THE USE OF GIBBERELLIC ACID AS A PRESOWING TREATMENT FOR CHERRYBARK AND NUTTALL OAK ACORNS

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Abstract—The use of gibberellic acid to enhance growth and development in plants has been shown in many species. Gibberellic acid is a naturally occurring hormone that can, in certain concentrations, affect dormancy, flowering, fruit set, growth, frost protection, root formation, and other growth processes. The positive effect on germination by this hormone treatment could help the nurseryman produce more uniform seedling germination and a higher germination value. Cherrybark (*Quercus pagoda* Rafinesque) and Nuttall (*Q. nuttalli* Buckley) oaks were chosen to evaluate seed treatment with gibberellic acid to enhance germination treatment. Three treatments and a control were used to treat the seed which were then planted in a greenhouse study with a 2 by 2 factorial with five observations in each species/treatment. Germination of the seedlings was monitored for 31 days and seedling germination times were recorded. Analysis of the effectiveness of the treatments was done using Czabator's germination value index. The use of the Czabator's gibberellic acid had a positive effect on both cherrybark and Nuttall oak. The cherrybark species responded significantly to the higher levels of the gibberellic acid indicating that the use of the hormone could be a useful tool in enhancing germination which may be important when seeds are in short supply.

INTRODUCTION

The use of gibberellic acid to enhance performance of certain plant growth attributes has been shown in numerous species ranging from monocots such as rice (Durand 1993) to dicots such as oak (Vogt 1970). Gibberellic acid is a strong, naturally occurring plant hormone and can influence flowering, dormancy, fruiting, growth, etc. (Riley 1987). Vogt (1970) found that northern red oak (*Quercus rubra*) had a positive response reducing the time to 50 percent germination from seven weeks to three weeks when treated with GA3. Farmer (1974) reported similar GA influenced results with northern red oak. Bonner (1976) working with cherrybark oak (*Q. pagoda*) noted enhanced germination when gibberellic acid soak was used. Singh reported that spruce seeds germinated better than silver fir when both species were treated with GA3. Rawat (2006) reported that germination of three species (*Abies pindrow, Cxupressus torulosa, and Picea smithiana*) was increased by a combination of GA3 and presoak temperatures. This increase in germination increased the available seedlings by increasing the total seedlings obtained from a lot of seed.

The germination and initial growth of oak seed especially cherrybark and Nuttall (*Q. nuttallii*) was of special interest in the Southern and Mid-South states because of the value of the cherrybark and the demand for the Nuttall oak in the aforestation effort in the Mississippi River floodplain. In some years, seed of both of these species are in short supply because of poor seed crops; any technique that would enhance the germination both in speed and completeness was of interest.

METHODS AND PROCEDURES

A group of cherrybark and Nuttall oak acorns was made from randomly selected trees of each species located in north LA. The seed was float tested and a random sample of 250 seeds per species was selected for use in this study. The seed were stratified in cold (35 °F), moist conditions from collections in November until the study began in the greenhouse in March.

Four treatments were applied to the seed. They were Gibberellic acid (GA3) in concentrations of 100, 200, 300 ppm GA3 and distilled water. Seed were removed from stratification and the seed were dried for 24 hours. The seed were placed in the appropriate treatment solution and soaked for 24 hours. Root-trainer seedling containers were filled with pro mix soil media and the seed were then placed approximately 1/2 inch under the surface of the soil media. Greenhouse temperatures were 80 °F daytime and 68 °F nighttime and the containers were watered when needed.

Two-hundred-fifty seed per treatment were placed in 50-seed groups for a total of 1,000 seeds in the study. After the first germinating oak was recorded, the planting was evaluated every 3 days until the study was terminated 30 days later. In each observation period, the number of germinants was recorded by day to get the cumulative germination value.

The evaluation of the effectiveness of the treatments was done by using a germination value calculated by using Czabator's (1962) formula (GV=PV X MDG), which combines the mean daily germination (MDG) and a peak value (PV), which combines both speed and completeness of germination. A germination curve plotting cumulative germination on a graph with a y=number of germinants and the x=the days in the test, was used by Czabator to determine the peak values. In this study, the PV was determined mathematically and used in the formula to determine the germinative value. The germinative value was then analyzed using both analysis of variance produced by PROC GLM (SAS 1995), and Duncan's multiple range test to separate the means. The study design was a 2 by 2

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factorial with five observations in each species by treatment combination.

RESULTS AND DISCUSSION

Analysis of variance indicates that there were no differences between the germination values of the treated Nuttall oak. There were significant differences in the germination values of the germination values of cherrybark oak (table 1). Duncan's Multiple Range Test indicates that for cherrybark oak the 300 ppm GA3 soak was effective and the germative value was significant (table 2). Only in the highest levels of treatment did a positive result occur indicating that for these two oak species there needs to be more work done to determine the level for the optimum response. In cherrybark oak, the threshold may have been reached with the 300 ppm level but either the strength of the treatment solution or the time of the soaking needs to be tweaked. The Nuttall oak had not reached a response level at the solutions that were used in this study, and again, the solution level and the length of treatment need to be evaluated in additional studies. If the effective treatments can be worked out for these and other oak species, better utilization of the seed collected in short seed years may be accomplished and the nurseryman will have another tool for seedling production.

Table 1—Composition of expected mean squares (EMS) variances and results for analysis of variation of germination value where both species and treatment are fixed effects

Source of Variation:	Expected Mean Squares	Mean Squares	F-value
Species (S)	$\sigma_e + tn\sigma_s$	13.67	< 0.0001
Treatment (T)	$\sigma_e + sn\sigma_t$	1.62	0.03
S*T	$\sigma_e + n\sigma_{st}$	2.26	0.01
Error	σ_e	0.46	

Table 2—Cherrybark and Nuttall oak by species by treatment germination value (GV) means

Species	Treatment (ppm)	Mean GV	Duncan Grouping
Cherrybark Oak	300	2.80	A
Cherrybark Oak	100	1.55	B
Cherrybark Oak	200	1.10	BC
Cherrybark Oak	Control	0.83	BC
Nuttal Oak	200	0.56	BC
Nuttal Oak	Control	0.38	C
Nuttal Oak	100	0.37	C
Nuttal Oak	300	0.29	C

Means followed by the same letter are not significant at the P < 0.05 probability.

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