir, pine, and spruce as tolerant ornamental trees. The maximum application rate for Frequency in a single postemergence treatment is 4.0 fl.oz/ac and the maximum seasonal application rate is 16.0 fluid oz/ac. Frequency herbicide label recommends a minimum of 30 days interval between two applications. Frequency herbicide requires crop oil concentrate (COC), or methylated seed oil (MSO) for maximum weed efficacy. Mission herbicide is also very effective in postemergence control of certain perennial weeds including bull thistle, Canada thistle, quackgrass, and yellow nutsedge. The maximum single application rate for Mission in a postemergence treatment may vary from 2.14 to 2.85 fl.oz/ac and the maximum seasonal application rate is 9.6 oz/ac. Mission herbicide requires non-ionic surfactant (MSO) for maximum weed efficacy. A minimum of 90 days interval between two applications of Mission herbicide.

2.3. Weed Suppression Mixes: It is also common to use a two-way mixture of clopyralid (Stinger/Sonora /Spur) at 2.5 ml (1/2 teaspoon) plus oxyfluorfen (Goal 2XL at 20 ml or 2/3 fluid ounce OR Goal Tender at 10 ml or 1/3 fluid ounce per gallon water) in mid-June to early-July to burn back perennial vines and bindweeds growing into the tree. Alternatively, a three way mixture of oxyfluorfen (Goal 2XL at 16 fluid ounces OR Goal Tender at 8 fluid ounces) plus glyphosate (Roundup original or equivalent at 4 fluid ounces) plus clopyralid (Stinger/Snora/Spur at 4 fluid ounces) per treated acre in 10 gallons water per acre is also popular for controlling annual broadleaf weeds (horseweed, common ragweed, and pigweeds etc.) and annual grasses (large crabgrass, fall panicum, and foxtails, etc.) up to 6-inch tall or for suppressing field horsetail, perennial vines such as field- and hedge-bindweeds, thistles and yellow nutsedge. Both above-mentioned mixtures, applied as a calibrated treatment, have been found safe (mid-June onwards) on trees even if the conifer foliage is lightly contacted. One or two repeat applications may be made at three to four weeks intervals for summer-long weed suppression. The three-way mixture is primarily recommended for grassy and broadleaf weed suppression both between and within the tree rows. Most growers use a Teejet TK-2 Floodjet nozzle that sprays over a 6-feet swath and delivers 10 gallons spray solution per treated acre when operating at a speed of 3.5 mph and 15 PSI pressure. Therefore, when making a band (3-feet) application just over the tree rows, use an appropriate banding nozzle to deliver half the solution (5-gallons) per acre.

2.4. Yellow Nutsedge Control: Yellow nutsedge can be managed preemergence with s-metolachlor (Pennant Magnum) flazasulfuron (Mission), or Tower (dimethenamid) herbicides applied as an over-the-top application before budbreak in the spring. Yellow nutsedge can also be controlled

with directed postemergence application(s) of bentazon (Basagran), flazasulfuron, or halosulfuron (Sedgehammer) herbicides, ideally when the yellow nutsedge is in 3- to 8-leaf stage. For postemergence control, these herbicides should be applied with a recommended surfactant (consult the product label). An application before the 3-leaf stage results in interception of the herbicide in sublethal amounts. if treated beyond the 8-leaf stage, the long-term yellow nutsedge control is reduced because new tubers (the vegetative propagules) have already formed. A single yellow nutsedge plant can produce as many as 7,000 additional tubers each year. In Connecticut, tuber formation has been observed around mid-July to early August.

2.5. Annual and Perennial Grass Control: For controlling annual and perennial grasses, the graminicides (herbicides specific for killing grasses) such as Intensity (clethodim) or Fusilade (fluazifop) may be applied once the new growth has sufficiently hardened. The grassy weeds should be small (6 to 8-inch tall, consult the product label), actively growing, and not showing symptoms of moisture stress (wilted). Graminicides are safe to the conifers regardless of the tree species, and age. Always add a non-ionic surfactant or crop-oil-concentrate (consult the herbicide label) to improve herbicide efficacy. Non-ionic surfactant has been found safer than crop-oil-concentrate, which may cause speckling when applied at or above 95 °F. Often a second application 10 to 15 days after the initial treatment is required to achieve satisfactory control of perennial grasses or annual grass weeds exceeding the label specified size (6 to 8-inch tall).

2.6. Perennial Broadleaf Weed, Vine, and Shrub Suppression: Both glyphosate (regardless of formulation) and triclopyr (Garlon 3 A, the amine formulation) may also be used for managing problematic perennial weeds during the summer, but only as a fully directed or shielded application. Use a coarse droplet nozzle and low nozzle pressure. Occasionally, certain growers utilizing untrained applicators or laborers for pesticide application have witnessed damage to Christmas trees with the summer application of glyphosate, particularly when herbicide particles or mist inadvertently contacted the trees. In most cases, glyphosate injury was not visible in the application year; however, it became evident the subsequent summer, presenting as yellow, stunted, and curly shoot-tips. This was accompanied by twisting, chlorosis, necrosis, and stunting injuries, which often led to leader kill. Preferably, a wick or wiper applicator such as Sideswipe may be used to treat perennial weeds during the summer. For this, carefully apply 1 part glyphosate (Roundup) or triclopyr amine (Garlon 3 A) mixed with 2 to 3 parts water to perennial weeds without contacting the conifer foliage. Glyphosate is effective in managing both grassy and broadleaf perennials, as well as in suppressing yellow nutsedge. In contrast, triclopyr is safe for grasses and exclusively targets broadleaf perennials. Summer applications of either glyphosate or triclopyr should solely aim to prevent perennial weeds from competing with trees.

To ensure maximum safety for Christmas trees and enhance the effectiveness against woody and perennial weeds, these herbicides should be applied in the fall, when the trees are fully hardened, while the targeted perennials still have adequate green tissue to facilitate uptake and translocation to their roots or underground storage organs, such as rhizomes and tubers, etc. in the fall, perennial weeds slow their top growth and begin translocating energy reserves to their roots. Systemic herbicides such as glyphosate and triclopyr hitchhike along with the downward moving

photosynthates resulting in root kill. In contrast, in the spring, energy reserves move from roots to the top. Application of glyphosate or triclopyr in the summer only provides top kill and plants often grow back.

3. Fall Herbicide Treatments for Controlling Tough Perennial Weeds and Shrub

In New England States, true firs, spruces, and Scotch pine harden by early September. Hardened trees are those which have accumulated waxy deposits on their needles and have thicker cuticles. The waxy deposits protect the trees from uptake of glyphosate or triclopyr. Douglas fir and white pine harden a couple of weeks later, usually after second or third week of September in Connecticut. Remember, both Douglas fir and white pines are more sensitive to glyphosate and triclopyr sprays. Therefore, avoid spraying even their basal foliage until they are about 2 feet tall. Dosage of glyphosate or triclopyr and application timing are very critical. True firs, spruces and Scotch pine that have grown in the field for at least one season can tolerate glyphosate (Roundup Original equivalent formulation) rates up to 1.5 quarts or triclopyr 3 A rates up to 1.0 quarts per treated acre. These rates should be adjusted/reduced if glyphosate or triclopyr amine were previously applied to the same trees, especially as an over-the-top application before budbreak, in the same spring. A combination of 1.5 qts glyphosate and 1.5 pints triclopyr amine per treated acre may also be used to broaden the perennial weed control, especially when the Oriental bittersweet, perennial vetches, red maple, or wild parsnip are present. Growers accustomed to non-calibrated spot sprays, can apply these herbicides at 1% solution (1/3 fluid ounce per gallon). A light spray hitting only the basal foliage of conifers will not injure the trees. When not sure of a glyphosate formulation safety to conifers, make a fully directed application or spot treatment and do not use any surfactant to any glyphosate or triclopyr products at any time of the year.

Water quality has a great impact on the effectiveness of glyphosate herbicide. If your water is hard (high in calcium or magnesium salts) or high in iron, add spray grade ammonium sulfate at 17 pounds per 100 gallons spray solution, **before adding glyphosate**, to neutralize these salts and anions. For higher weed control with glyphosate or triclopyr, avoid spraying weeds wet with heavy dew, when soil is excessively dry (stressed weeds), or when rainfall is expected within 2 to 4 hours.

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Disclaimer:

The mention of trade names in this publication is solely for the purpose of providing specific information. The authors do not guarantee or warranty the products named, and references to them in this publication and do not signify their approval to the exclusion of other products of suitable composition. Always consult the pesticide label before making an application.

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Table 1: Preemergence herbicides and application rates for weed control in Christmas trees.		
Seed beds	Goal XL, or Galigan 2E @ 1 to 2 pints/ac or Goal Tender @ 0.5 to 1 pint/ac.	Apply higher rate after seeding "LABELED CONIFERS" and lower rate 5 to 6 weeks after conifer emergence.
Transplant beds (2-years or older seedlings)	Use one of the following herbicides: Treflan 5G @ 10-20 lbs/ac if incorporated or 30-50 lbs if surface applied. Ronstar G @ 150 lbs/ac. Goal XL/Galligan 2E @ 2 to 4 pints/ac. Goal Tender @ 1 to 2 pints/ac. Sureguard 51 WDG @ 8-12 oz/ac. Pennant Magnum @ 2 to 2.5 pints/ac.	Apply to dormant conifers before budbreak in summer. Princep 4L @ 2 pints/ac or Pennant Magnum @ 2 to 2.5 pints/ac may be combined with Galigan 2E @ 2 pints/ac or Ronstar G @100 lbs/ac. (Princep, Simtrol and Ronstar are safe on the early flush. However, avoid Goal XL, Galigan, or Goal Tender on early flush of spruces or true firs).
First year plantings	Use one of the following herbicides: Princep 4L @ 4 to 6 pints/ac. Frequency @ 4.0 fl.oz/ac or Gallery 75 DF @ 0.66 to 1 **lb/ac or** Goal 2XL @ 4.5 to 6 pints/ac or Mission/Katana @ 2.14 to 2.85 oz/ac or Sureguard 51 WDG @ 10 to 12 oz/ac or Westar @ 6 oz/ac.	Broadcast or band apply over-the-top of dormant conifers before budbreak. To improve control of annual grasses, **tank-mix** Surflan AS @ 6 to 8 pints/ac or Pennant Magnum @ 2 to 2.5 pints/ac or Pendulum @ 4.8 to 9.6 pints/ac or Barricade @ 2.3 lbs/ac **with** Princep 4L @ 4 pints/ac or Gallery 75 DF @ 0.66 to 1 lb/ac or Goal 2 XL @ 4.5 to 6 pints/ac.
Established Stands (Trees growing in field for one or more seasons)	Use one of the following herbicides: Princep 4L @ 4 to 8 pints/ac or Princep 4L @ 4 pints/ac + Aatrex 4L each @ 2 pints/ac or Frequency @ 4.0 fl.oz/ac or Gallery 75 DF @ 0.66 to 1 lb/ac or Goal 2XL @ 4.5 to 6 pints/ac or Mission/Katana @ 2.14 to 2.85 oz/ac or Sureguard 51 WDG @ 10 to 12 oz/ac or Westar @ 6 to 10 oz/ac or Esplanade @ 3.0 to 6 oz/ac or Marengo @ 7.5 to 15.5 floz/ac	Broadcast or band apply over-the-top of dormant conifers before budbreak. To improve control of annual grasses, **tank-mix** Surflan AS @ 6 to 8 pints/ac or Pennant Magnum @ 2 to 2.5 pints/ac or Pendulum @ 4.8 to 9.6 pints/ac or Barricade @ 2.3 lbs/ac **with** Princep 4L @ 4 pints/ac or Gallery 75 DF @ 0.66 to 1 **lb/ac** or Goal 2 XL @ 4.5 to 6 pints/ac.

Table 2: Preemergence herbicides efficacy on weeds of Christmas tree plantations.

Common name	Scientific name	Atrazine 4L	Gallery 75 DF/ Gallery SC	Goal Tender*Goal 2 XL	Marengo SC/Marengo G	Pendulum 3.3 EC	Pennant Magnum	Sureguard	Simazine 4L	Surflan AS/Oryzalin 4 AS	Westar
Alyssum, Hoary	*Berteroa incana*							c	c		c
Annual Bluegrass	*Poa annua*			c*	c	c	c	c	c	c	
Barnyardgrass	*Echinochloa crus-galli*	s		c*	c	c	c	c	c	c	
Bittercress, Hairy	*Cardamine hirsuta*		c	.	c			c		c	c
Bramble/Blackberry	*Rubus fruticosus*							.			s
Chickweed, Common	*Stellaria media*		c		c	c		c	c		
Chickweed, Mouseear	*Cerastium vulgatum*		c*		c	c		c			
Common Evening Primrose[1]	*Oenothera lbiennis*			c	c	c					
Crabgrass Large	*Digitaria sanguinalis*	s		c*	c	c	c	c	c	c	c
Crabgrass, Smooth	*Digitaria ischaemum*	s		c*	c	c	c	c	c	c	.
Dandelion[1]	*Taraxacum officinale*		c		c			c			c
Downy Brome	*Bromus tectorum*							.	c	c	
Fireweed	*epilobium angustifolium*			c							
Foxtail Giant	*Setaria faberi*	s		c*	c	c	c	c	c	c	c
Foxtail Green	*Setaria viridis*	s		c	c	c	c	c	c	c	c
Foxtail Yellow	*Setaria glauca*	s		c	c	c	c	c	c	c	c
Groundsel, Common	*Senecio vulgaris*		c	c	c		c	c	c	c	
Henbit	*Lamium amplexicaule*		c	c	c	c		c	c	c	
Horseweed	*Conyza canadensis*		c	c	c			c			c
Ivy, Ground[1]	*Glechoma hederacea*							c			
Ladysthumb	*Polygonum persicaria*		c	c				c			
Lambsquarters, Common	*Chenopodium album*	c	c	c	c	c		c		c	c
Lettuce, Prickly	*Lactuca serriola*		c	c				.		s	
Mallow, Common	*Malva neglecta*		c	c				c		s	
Mallow, Little	*Malva parviflora*		c	c	c			c			
Mustard, Wild	*Brassica kaber*	c	c	c				c	c	s	

c- Weed species controlled.
c* Higher rates required for some weeds.
[1]Biennial or perennial weed emerging from seed only.
s- Suppression only.

Table 2: Preemergence herbicides efficacy on weeds of Christmas tree plantations.

Common name	Scientific name	Atrazine 4L	Gallery 75 DF/ Gallery SC	Goal Tender*Goal 2 XL	Marengo SC/Marengo G	Pendulum 3.3 EC	Pennant Magnum	Sureguard	Simazine 4L	Surflan AS/Oryzalin 4 AS	Westar
Nightshade, Eastern Black	*Solanum ptycanthum*	*c*	*c*	*c*				c			
Northern Willowherb	*Epilobium cillatum*							c			
Nutsedge, Yellow	*Cyperus esculentus*				*s*		*c*	.			s
Orchardgrass	*Dactylus glomerata*							.			c
Panicum, Fall	*Panicum dichotomiflorum*			*c*		*c*	*c*	c	c	c	c
Pennycress, Field	*Thlaspi arvense*							c			
Pigweed, Redroot	*Amaranthus retroflexus*	*c*	*c*	*c*	*c*	*c*	*c*	c		c	
Plantain, Broadleaf[1]	*Plantago major*		*c*					c			
Plantain, Buckhorn[1]	*Plantago lanceolata*		*c*		*c*			c			
Purslane, Common	*Portulaca oleracea*	*c*	*c*	*c*	*c*	*c*	*c*	c	c	c	
Quackgrass	Agropyron repens							.			c
Ragweed, Common	*Ambrosia artemisiifolia*	*c*	*c*	*c*	*c*			c	c	s	c
Ragweed, Giant	*Ambrosia trifida*	*c*	.					c		s	.
Sandbur, Field	*Cenchrus incertus*			*c*	*c*	*c*	*c*	.		c	
Smartweed, Pennsylvania	*Polygonum pensylvanicum*	*c*	*c*	*c*	*c*	*c*		c	c	s	
Sorrel, Red[1]	*Rumex acetocella*		*c*					.			s
Sowthistle, Annual	*Sonchus oleraceus*		*c*	*c*	*c*			c		s	
Spiderwort, Tropical	*Commelina benghalensis*							c			
Thistle, Canada[1]	*Cirsium arvense*							c			c
Velvetleaf	*Abutilon theophrasti*	*s*		*c*	*c**	*c*		c		s	
Wild Carrot[1]	*Daucus carrota*		*c*		*c**			.			c
Wild Radish	*raphanus raphanistrum*		c								
Willowherb	*epilobium brachycarpum*				c						

c- Weed species controlled.
c* Higher rates required for some weeds.
[1]Biennial or perennial weed emerging from seed only.
s- Suppression only.

Figure 1: Uncontrolled weeds in a Douglas fir plantation.

Figure 2: An untreated control plot in a Fraser x balsam hybrid fir plantation in CT.

Figure 3: Mission (flazasulfuron) herbicide applied at 2.85 ounces/acre in a Fraser x balsam hybrid fir plantation in CT.

Figure 4: Frequency (topramezone) herbicide applied at 4.0 fluid ounces/acre in a Fraser x balsam hybrid fir plantation in CT.

Delphinella Shoot Blight – TECHNICAL NOTE

Julie Marcoux, DTA, and Dominique Choquette, P.Ag. (MAPAQ).

Scientific Name: *Delphinella balsameae* (Waterm.) E. Muller

Common Names: Delphinella shoot blight, Balsam fir tip blight

Classification: Phytopathogenic fungus

Introduction: The fungus *Delphinella balsameae* specifically attacks fir trees, causing shoot blight. Well-known in the forestry sector, this disease can severely affect current year needles and stems. The rainy seasons of 2009 and 2010 significantly contributed to its spread in Christmas tree plantations in certain areas of the Eastern Townships region. Since then, its presence has increased, not only in the Eastern Townships, but also in the Chaudière-Appalaches (Appalacian) region.

Hosts: Delphinella shoot blight primarily affects balsam fir. (Fraser fir is also susceptible) Wild stand (forest stand) firs are also hosts to the disease, and Christmas tree plantations are often infected by spores for neighboring forests with Balsam fir.

Life Cycle: In the spring, when weather conditions are favorable, fungal spores are released from the previous season's fruiting bodies to infect young needles and developing shoots. These spores are dispersed by wind or rain splash. The spore release period appears to extend from the beginning of bud break until stage IV of bud development. There is no secondary life cycle of the disease during the growing season. The disease does not spread during the summer. About six weeks after infection, the fungus produces black fruiting bodies (pycnidia) on the affected needles and current-year shoots. These structures will produce spores again the following spring.

The disease is often found on balsam fir trees near the edges of wooded areas, where natural fir trees (forest) are present and ventilation is poorer. The level of susceptibility varies from tree to tree; it appears to be linked to a genetic predisposition.

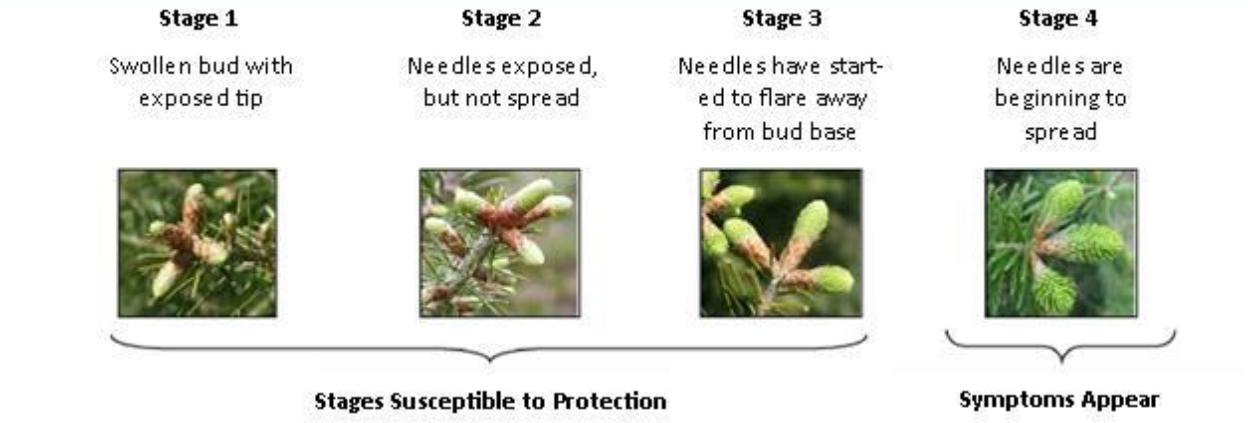
Symptoms: Generally, damage appears on the current year's shoots two to three weeks after infection, often starting in the second week of June. Depending on the stage of development at the time of infection, the disease can produce two different symptoms:

• **Needle blight:** appearance of a variable number of orange-red needles. Some of the needles dry out rapidly and fall to the ground. Affected needles are twisted and develop black pycnidia (black spots) at the end of the season. Needles that remain on the trees turn gray the following year.

• **Shoot blight:** reddening of the current year's shoots at stage IV. Rapid drying and curling follow. These shoots remain on the trees. They are grayish the following year and also develop black pycnidia.

Trees showing symptoms constitute a source of infection from which the disease can spread to other trees the following spring (see the proposed strategy below).

Conditions Favorable to its Development: High planting density and slow drying of foliage promote the development of the fungus. Nearby infestation sites (wooded areas or plantations) should also be monitored. Frequent rainfall in May, as well as genetic susceptibility, also favor the development of the disease.



Phytosanitary monitoring: Apply it before a rainy period to protect the shoots in the areas identified during your scouting. An additional application is necessary when shoot growth is significant, as the fungicide is poorly distributed to new developing tissue.

FLINT and CGA279202 50W are topical systemic fungicides; therefore, they cannot be washed off by rain. (Both are Bayer Crop Science trifloxystrobin registrations.) Banner Maxx is also registered for Delphinella control.

Note that few growers need to take action against this disease. The various trials conducted over the years have provided tools to react quickly to limit its spread.

Prevention and Best Practices:

- Remove wild balsam fir trees affected by shoot blight from the edges of wooded areas.
- Limit tree density to allow for good air circulation in the foliage and planting.
- Maintain a minimum spacing of 1.5 m (5 ft) between trees and 1.7 m (5.5 ft) between rows. High tree density promotes disease development.

- Quickly remove and burn trees severely affected by the disease from the plantation, as the affected needles fall to the ground. This will reduce the level of inoculum (spores from the fallen needles) and associated infection for the following year.

Chemical control: The fungicides FLINT (trifloxystrobin) and CGA279202 50WG (trifloxystrobin) are registered for use against fir shoot blight. This active ingredient demonstrated very good efficacy against Delphinella in a trial conducted by the EstrieAgro-Environmental Club, in collaboration with the Ministry of Agriculture, Fisheries and Food (MAPAQ).

Tree severely affected by shoot blight (June 25, 2014) Photo: MAPAQ - Estrie

As it is the only registered active ingredient, screening tests were carried out in Quebec. This work will lead to the registration of effective fungicides. (Editor's Note: Banner Maxx is now registered as a second active for Delphinella)

Additional Explanation from Dominique: In general, two treatments 7-10 days apart are recommended to protect the sensitive period of new shoots, depending on rainfall. The sensitive stage is II to III+ as shown in the photos in the fact sheet.

To target the first treatment, we monitor the bud break of trees that showed symptoms of Delphinella (susceptible to the disease). As soon as stage II is observed in these trees, treatment with Flint is recommended before rain. If it has not been possible to treat before, early application after rain, when the foliage is dry, is generally effective due to the eradicating effect of this fungicide.

If the annual shoots of susceptible trees develop significantly after treatment, it will be necessary to protect the new foliage exposed before rain with a second application of Flint. When the shoots have reached stage IV, sporulation of this fungus is generally complete.

We have noticed that if the disease has spread to the new foliage, symptoms will generally appear 10 days later (in the Eastern Townships of Quebec, this is around June 10). There is no secondary cycle after the appearance of symptoms.

If treatment is done with an airblast sprayer, at least 300 liters/ha of water must be applied to sufficiently cover the new shoots.

Additional Information: To monitor the progression of the disease, consult the RAP's phytosanitary warnings. They inform you of the risk of infection and the development of the disease during the critical period.

- Pests, Diseases and Enemies of Christmas Trees in Quebec: Identification Guide and Best Practices, available from APANQ.
- SAgE Pesticides website (information on registered pesticides and their safe and rational management).
- Presentation on foliar diseases.
- The newsletter Useful References and Links.

For further information, you can contact the Christmas Tree Network advisor or the RAP secretariat.

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