BLACK WILLOW TREE IMPROVEMENT: DEVELOPMENT OF A BIOMASS SPECIES FOR MARGINAL AGRICULTURAL LAND IN THE LOWER MISSISSIPPI ALLUVIAL VALLEY

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ABSTRACT

Introduction

Short rotation woody crops, such as willows (*Salix* spp.), continue to be examined as biomass species because of their fast growth, ease of vegetative propagation, and ability to be coppice regenerated. Black willow (*Salix nigra* Marsh.) fits well into a biomass program for the southern United States because of its ability to grow on marginal agricultural sites that are poorly drained.

Methods

In 2008, Mississippi State University and the U.S. Forest Service Center for Bottomland Hardwood Research entered into a joint venture to develop genetically superior black willow clones as feedstock for a growing bioenergy and biofuels market. An initial collection of 113 clones was made in the fall and winter of 2008-2009 from five geographic areas. Following 1 year in stoolbed culture, the clonal material was placed into a series of genetic screening trials in 2010 and 2011. A total of four clonal screening trials, two in 2010 and two in 2011, were established on various sites in Mississippi. These trials were annually measured for total height, diameter, and number of stems. Thus, up-to-date measurements include the first 3 years for the 2010 and 2011 trials. However, as a method of hopefully getting ahead of the selection process, the age-two data was used to select clones for the 2012 black willow clone test. In 2013, the age-three data from the 2010 screening trial and the age-two data from the 2011 screening trial were used to select clones for the 2013 black willow clonal test.

Results

Growth from age-three trials indicated that spacing could be reduced from 54 square feet per tree to 18 square feet per tree, thus in 2012 the first clone test employed a 3 foot x 6 foot spacing. Growth was impressive the first year with the crowns closing toward the end of the first growing season. Age-two measurements continued to show increased growth, even at this tight spacing. In addition, the 2013 clone tests used this same spacing.

All of the screening and clone tests to date have shown excellent survival rates. However, in both the 2010 and 2011 trials, a limited number of sandbar willow (*Salix exigua* Nutt.) clones were included. Survival of the sandbar clones in the 2010 and 2011 test sites located near Prairie, MS exhibited nearly total mortality. It was discovered that the mortality was due to the acidic soil (pH of 4.6) as compared to the Stoneville and Hollandale test sites (which exhibited a soil pH of 7.0). Sandbar willow has also been determined to lack the rooting capacity of black willow, which may relate to its

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low growth and survival rates in these tests. Additionally, sandbar willow has a propensity to root sucker, thus creating problems in stoolbed culture.

The age-three data of the 2010 screening trial showed significant geographic source and clone differences. However, as age increased, geographic variation diminished while clone variation increased. Age-two data from the 2010 and 2011 trials were used to select the top 25 performing clones to be established in the 2012 black willow clone test. All geographic sources were present in this trial, although there were a higher number of clones representing the Atchafalaya geographic source. The results of the age-two data at Sessums, MS showed clone ATCR 4-4 was the best performing clone, and the poorest performance was from the only sandbar clone included in the test. The top four performing clones from the combined analysis of the 2010-2011 clonal screening trials have also outperformed the majority of the other clones.

Summary

The primary objective of this study was to identify genetically superior clones of black willow for the production of biomass for bioenergy and biofuels. Suitable biomass growth on marginal sites should be achievable using genetically superior black willow. As screening trials and clone tests age, we will be able to determine the viability of black willow as a biomass species for the production of bioenergy and biofuels. While this venture is new, it has shown promise, and different concepts are being examined to determine future steps for increasing gain and viability of black willow as a biomass species for the production of bioenergy and biofuels.