How to Speak Christmas Tree:

IPM: Weed Management

Image 1. *– If not managed properly, weeds can out-compete crop trees (circled) for water, nutrients, and light.*

Image 2. *– Horsetail is often difficult to control because it is a primitive plant that is not closely related to other common weed species.*

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This article is the last in our 'How to Speak Christmas Tree' series on Integrated Pest Management, or IPM. IPM is a systematic approach to managing pests and other damaging agents in Christmas tree production. The goal of IPM is to keep pests below economically damaging levels while minimizing pesticide inputs through early detection via scouting and using non-chemical control. Our previous articles on IPM considered the impacts and management of insects, fungal pathogens, and environmental disorders in Christmas tree production in the Great Lakes region. In this edition we examine weed management through an IPM lens.

Treatment	Fraser fir		Colorado blue spruce	
	Survival (%)	Height growth (cm)	Survival (%)	Height growth (cm)
No weed control	67.0	3.7	71.0	4.0
Weed-free*	95.0	5.3	88.0	6.9
Wood chip mulch	100.0	10.3	95.0	9.3

**Weeds controlled by hand-weeding and spot-sprays of glyphosate*
Adapted from Cregg et al., 2009.

Table 1. – *Survival and height growth of Fraser fir and Colorado blue spruce trees in response to weed control for 2 years after planting at MSU Southwest Michigan Research and Extension Center, Benton Harbor, MI*

What is a weed?

Weeds are undesirable plants in a particular situation or in other words "A plant in the wrong place". Taxonomically, the term "weed" has no botanical significance. However, weeds can cause serious economic impacts in agricultural/ horticultural production. There are over 250,000 plant species, among them only 1% (2500) are considered as weedy plant species, and 0.1% (250) are the most problematic weeds. However, these weedy species possess unique characteristics that help them out-compete our desired crop plants. These include:

- Rapid seedling growth and the ability to reproduce when young.
- Quick maturation period or short vegetative phase.
- Weeds may have dual modes of reproduction (e.g., reproduce by seeds and vegetatively).
- Weeds have environmental plasticity; that is, they tolerate a wide range of climatic and soil conditions.
- Weeds are often self-compatible, but self-pollination is not obligatory.
- Weed seeds resist decay for long periods in soil and may have long dormancy periods.
- Some annual weeds produce more than one seed flush per year and seed is produced if growing conditions permit.
- Each weed plant can produce a large number of seeds per plant and seed is produced over a wide range of environmental conditions.
- Roots and other vegetative parts of perennial weeds are vigorous with large food reserves, enabling them to withstand environmental stress.
- Great competitive ability for nutrients, light and water and can compete by special means (e.g., Rosette formation, climbing growth and allelopathy).
- Weeds resist control, including herbicides.
- There is a presence of high level of genetic diversity among weed populations.

Importance of weed control in Christmas tree production:

Weeds compete with Christmas trees for nutrients, water, space, light, and can harbor pests and pathogens. Weeds interfere with tree growth at any stage of production or time of year, and when left unchecked, can reduce the growth of Christmas trees by 50% (Warren et al., 1987). Effective weed control is particularly important in seedling beds and in the first three years after transplanting in the field (Image 1). Weed competition during the year of establishment may suppress tree growth and can lead to tree mortality. For example, in a trial at the MSU Horticulture Station near Benton Harbor, MI, we found that controlling weeds, through hand-weeding and applying post-emergent herbicides or applying weed chip mulch, increased seedling survival and growth compared to plots where weeds were not controlled (Table 1). Young trees that grow with minimal weed competition develop extensive root systems, which allow them to better withstand drought and adverse conditions. The rate of growth in the second and third years is related directly to the amount of weed competition in the previous year(s). On light textured soils, weeds may use up available moisture, and young trees may succumb to drought stress. In larger trees, weeds interfere with field practices such as shearing, spraying for pests, and harvest operations. It is difficult for workers to access fields infested with Canada thistle, horsenettle, poison ivy, horseweed, ragweed, pokeweed, sumac and other large or poisonous weeds. Stems of tall woody weeds like ragweed or hardwood tree saplings can interfere with shearing operations. Tall vegetation may also affect pesticide spray deposition to target trees, leading to greater insect and disease pressure. Weeds that grow into tree canopies, such as seedheads of some grasses, vining stems of bindweed or bittersweet, or woody stems of tall weeds can be difficult to remove at harvest. An effective weed management program helps to strike a balance between protecting soil and water resources while also reducing weed competition with trees (Peachy et al., 2017, p. 1).

Importance of weed identification: Proper identification of dominant weeds is a critical component of effective IPM in Christmas tree production. Not all

weeds respond equally well to all treatment measures (Sosnoskie, 2019). For a given weed species, different types of herbicides may range from highly effective to completely ineffective. Likewise, some weeds can be controlled relatively easily via non-chemical methods, such as mowing or mulching, while others are difficult to control without herbicide applications. Proper identification can help to determine the weed's life cycles, time of reproduction, and other key traits. This information can inform decisions on herbicide selection and timing for effective control (Image 2).

To aid growers in identifying weeds on their farms, Michigan State University Extension produced 'A Guide for IPM Weed Identification in Christmas Tree.' (Image 3) This full-color document is available for download and provides basic information on weed ID and key identifying characteristics of weeds commonly found in Christmas tree plantations in the Great Lakes region. To download a .pdf of the guide to your PC, tablet, or phone, search 'MSU Christmas tree weed ID.'

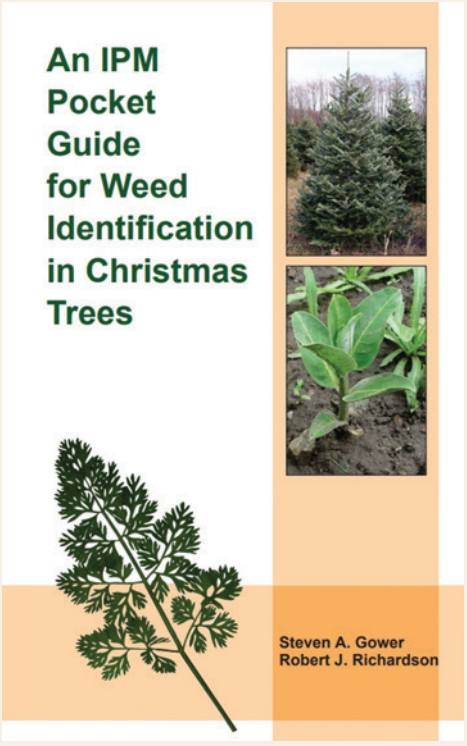

Image 3. – *MSU's Weed Identification Guide can help growers identify problem weeds on their farm.*

Weed management strategies

Non-chemical methods: Preventing weeds from entering or becoming established on your farm is one of the most important steps in a non-chemical weed management plan. With regular scouting of fields, growers can observe when new weed species are encroaching or have been introduced. Removing them prior to their establishment and reproductive phases will reduce weed pressure in future years. Mechanical control methods involve the use of tools or implements that can remove, kill, or otherwise prevent weeds from completing their life cycle. Mowing is by far the most common form of non-chemical weed control used by Christmas tree growers in the Great Lakes region. Mowing also reduces the height of weeds, thereby improving air flow and drainage around trees and making the micro-environment less conducive for insect and disease development. Mowing improves access to the field and access to trees for shearing and tagging. It can also make the environment around trees less habitable for wildlife (rabbits, voles, etc.) that can feed on trees. Cultivation is another means of mechanical weed control. Cultivation may also be an effective weed management practice in recently planted trees. Disadvantages of cultivation is that it needs to be continually repeated to eliminate new weed seedlings as they emerge. Cultivation is not desirable on steep slopes, as this can lead to soil erosion. The use of mulches can also be used successfully to manage weeds (Image 4). Mulches function by creating a physical barrier between the germinating weed seeds in the soil and soil surface, thereby preventing establishment. Coarse textured, large particle sized mulches, such as pine bark, tend to exhibit better weed control than fine textured small particle sized mulches, such as sawdust. Another advantage of organic mulch is the potential for improved soil physical properties. Mulches can reduce soil compaction and erosion, improve water and nutrient holding capacity, and moderate soil temperatures. Numerous studies have found increases in growth of Christmas tree with the use of mulches (Saha et al., 2020). Cover crops can be used to reduce weed competition. Cover crops compete directly with weeds and can suppress or prevent weed emergence. Like organic

Image 4. – *Mulch is commonly used method of non-chemical weed control in Christmas tree plantations.*

mulches, cover crops can improve the physical properties of the soil. Depending on the species of cover crop, other benefits may include preventing erosion and compaction, nitrogen fixation (ex. legumes), and increasing soil organic matter.

Chemical methods: Depending on site factors and weed pressure, relying only on non-chemical methods may not provide adequate weed control. In these cases, growers need to employ chemical control as well (Image 5). Various types of herbicides are used in Christmas tree production for controlling weeds. In this section we will discuss the categories of herbicides available to growers.

Non-selective vs selective herbicides: Non-selective herbicides are chemicals that can kill or damage all plants that they come into contact with. One of the most widely recognized examples of a non-selective herbicide is glyphosate (Roundup). Nearly any plant sprayed with glyphosate will be damaged or killed. Whereas selective herbicides are chemicals that are designed to kill or damage certain types of weeds, grasses, sedges, and other plants without harming others. A common delineation for selective herbicides is broad-leaved plants versus grasses. For example, clethodim (Envoy plus) is a selective herbicide which controls grasses only, while 2-4-D (Defy Amine 4) will kill broad-leaved weeds but not grasses

Preemergence herbicides: Preemergence herbicides are applied before weed seeds germinate and mostly before Christmas trees break bud. Once applied, preemergence herbicides require rainfall or irrigation to activate them in the soil profile. Once activated, these herbicides function by targeting the radicle of germinating seedlings and prevent further plant development. For new tree plantings, it is important that the soil has settled around tree roots prior to herbicide application. This will prevent direct contact between herbicides and tree roots that can cause damage. Preemergence herbicides are applied soon after transplanting to minimize weeds from competing with tree seedlings. Some herbicides have stronger activity on either grass or broadleaf weeds. For best weed control results, growers should apply a combination of preemergence herbicides that target both (Kuhn, 2018). Some of the common preemergence herbicides used in Christmas tree production are dichlobenil (Casoron), indaziflam (Marengo), isoxaben (Gallery), napromide (Devrinol), pendimethalin (Pendulum; Pendulum Aquacap), and simazine (Princep).

Postemergence herbicides: Postemergence herbicides are applied after weed seedlings have emerged and when they are young and actively growing. Postemergence herbicides are most effective if they are applied before weeds enter their reproductive cycle. These products are primarily absorbed through the leaf surface and target weeds by rupturing cellular membranes, arresting production of essential compounds, or distorting growth by hormone mimicry. Postemergence herbicides can be classified as either contact, which damage tissues to which they are applied to or translocated, which move throughout the plant. Conifers can be sensitive to postemergence herbicides, especially when tree shoots are actively growing. Therefore, it is important to follow label instructions regarding tree age,

Image 5. – *Effective weed management often relies on appropriate application of pre-emergence and post-emergence herbicides.*

Image 6. – *Growers can control weeds without damage to crop trees (phytotoxicity) through proper herbicide selection and spray timing.*

size, and herbicide timing (Gallina et al., 2022). Severe phytotoxic injuries (damage to crop trees caused by herbicide drift or unintended application) to different species of Christmas trees can be caused by postemergence herbicides, including stunted growth, burning, and dropping of needles, chlorosis, and even complete death of the tree (Saha et al., 2020). Directing the spray to avoid tree contact helps to minimize tree injury. Some of the common postemergence herbicides used in Christmas tree production are clopyralid (Stinger), clethodim (EnvoyPlus), 2,4-D (Turret), glufosinate (Finale), glyphosate (Roundup), and sethoxydim (Segment).

There is another class of herbicides that have both pre- and postemergence activity such as SureGuard (flumioxazin), Velpar (hexazinone) and Mission (flazasulfuron) (Peachey et al., 2017).

Growers are encouraged to download and consult MSU Extension's "Weed Control in Christmas Trees" (Image 7) for a comprehensive list of herbicides registered for application in Christmas tree plantations. (Google: MSU Christmas Tree Weed Control).

Herbicide resistance and its management: Repeated applications of a single herbicide, or herbicides with the same mode of action, can result in the development of herbicide-resistant weed populations. Herbicide resistant weeds are no longer impacted by the herbicide that previously provided control. For example: glyphosate controlled most of the horseweed and pigweed in farm fields, but now there are many fields with these (and other weeds) where glyphosate no longer provides adequate control. Herbicide resistance originates from genetic differences among individual weeds within a population. The individuals not controlled by the herbicide survive and produce seeds. The seedlings of this population (and subsequent generations) carry the genetic trait that imparts resistance. It is not reversible as the resistant trait remains in the weed population. It can be managed by switching to a different herbicide mode of action or with the use of non-chemical control strategies such as mulching, cultivation, flame weeding, or mowing.

To prevent herbicide resistant weeds, growers should integrate chemicals with non-chemical weed control practices. We also recommend that applicators use herbicides with different modes/sites of action in rotation or in combination/sequence. Crop rotation is another strategy as it diversifies herbicides, farming practices and weed populations, though this may not be practical on all Christmas tree plantations. Scouting fields and recording weed escapes is also useful as it allows the grower to keep track of resistant populations and devise management tools. Growers should follow preventive measures that avoid introduction of resistant weed seeds into fields such as cleaning tools and equipment, preventing weed infested stock plants from entering the field, and controlling weeds in areas that are not currently in production.


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Weed Control in Christmas Trees

Why Weed Control in Christmas Trees Matters

Weeds compete with Christmas trees for nutrients, water, space, and light, and can harbor pests and pathogens. Weeds interfere with tree growth at every stage of production and every time of year. When left unchecked, weeds can reduce the growth of Christmas trees by 50% (Warren et al., 1987).

Effective weed control is particularly important in seedling beds and in the first three years after transplanting in the field (Figure 1). Weed competition during the establishment stage (the first two years in the field after transplantation) may suppress tree growth and can lead to tree mortality (Figure 2). Young trees that grow with minimal weed competition develop extensive root systems that allow them to better withstand drought and adverse conditions.

The rate of growth in the second and third years is related directly to the amount of weed competition in the previous years. On light-textured soils, weeds may use up all of the available moisture, leaving young trees to succumb to drought stress. In stands of larger trees, weeds interfere with field practices such as shearing, spraying for pests, and harvesting trees.

It is hard for workers to access fields infested with Canada thistle, horsenettle, poison ivy, horseweed, ragweed, pokeweed, sumac, and other large or toxic weeds. Volunteer tree saplings and the stems of tall woody weeds like ragweed can interfere with shearing operations. Tall vegetation may also block other pesticide sprays from reaching the trees, increasing insect and disease pressure on them. Weeds that have grown into the tree canopies, such as some grasses with troublesome seedheads, bindweed or bittersweet with troublesome vining stems, and tall weeds with woody stems can be difficult to remove from the trees at harvest.

Effective weed control programs help growers balance the need to reduce competition from weeds with the need to protect soil and water resources (Peachey et al., 2017, p. 1). Such programs may combine nonchemical methods such as mowing and hand weeding with chemical methods such as applying residual preemergence or postemergence herbicides (or both) that have different modes of action.

In this bulletin we will discuss nonchemical and chemical weed control methods, herbicides that are labeled for use in Christmas trees, herbicide-resistant weeds, and the potential negative effects of herbicides on the environment.

Figure 1 (left). Successful management of weeds in Christmas tree production typically requires a combination of mechanical control methods (such as mowing) and proper herbicide application. (Photo: Debalina Saha, MSU Department of Horticulture)

Figure 2. Weeds competing with Christmas trees during the establishment stage (left) and later, during the mature stage (right). (Photos: Joe Neal, North Carolina State University [right], and Debalina Saha, MSU Department of Horticulture [left])

This publication contains pesticide recommendations based on research and pesticide regulations. However, changes in pesticide regulations occur constantly.

Some pesticides mentioned may no longer be available, and some uses may no longer be legal. If you have questions about the legality and/or registration status for using pesticides, contact your county MSU Extension office.

The information contained herein does not supersede the label directions. To protect yourself, others, and the environment, always read the label before applying any pesticide.

Image 7. – *MSU Extension's "Weed Control in Christmas Trees" provides a comprehensive guide to managing weeds in Christmas tree production.*

Summary

Managing weeds is one of the most critical, and often frustrating, components of operating a Christmas tree farm. As with other forms of pest management, adopting an IPM approach to weeds can help growers keep weeds in check in a cost effective and environmentally sustainable manner so that they don't impact tree survival or growth or impact farm operations. Key components of IPM for weed management in Christmas trees includes scouting to identify problematic weeds before they overtake a planting, using non-chemical controls, and judiciously integrating pre- and post-emergence herbicides as needed. Finally, growers can reduce the likelihood of weeds developing herbicide resistance by varying their herbicide products and modes of action.

REFERENCES:

Cregg, B. M., Nzokou, P., & Goldy, R. (2009). Growth and physiology of newly planted Fraser fir (*Abies fraseri*) and Colorado blue spruce (*Picea pungens*) Christmas trees in response to mulch and irrigation. HortScience, 44(3), 660-665.

Gallina, G.C., Cregg, B.M., Patterson, E.L., & Saha, D. (2022). A Review of Chemical Weed Control Practices in Christmas Tree Production in the United States. Forests. 13(2):250. https://doi.org/10.3390/f13020250

Kuhns, L.J. (2018). Weed Control Recommendations for Christmas Tree Growers. Hort. Mimeo Ser. II, 2–22.

Peachey, E., Landgren, C., & Miller, T. (2017). Weed and Vegetation Management Strategies in Christmas Trees. Pac. *Northwest Extension Bulletin* PNW 2017, 625, 1–20. https://cropandsoil.oregonstate.edu/sites/agscid7/files/crop-soil/pnw625.pdf

Saha, D., Cregg, B. M., & Sidhu, M. K. (2020). A Review of Non-Chemical Weed Control Practices in Christmas Tree Production. Forests, 11(5), 554. https://doi.org/10.3390/f11050554

Sosnoskie, L.M. (2019). Weed identification- Why it's important and where to go for help. University of California Agriculture and Natural Resources. https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=30138

Warren, S. L., Skroch, W. A., Perry, K. B., & Monaco, T. J. (1987). Vegetation Management: Its Influence on Survival and Early Growth of Fraser Fir and Norway Spruce. *Journal of the American Society for Horticultural Science*, 112(6), 955-962.