EXAMINING POSSIBLE CAUSES OF MORTALITY IN WHITE PINE SEEDLINGS

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ABSTRACT

White pine (*Pinus strobus* L.) is one of the most important timber trees in the northeastern United States and eastern Canada (Demeritt and Garrett 1996). White pine is not native to Missouri; it is commonly planted for wind breaks and erosion control and as an ornamental. Unusual mortality of bare-root seedlings of white pine purchased from the George O. White State Forest Nursery has been occurring after planting throughout the state. There are numerous possible explanations for white pine seedling mortality which may act alone or in combination. Lifting, packing, transportation, storage, and planting techniques can all influence seedling mortality after planting (Venator 1985). Also, extreme weather conditions after planting will increase seedling mortality (e.g., drought, overwatering, flooding, hot summers). The objective of this study was to determine the perspectives of private landowners toward possible causes of white pine mortality.

In early 2009, a telephone survey was conducted of individuals selected from the State Forest Nursery customer database for 2007, 2008, and 2009. One hundred and sixty people were called between April 21 and May 13, 2009. Each household was called two to five times during this period. Fifty individuals completed the telephone survey.

Forty-eight percent of respondents reported an increase in white pine seedling mortality during the past 3 years, but the increase was not limited to any particular area of the state. A majority of respondents who noticed an increase in mortality (62 percent) indicated that the mortality problem started in 2007. Most respondents (60 percent) did not have an opinion on what might be causing the mortality; however, 45 percent of the respondents who expressed an opinion about the possible cause of white pine seedling mortality thought that the mortality was caused by drought or flooding after planting. In fact, a number of people suggested that 2007 had drought-like conditions, and 2008 and 2009 were too wet, and this combination contributed to seedling mortality during the past 3 years. Twenty percent of respondents that experienced a problem believed that packaging and transportation caused the seedlings to die.

The factors responsible for seedling mortality were believed to be 1) rough handling during transportation, which caused seedlings to arrive with broken tops; 2) the large number of seedlings in each bundle, which they believe caused root mold; 3) the variation in size of seedlings in each bundle, which they believed led to machine planting problems; and 4) rough handling during transportation, which they believed caused roots of seedlings to arrive at their destination dried out. To avoid roots drying out, it was suggested that roots should be clay dipped prior to shipping.

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Ten percent of the respondents that experienced a problem believed that the seedlings were too big. They indicated that the overall size had increased over time and was highly variable within individual bundles. According to the respondents, the size of the seedlings and variability in sizes in each bundle made machine planting difficult. They also believed that size of the seedlings resulted in an unfavorable root-to-shoot ratio.

Other reasons advanced by a small minority of respondents were 1) planting on wrong sites, such as clayey soils; 2) planting on sites with little sunlight; and 3) conditions under which the seedlings were raised at the State Forest Nursery. Conditions at the nursery that may affect seedling survival after field planting include watering regime, soils, fertilization, root pruning, length of cold storage, and how seedlings are stressed prior to lifting.

There were no noticeable differences in transportation, planting, or management of the seedlings after planting between people experiencing seedling mortality and those who had not. For example, some people had been planting white pine for 20 years and had not changed the way they handle and manage white pine, but observed mortality problems recently. On the other hand, other people planted white pine over the same period and their trees were fine.

The mortality problems have caused several people to stop buying white pine seedlings from the nursery. Looking at the list of who bought white pine in 2007, 2008, and 2009, we see that although there is around the same number of names, there is a big change in who is on the list in 2007 and 2008. Very few individuals show up on the list for all 3 years. We think customers may have noticed a change in survivorship and may have started buying their white pine seedlings elsewhere.

The survey suggested that the increased white pine seedling mortality started in 2007, and weather, transportation and packaging, seedling size, and nursery conditions were the probable causes. White pine seedlings are known to be intolerant to drought, heat, and flooding (Gilman and Watson 1994). While these weather factors are beyond our control, other factors could be modified to improve survivability. For example, private landowners should avoid planting white pine in clayey soils or in areas where the seedlings do not receive enough sunlight. The State Nursery should ensure that the root-to-shoot ratio is high because seedlings with a higher ratio usually have better survival (South and others 2005). The nursery can also improve uniformity of seedlings within each bundle. Length of cold storage can be ruled out as a factor because seedlings are now rarely stored for a long time. Gwaze and Hoss (2007) found that seedlings of white pine planted immediately after lifting had better survival.

Further research into other factors believed to be affecting mortality in white pine seedlings is needed. In the future, the nursery is likely to examine the following factors: 1) seed source effects (North Carolina and Virginia), age effects (2- and 3-year-olds), effect of watering (normal watering after lifting and watering plus root gel application), and effect of rough handling from nursery to planting site (UPS and individual landowner pick up). The investigation suggested by the State Forest Nursery provides an important step in understanding factor(s) responsible for the seedling mortality in white pine. The results will be useful in enhancing the planting of white pine seedlings to meet aesthetic, economic, and restoration objectives.

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