Growth inhibitor reversed

Giberellic, Citric Acids and Stratification Enhance White Ash Germination

Joe R. McBride 1 and Richard Dickson 2

White ash *(Fraxinus americana)* exhibits seed dormancy that can be broken by stratification. However, we have found some seedlots of apparently sound seed that would not germinate satisfactorily (less than 1-3 percent germination) even after 90 days stratification. This seed remained sound (cutting tests showed full seed with no appearance of decay) and continued to germinate sporadically all summer. One flat of seeds from a completed germination test which had been left in a cold greenhouse bay over winter produced numerous seedlings the following spring. Similar delayed germination of white ash has been noted in the field (Leak, 1963).

Recent investigations (Sondheimer and Galson, 1966; Snodheimer *et al.,* 1968) have indicated the presence of a germination inhibitor in the seeds of white ash which is reduced in concentration during stratification. The substance, identified as *abscisic acid,* inhibits the growth of excised embryos. This inhibition can be reversed by application of gibberellic acid. Citric acid in low concentration has also been shown to increase germination in other species exhibiting embryo dormancy (Jones, 1963; Cotrufo, 1963). The objective of our study was to determine the effect of gibberellic acid and citric acid on the germination of stratified and nonstratified white ash seed.

Methods

Seeds for this study were collected in the autumn of 1969 and stored dry at 410 F for 8 months.

Prior to stratification and germination testing, 12 lots of 100 seeds each were tied in cheesecloth bags and soaked for 12 hours in each of the following aerated solutions: (1) distilled H2O, (2) 1 ppm gibberellic acid (GA,), (3) 10 ppm gibberellic acid, (4) 100 ppm gibberellic acid, (5) 0.1 percent citric acid, (6) 1 percent citric acid, and (7) 10 percent citric acid. Three replicates of 100 seeds from each of the soaking treatments were planted in sand-filled trays in the greenhouse. These seeds constituted a non-stratification treatment. Their germination was observed for 60 days. The remaining soaked seeds were stored at 41 F for two different periods, 30 and 60 days. At the end of each of these stratification periods, the seeds were placed in sand for germination. During the germination test, the seeds were watered daily. Successful germination was defined as the appearance of the cotyledons above the surface of the sand in the trays.

Two additional lots of 100 seeds were used to test the viability of the seed source. Filled seeds, as determined by cutting, were considered viable.

Results and Discussion

Germination was enhanced by gibberellic acid treatment, citric. acid treatment, and by stratification (table I and figure 1). Analysis of variance and Student's t test were used to statistically evaluate the data (Prodan, 1968). The difference in germination between each of the three stratification treatments (0, 30, 60 days) was significant when the seeds were presoaked in distilled water. With seeds presoaked in gibberellic acid, germination differences were

This is journal Paper No. J-6934 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 1857

1 Assistant professor, Department of Forestry, Iowa State University, Ames, Iowa. (Present address: School of For

estry and Conservation, University of California, Berkeley.)

2 Plant physiologist, USDA Forest Service. North Central Forest Expt. Sta., Ames Laboratory, Ames, Iowa. (Present

address: Inst. of Forest Genetics, Rhinelander, Wisc.)

TABLE 1.—*Effect of gibberellic acid, citric acid, and stratification on germination of white ash*

Treatment	Average Germination Percent		
	Nonstratified	30-Day Stratified	60-Day Stratified
H_2O	2.0	14.0	27.0
1 ppm GA	10.3	27.3	31.0
10 ppm GA	10.0	25.0	30.0
100 ppm GA	11.0	25.3	30.3
0.1% CA	6.3	27.6	28.0
1% CA	0.6	7.6	5.6
10% CA	2.6	6.0	4.3

A difference greater than 2.33 between any two values in this table is statistically significant at the 95 percent confidence level.

significant between the nonstratified and the stratified seed treatments (30 or 60 days). No significant difference existed between the germination of seeds treated with gibberellic acid in the 30- and 60day stratification treatments. Within each stratification treatment, germination was significantly higher when seeds were presoaked in gibberellic acid. Differences between concentrations of gibberellic acid (1 ppm, 10 ppm, and 100 ppm) were not, however, significant. This lack of significant difference suggests a low threshold level exists for exogenous gibberellic acid in white ash, as was found for elm (Grover, 1962).

Seed pretreatment with 0.1 percent citric acid increased germination of the nonstratified and 30day stratified seed when compared to the water treatments. Citric acid treatment with 30 days stratification increased germination as much as the gibberellic acid treatments. The 1 percent and 10 percent citric acid treatments decreased germination in all stratification periods.

Germination percentages were low in comparison with those reported in the literature (USDA Forest Service, 1948). This may be due in part to the viability of the seeds at the beginning of the experiment. An average of 78 percent of the seeds in the seed supply used in this study were filled, as indicated by cutting.

The results of this experiment indicate that the stratification period required for germination of white ash can be reduced and perhaps eliminated if seeds are presoaked in aerated solutions of gibberellic acid or citric acid. This reduction of 30 to 60 days in the time necessary to produce seedlings can be of practical value to both research scientists and nurserymen.

Literature Cited

Cotrufo, C.
1963. Stimulation by citric acid of germination of eastern red cedar *(Juniperus virginiana L.).* Nature 199:92-93.

Grover, R.
1962. Effect of gibberellic acid on seed germination of elm, scotch pine, Colorado and white spruce. For. Sci. 8: 187-190.

Jones, L.
1963. Effect of various pre-germination treatments on germination of black cherry seed. U. S. Forest Service Research Note SE-8. 2 p.

Leak, W. B.
1963. Delayed germination of white ash seeds under forest conditions. J. For. 61:768-772.

Prodan, M.
1968. Forest Biometrics. Pergamon Press. New York. p. 169-175.

Sondheimer, E. and E. C. Galson.
1966. Effects of Abscisin II and other plant growth substances on germination of seeds with stratification -requirements. Plant Physiol. 41:13971398.

Sondheimer, E. et al.
1968. Abscisic acid levels and seed dormancy. Plant Physiol. 43:14431447.

USDA Forest Service
1948. Woody-plant Seed Manual. USDA Misc. Publ. 654. p. 178-183.

Figure 1.—Effect of gibberellic acid, citric acid, and stratification on germination of white ash.