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Cover Page Footnote

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Michigan Conifer Growers' Perspectives on Disease Management

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Abstract. A survey of commercial nursery and Christmas tree growers was implemented online and by mail in 2018 to understand disease issues and information preferences. Overall, the majority of the respondents reported that they prefer online sources of information and many are using Extension bulletins and sources. Cultural, chemical, and weed control methods were considered extremely effective by participants and very few used biological control methods to control disease. Participants identified spruce decline, boxwood blight, and hemlock woolly adelgid as emerging disease threats, so future information to growers should focus on identification and management of these threats.

INTRODUCTION

The nursery crop industry in the United States was valued at $4.65 billion as of 2007 (National Agricultural Statistics Service, United States Department of Agriculture [NASS, USDA], 2007b). The economic impact of Michigan's nursery, perennial production, Christmas tree, turf production, landscaping, and lawn care industries was $5.71 billion as of 2012 (Knudson & Peterson, 2012). Climate, soils, and a centralized location to large domestic markets combine to make Michigan a national leader in the production of landscape nursery stock and Christmas trees. Michigan is the third largest producer of Christmas trees in the United States behind Oregon and North Carolina. Michigan ranks 11th in the nation in nursery stock sold. The most recently available report, published in 2008, indicated that Michigan ranked 10th nationally in nursery worker employment (with 7,555 permanent and temporary jobs) and approximately 57% of total production was sold wholesale with 31% being sold wholesale to landscape service firms (Hall et al., 2020). Diseases are important limiting factors in crop production and are also drivers of increasing operation costs; there were 3.9 million pounds of chemicals applied to nursery crops in 2006 (NASS, USDA, 2007a). Disease issues affecting conifers in Michigan include a range of fungal and oomycete pathogens that attack the roots, wood, and foliage of these plants throughout different age classes. These pathogens cause needle loss, branch and tip dieback, and, in some cases, tree and seedling mortality. Some key pathogens the affect conifers include the suite of fungal pathogens behind "Spruce Decline," unculturable rust diseases such as Weir's cushion rust, and the root rot *Phytophthora* species.

Extension educators; nursery, seedling, and Christmas tree growers; and other industry professionals in Michigan have identified the need for efficient and rapid diagnoses of diseases affecting conifers and other woody ornamentals as a pressing issue. These concerns, however, have been expressed by specific individuals; the extent to which the entire conifer grower community in Michigan faces these challenges is unknown. Crop-growing conditions (monoculture) and the addition of moisture and nutrients promote pathogen proliferation, so early detection, efficient containment, and eradication of plant pathogens is crucial. Once a plant pathogen is suspected, it must be properly identified and surveyed. Alongside timely and accurate identification of disease-causing agents, mitigation strategies need to be updated or developed. Current chemical treatment plans are based on anecdotal grower experiences or recommendations from university educators and other industry professionals. The labels on treatment chemicals give instructions limited to few species and may not be legally used in tree species that are commonly cultivated. There is an urgent need to review currently used disease treatments and scientifically validate them. Similarly, a new methodology that objectively identifies the most at-risk tree crops and the most serious pathogens and mitigation strategies of concern to growers, diagnostic labs, agencies, and extension educators is needed. Finally, research findings need to be communicated back to stakeholders and end users using optimized information, communication materials, and methods.

Therefore, there is a strong need to understand the challenges and issues faced by conifer growers to provide timely and effective Extension services to these individuals and to support their efforts statewide. This study implemented a statewide survey to systematically evaluate stakeholders and end user's needs, concerns, and perspectives in relation to conifer disease issues.

METHODS

A hybrid survey was distributed through mail and online in 2018 to a list of all known Michigan nursery, seedling, and Christmas tree growers, as provided by Extension educators working in the state (N = 587). The survey instrument was developed with a group of key stakeholders and included the following sections: Background, Species and Diseases, Effectiveness of Current Practices, Barriers, Information Seeking Behaviors, Monitoring Behaviors, Regulatory Pressures, and Research Needs. The survey was first sent to LISTSERVs maintained by Extension educators via an online link generated in the Qualtrics survey platform. Then, postcards, mail surveys, and follow-up surveys for non-responders were prepared and sent to firms across the state. The results reported below may not add to 100%, as participants could select more than one option. Additionally, there were individuals that did not respond to certain questions (item non-response); percentages reflect only a portion of the number of individuals in a given category that responded to the question. This is a more conservative summary of results, as it is impossible to speculate why an item was left blank.

RESULTS

There were 30 mail surveys and 16 emails that were returned as undeliverable. A total of 87 responses were received via mail and by the online link of the survey for an adjusted response rate of 16%. A statistical comparison of early and late responders to test for non-response bias (ANOVA, R statistical software) revealed no significant differences in the type of farm, number of trees managed, or a composite number of conifer species grown. Responses were received from 36 counties and the average number of acres cultivated by respondents was 356.

Of the respondents that answered what type of farm they operated (n = 80), 47% grew Christmas trees, 31% grew large Ball and Burlap nursery trees, and 17% grew container nursery trees. Less than 10% grew bare root seedlings, potted liners, and plastic liners in greenhouses.

Half of respondents grew some type of coniferous tree: 24% grew deciduous trees, 16% grew shrubs, 14% grew woody perennials, and 8% grew ground cover. Results do not add to 100%, as some respondents grew multiple tree types. The most commonly grown species were Colorado blue spruce (*Picea pungens*), white pine (*Pinus strobus*), Fraser fir (*Abies fraseri*), Norway spruce (*Picea abies*), Black Hills spruce (*Picea glauca* var. densata), concolor fir (*Abies concolor*), and Canaan fir (*Abies balsamea* var. phanerolepis). The most common diseases encountered were Rhizosphaera needle cast (called needle blight on the survey) of spruce, Phytophthora root rot, spruce decline, Diplodia tip blight, and Rhabdocline needle cast, as measured by the number of times a respondent listed the disease in the Top 10 Diseases Encountered question. Respondents most commonly avoided planting Colorado blue spruce and Douglas fir due to concerns about disease vulnerability.

Respondents indicated that cultural (e.g., water mechanical and site selection), weed control, and chemical control measures were quite effective (Figure 1), while biological agents were not typically used by growers. The most commonly reported barrier to disease control was lack of effective products (10%) followed by lack of information (8%).

The most commonly used sources of information by respondents were Michigan State University (MSU) Extension bulletins and websites (n = 18) followed by the MSU Christmas Tree pest management guide (n = 16). Fifteen respondents personally contacted MSU Extension educators, and 14 respondents reported contacting other growers. Only 11 respondents indicated that they needed additional materials, which included resources for identifying diseases and timing pesticide applications. The emerging diseases indicated by respondents were spruce decline, boxwood blight, and hemlock woolly adelgid. Nearly half of respondents (n = 35) reported having monitoring/scouting programs, with the most common timing being whenever they are out in the field. Finally, respondents' preferred modes of communication were Extension bulletins (n = 31) and websites (n = 28). Of the 32 respondents who answered the question about participating in a future annual growers survey, 81% were willing to participate. Of those willing to participate, 90% preferred to answer a questionnaire in the winter and 95% preferred a web-based format. The remaining 5% preferred either a paper questionnaire or an in-person format.

DISCUSSION

With fewer extension educators covering expanding industries and the limited time of growers to attend in person meetings, or even listen to webinar recordings, methods of efficient engagement are critical to ensure stakeholders and the extension community receive timely and relevant knowledge. Methods like annual online surveys may ensure that resources are directed towards critical research to serve these communities, as defined by the individual growers in those communities.

A 30-question survey was distributed to 587 conifer growers in Michigan; 16% of the surveys were returned

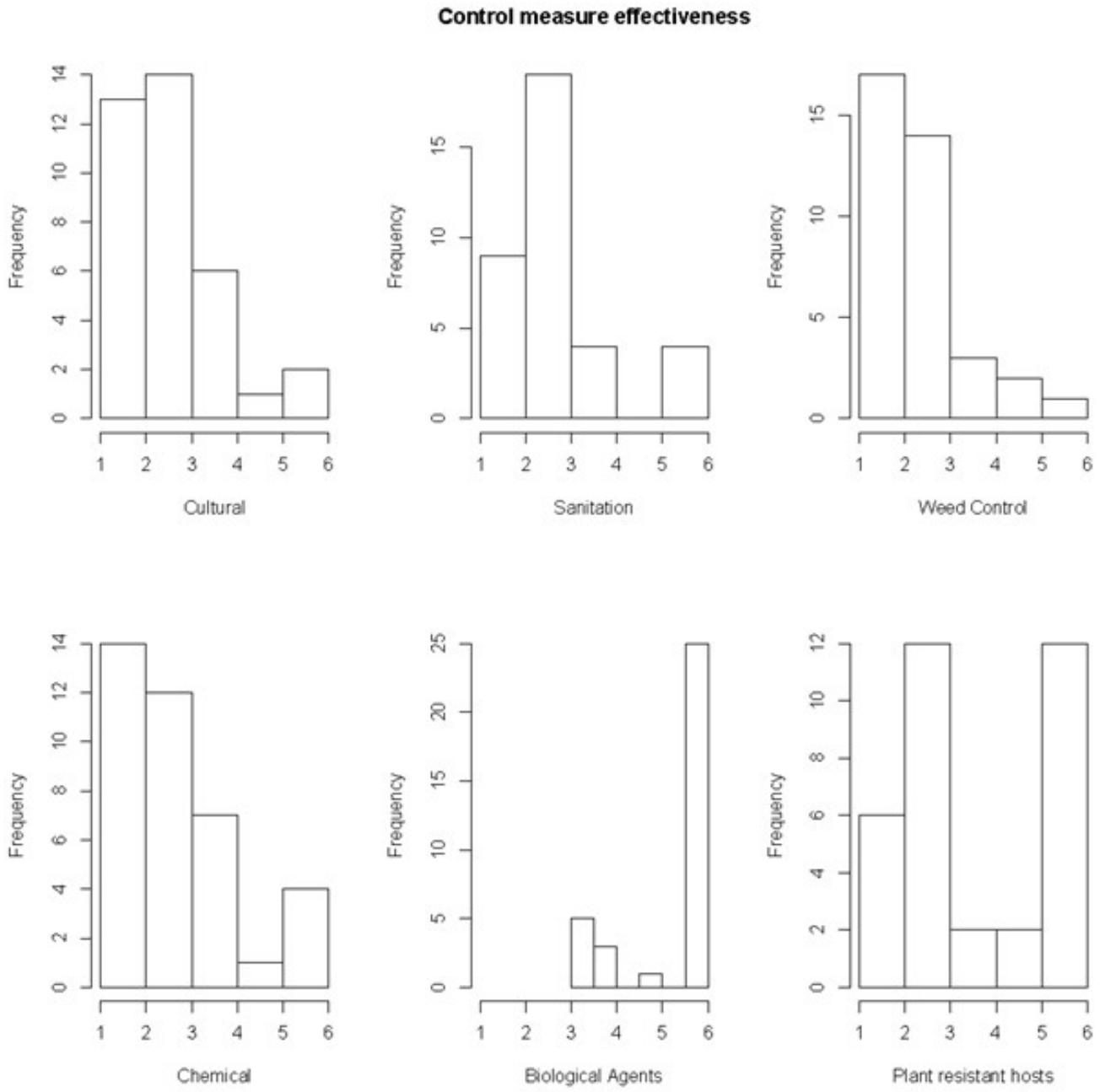

Figure 1. Participant ranking of control measure effectiveness. 1 = *Extremely effective*, 5 = *Not effective at all*, 6 = *I do not use this control measure*.

(n = 87 respondents), and respondents represented both the lower and upper peninsula of Michigan. While respondents indicated a variety of preferences for receiving information, which is consistent with similar efforts to understand grower needs (e.g., Alston & Redding, 1998), most participants preferred online formats. Online communication could take many forms, including traditional Extension outlets and social media (Darr et al., 2020).

Allowing growers to skip questions did mean that all requested information was not captured for each respondent. However, this option was included to enable more respondents to fill in the survey overall. Using multiple choice for some questions and including a text option for others—where respondents could type in their own answer—was important for capturing information that may not have been gathered using preset answers. The online version of the survey was preferred, but there were still some growers that preferred to respond (and did) by mail, so a hybrid approach seems appropriate for the foreseeable future.

Responses indicated that while Colorado blue spruce and Fraser fir accounted for the most commonly grown tree species, respondents avoided planting these trees due to disease concerns. Needle casts and blights (Rhizosphaera needle cast of spruce, Diplodia, and Rhabdocline needle cast), Phytophthora root rot, and spruce decline were considered the most common diseases encountered. Respondents indicated a lack of chemical control options limiting their management of these diseases. Considering Colorado blue spruces are affected by Rhizosphaera and spruce decline and Fraser firs are affected by Phytophthora root rot, effective control of these diseases is critical for industry expansion and stability. Grower perceptions of effective control methods indicated widespread support for cultural, chemical, and weed control methods but little support for biological agents. Therefore, more knowledge and skill building around biological agents will be necessary with this audience.

Future research efforts similar to this would ideally tailor questions to the issues facing growers and would facilitate fast and efficient information gathering (e.g., easy check boxes with lists of diseases). It may be prudent not to allow participants to skip questions (in the online version) so that better data is captured; including a "does not apply to me" option would be critical in this case. A future survey should also include images of typical signs and symptoms of a disease to ensure respondents are selecting the disease even if they do not know the name. Basic pest and pathogen identification has been identified as a knowledge gap in other survey efforts (Byamukama et al., 2016). Assessing growers' general knowledge of diseases and emerging threats would be a useful addition to this effort, as would further exploration of growers' best management practices (Fain et al., 2000).

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