Auburn University
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Management Cooperative

RESEARCH REPORT 15-04

EFFECT OF TERRACYTE®PRO AND ECOTEC® APPLICATIONS ON MOSS CONTROL AND TOLERANCE TO CONTAINER-GROWN FRASIER FIR SEEDLINGS

by
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INTRODUCTION

Control of moss (*Bryophtyta*: *Sphagnum* spp.) has been a problem for container nurseries and plant propagators in greenhouse production systems. Because these plants can reproduce rapidly under the right growing conditions, once established in containers and trays, eradication is often difficult. A single moss spore produces multiple moss plants, and spores can travel over long distances and live for up to 40 years. Other studies on chemical control of moss have been implemented for its control on golf courses: on fairways, tees, and in particular, putting greens, rather than in plant nurseries (Thompson et al. 2011; Brosnan et al. 2014). Moss is ectohydric, relying on water movement on the surface of the plant by capillary action. Because the plant has a shallow root-like structure, moss thrives where nutrients are abundant, especially if fertilizer is applied at the surface. It is thought that moss does not compete for resources in the deeper root zones of plants in larger nursery containers. However, in smaller tray containers such as those used in forest-tree nurseries, moss competes for water and nutrients (especially when fertilizer is applied through irrigation) with desired species. Also, the presence of moss reduces the aesthetic quality of the final product, requiring expense of resources to remove moss prior to shipping.

Several studies for control of moss have been made over seedlings in forest-tree containers using two products similar to those used in this study (Khadduri 2011; Fausey 2003). TerraCyte®PRO (27.60% hydrogen dioxide) is a broad spectrum algaecide and fungicide produced by BioSafe Systems, LLC, and is used primarily on golf course fairways, greens and tees. Its label also lists suppression and control of moss and algae in container-grown plants and trees as an acceptable use. The product is formulated as a fine granular flowable that is activated by water, breaking down into hydrogen peroxide that can kill organisms by oxidizing cell membranes. A second product that nursery managers have used to control moss is Sporatec®, a liquid fungicide. However, this compound's production has been discontinued due to supply issues with one of its ingredients. A similar product manufactured by the same company, Brandt Consolidated, Inc., is Ecotec®, which contains the same primary active ingredient (rosemary oil) as Sporatec®. This product is labelled as a broad spectrum insecticide and miticide and is an exempt pesticide under FIFRA regulations. Control of bryophtyes (liverworts, hornworts and mosses) is listed on the Sporatec® label by using 1-2 ounces of product per gallon water, wetting the targeted plant heavily. Because Sporatec® is no longer available and there are no label recommendations for moss control on the Ecotec® label, Ecotec® was used in this study at the recommended rates of Sporatec®. The objectives of this

study were 1) to test the effectiveness of TerraCyte®PRO and Ecotec® on moss control at two application rates and times of application in a container nursery setting, and 2) to determine Frasier fir seedling tolerance to TerraCyte®PRO and Ecotec® at two application rates and times.

METHODOLOGY

This trial was conducted at the North Carolina Forest Service's Linville River Nursery in Newland, North Carolina on containerized Frasier fir (*Abies fraseri*). Two application rates of each product were used (Table 1.) over the growing season (13 weeks post-sowing and 19 weeks post-sowing). The initial application was made in June and a second application was made in July to half of the previously treated trays. Each product was applied as a soil drench with a watering can by Nursery Cooperative personnel. At the end of the growing season, the cells in each tray with moss covering the soil present were counted.

Each treatment was one seedling tray that was replicated five times for each product (Ecotec® and TerraCyte®PRO), rate (Check, Low, High) and time of application (June & July). Moss counts in the seedling trays and seedling density counts were made from each tray at the end of the growing season in December 2014. Random samples of 10 Frasier fir seedlings from each tray (by product, rate and time of application) were brought to the Nursery Cooperative laboratory in Auburn for evaluation of seedling tolerance to the products. Measurements were made on each seedling for shoot height, RCD, and biomass (root and shoot dry weights) on both treated and non-treated control seedlings. Data was analyzed using SAS and treatment means separated using Duncan's and Dunnett's test at alpha=0.05.

RESULTS AND DISCUSSION

Except at the high rate of TerraCyte®PRO, the use of each product (TerraCyte®PRO and Ecotec®) for moss control in container systems resulted in no detrimental effects on Frasier fir seedlings. While not consistent across application times, a trend developed that showed a decrease in Frasier fir seedling shoot height, RCD, shoot weight and root weight at this high rate when compared to non-treated control seedlings. The comparison of seedling heights, root collar diameters, shoot dry weights and root dry weights showing differences when compared to the non-treated control seedling characteristics is found in Tables 2a and 2b.

The amount of moss at the end of the growing season indicated the relative ineffectiveness of each of the products in controlling moss on the Frasier fir containers. The moss coverage in each tray at the end of the growing season shows that the use of TerraCyte®PRO or Ecotec® at either rate or application time did not reduce the amount of moss in trays when compared to the non-treated control trays. However, multiple applications of both products did result in a **smaller increase** in moss coverage than did single applications of the products. Thus, the multiple applications slowed the rate of spread. Anecdotal evidence from the nursery manager indicated that Sporatec® had previously been used successfully to limit the spread of moss, using up to 4 applications of the product over the growing season to achieve this control. There are questions as to why these products were not as effective in this study. The population level of moss in containers prior to the initial treatment may have exceeded a threshold for adequate response from any treatment. The ingredient missing from Ecotec® but present in Sporatec® is clove oil,

which may have played a part in previously seen moss control at this nursery. Also, an insufficient number of applications of the products made and/or cultural practices in this particular greenhouse, such as over-watering or insufficient air circulation, may have contributed to the widespread moss levels and lack of effectiveness of the products. Additionally, sawdust was used as a capping material and while it primarily serves to limit excess moisture, its presence on trays with excessive moisture may have provided a medium on which the moss spread from cell to cell.

MANAGEMENT IMPLICATIONS

- While the spread of moss was limited by repeated applications, the use of either TerraCyte®PRO or Ecotec® for the eradication of moss in containerized Frasier fir was not shown to be effective. Earlier and repeated, even weekly, applications of products may be required with these products. Greenhouse cultural practices that address overwatering and provide consistent air circulation to limit surface moisture may provide more effective moss control. Alternative fertilization strategies of incorporating slow-release fertilizer into container media rather than fertilizing through irrigation may reduce the availability of nutrients to moss at the surface of the containers.

- The study showed no negative effect of either product at any rate and timing combination on Frasier fir seedlings except at the high rate of TerraCyte®PRO. Growers wishing to use either product on other species should utilize the products on a small number of containers to test for species' phytotoxicity prior to operational use.

LITERATURE CITED

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Table 1. Treatment rates and application times used on Frasier fir seedlings to control moss, Linville River Nursery, NC 2014.

Treatment	Low Rate	High Rate	Applications
Check	None	None	None
Ecotec	2.5 mL/gal	5 mL/gal	June
Ecotec	2.5 mL/gal	5 mL/gal	June and July
TerraCyte	10.5 grams/gal	21.0 grams/gal	June
TerraCyte	10.5 grams/gal	21.0 grams/gal	June and July

Table 2a. Container Frasier fir seedling characteristics treated with two herbicides at two rates at two times over the growing season, Linville River Nursery, Newland, NC 2014.

		Seedling Shoot Hgt (cm)		Seedling RCD (mm)		Seedling Shoot Weight (g)	
Treatment	Rate	Time of Application		Time of Application		Time of Application	
		June	June and July	June	June and July	June	June and July
Control	Control	7.4	7.4	2.29	2.29	0.46	0.46
Ecotec	Low	7.3 a	6.5 b	2.17	2.29	0.42	0.43
Ecotec	High	7.2	6.8	2.23	2.32	0.43	0.44
TerraCyte	Low	7.7	7.1	2.28	2.30	0.48	0.46
TerraCyte	High	6.9	6.4	2.16	2.21	0.41	0.43

Different letters (a, b) within a Seedling Characteristic row indicate significant treatment difference in Time of Application within a Rate.

Underlined means within a Seedling Characteristic indicate significant treatment difference from that of the non-treated Control at that Treatment, Rate and Time of Application.

Table 2b. Container Frasier fir seedling characteristics treated with two herbicides at two rates at two times over the growing season, Linville River Nursery, Newland, NC 2014.

		Seedling Root Weight (g)		% Increase Moss Coverage/Tray[1]		Final % Moss Coverage/Tray[2]	
Treatment	Rate	Time of Application		Time of Application		Time of Application	
		June	June and July	June	June and July	June	June and July
Control	Control	0.36	0.36	12.5	12.5	98.8	98.8
Ecotec	Low	0.34	0.34	19.1 a	2.7 b	99.1	99.4
Ecotec	High	0.32	0.35	34.5 a	1.3 b	99.5	99.6
TerraCyte	Low	0.39	0.36	18.4 a	3.4 b	98.7	98.1
TerraCyte	High	0.30	0.34	30.3 a	2.7 b	99.3	97.8

Different letters (a, b) within a Seedling Characteristic row indicate significant treatment difference in Time of Application within a Rate.

Underlined means within a Seedling Characteristic indicate significant treatment difference from that of the non-treated Control at that Treatment, Rate and Time of Application.

[1]Percent increase in moss coverage per tray measured from June 2014 to December 2014.

[2] Final percent moss coverage per tray measured in December 2014.