

# Stratification Not Required for Tree-of-Heaven Seed Germination

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*Tree-of-heaven (Ailanthus altissima (Mill.) Swingle) seed germination and shoot dry weight were determined after stratifying samaras at 5 and 25 °C for up to 28 days. Seeds of samaras stratified at 5 °C for 0, 4, and 12 days showed 70, 77, and 96% germination, respectively, 7 days after sowing. Fourteen days after sowing, 90% of nonstratified seeds had germinated, but shoot weight of nonstratified seedlings was 16% less than that of seedlings from fruit stratified at 5 °C for 12 days. Germination 7 days after sowing was greater after stratification at 5 °C than at 25 °C, but the capacity for a large percentage of untreated seeds to germinate within 14 days after sowing indicates stratification is unwarranted for most growers. Tree Planters' Notes 41(1): 1012; 1990.*

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Tree-of-heaven grows rapidly in environments where other trees do not survive. Its capacity to resist urban microclimates and to produce biomass rapidly when planted on reclaimed land have been the focus of recent research (1,2). Reports of these studies indicate that tree-of-heaven seeds germinate without stratification.

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Scientific article 8129, Contribution A-5070 from the Maryland Agricultural Experiment Station.

However, plant propagation reference books suggest that tree-of-heaven seeds have dormant embryos and require a 30 to 60-day cold stratification before germination (3-5). The objective of this study was to quantify the effects of stratification on tree-of-heaven seed germination and seedling dry weight.

## Materials and Methods

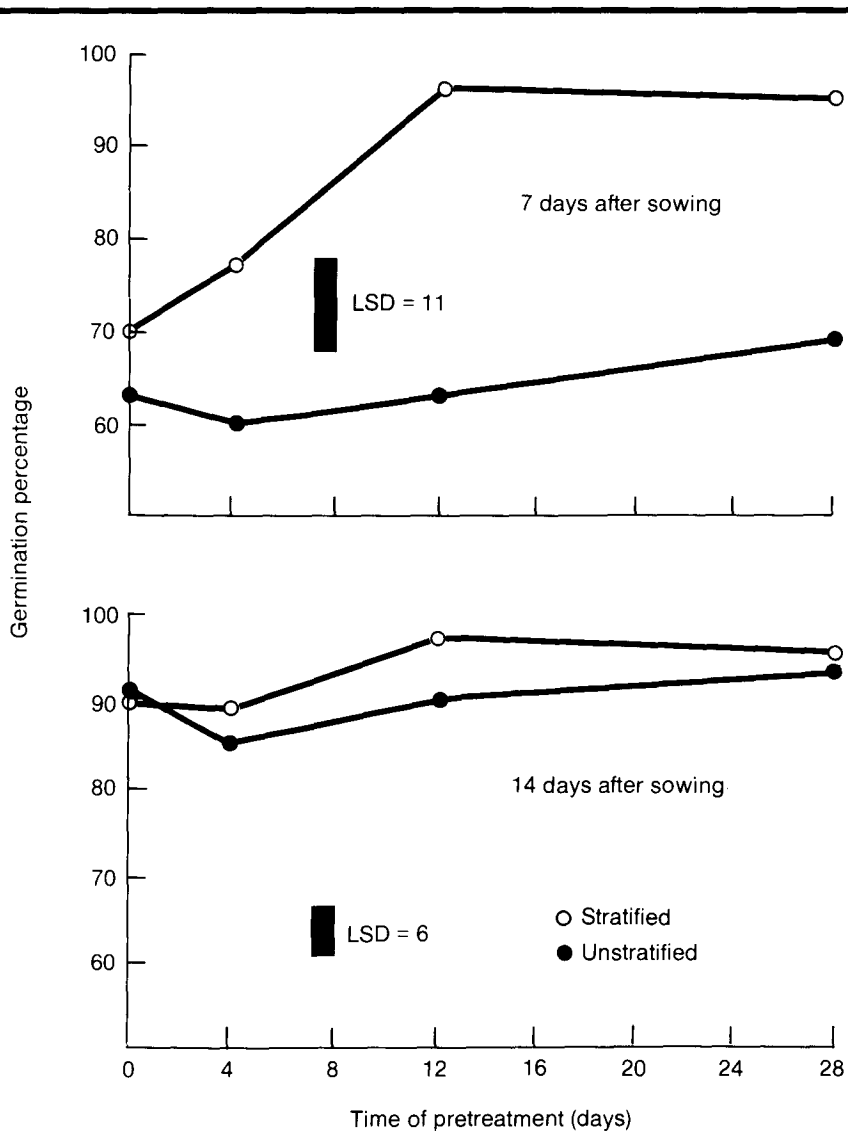
Samaras with dry, brown wings were harvested from a tree-of-heaven in College Park, MD, on October 28, 1988. The samaras were sealed in polyethylene and stored at 11.5 °C ( $\pm 0.5$  °C) until November 3, when 72 lots of 30 samaras were selected. Each lot was mixed with 125 cm<sup>3</sup> coarse vermiculite (Schundler Co., Metuchen, N)) in separate polyethylene bags, and 36 lots were assigned randomly to each of two pregermination treatments, cold stratification and nonstratified. Forty cubic centimeters of deionized water was added to 27 lots in the stratification group; bags with these lots were sealed and placed in a dark refrigerator at 5 °C. Twenty-seven bags with lots in the nonstratified group were sealed and returned to storage.

Seeds in the nine lots remaining from both treatments were sown on November 3 (day 0). Each lot of 30 samaras was

arranged in a single layer on two Steel Blue Seed Germination Blotters (Anchor Paper Co., St. Paul, MN) saturated with deionized water.

A third moist blotter was placed on top of each lot of samaras. The 18 groups of blotters and samaras were enclosed in separate 127 x 133 x 33-mm acrylic germination trays (Hoffman Manufacturing Co., Albany, OR), and trays were arranged randomly in a dark seed germination incubator with alternating temperatures of 20 °C (-0.5 °C, 16 hr) and 30 °C ( $\pm 0.5$  °C, 8 hr). The number of germinated seeds in each lot was determined 7 and 14 days later by inspecting each samara for emergence of a radicle. After germination data were collected on day 14, all shoot tissue was removed from each lot, dried in an oven at 65 °C for 24 hours, and weighed. These procedures were repeated for nine lots chosen randomly from both groups on days 4, 12, and 28.

A second experiment began on December 22, when samaras were removed from storage, and 48 lots were prepared. Forty cubic centimeters of deionized water was added to 24 lots, and all bags were sealed. Twelve lots with water and 12 without water were placed in the refrigerator at 5 °C; all other lots were placed in a light-tight container in a laboratory at 25 °C. Twelve days



**Figure 1**—Effect of moist stratification at 5 °C on germination of tree-of-heaven seeds. Each point is the mean of 9 replicates, each composed of 30 seeds. Vertical bars represent LSD ( $\alpha = 0.01$ ).

later, the samaras were removed from bags and arranged on blotters in germination trays. The number of germinated seeds was determined after incubating the samaras for 7 days under the same conditions described for the first experiment.

Each lot of 30 seeds was considered an experimental unit for the statistical analysis of both experiments. Analysis of variance was used to determine the significance of stratification and time effects. Least significant difference (LSD) values were calculated for each dependent variable as described by Steel and Torrie (6) because interactions between main effects in both experiments were significant ( $P < 0.05$ ).

## Results

Stratification at 5 °C for as little as 4 days increased the percentage of tree-of-heaven seeds that had germinated 7 days after sowing, and germination increased with time of stratification up to 12 days (figure 1). Differences between percentage germination of stratified and nonstratified seeds were not statistically significant 14 days after sowing. However, the dry weight of seedling shoots at day 14 was greater for seedlings from samaras stratified 12 and 28 days than for seedlings from nonstratified samaras (table 1).

Results of the second experiment show that moist pretreatment at both stratification temperatures increased percentage germination 7 days after sowing (table 2). Among seeds treated with moist stratification, germination was significantly greater for seeds pretreated at 5 °C than for those pretreated at 25 °C.

**Discussion**

The results of this study show that stratifying tree-of-heaven seeds for as little as 4 days speeds germination, with maximum germination occurring after less than half the stratification time recommended previously (3-5). Mechanisms by which stratification hastened germination could include imbibition of seeds with water and the breakdown or leaching of chemical inhibitors. Data from the second experiment indicate that both mechanisms were involved because both moisture and low temperature were required for maximum germination. Despite the increase in germination 7 days after sowing for stratified seeds, stratification of tree-of-heaven seeds does not appear justified because high percentages of both stratified and nonstratified seeds had germinated within 14 days after sowing.

Although this study tested effects of stratification on the

**Table 1-Shoot dry weight of tree-of-heaven seedlings after seed stratification at 5 °C for up to 28 days**

Time of pretreatment (days)	Shoot dry weight (mg)	Stratified
0	162	
4	168	
12	154	
194	169	153
28		
197		169

Each value is the mean of 9 replicates; LSD = 21 (a = 0.01).

**Table 2-Germination of tree-of-heaven seeds after moist and dry stratification at 5 and 25 °C**

Percentage 12-day pretreatment	germination 7 days after sowing
Dry stratification	
5 °C	76
25 °C	75
Moist stratification	
5 °C	95
25 °C	84

Values are means of 12 replicates, each composed of 30 seeds; LSD = 8 (a = 0.01).

germination of seeds from a single tree in Maryland, the results are consistent with reports that tree-of-heaven seeds collected in New York (1) and Illinois and Massachusetts (3) germinated without pretreatment. Germination percentages and rates were not specified in these reports, however, so the degree to which tree-of-heaven seed dormancy varies with seed source is unknown.

**Literature Cited**

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