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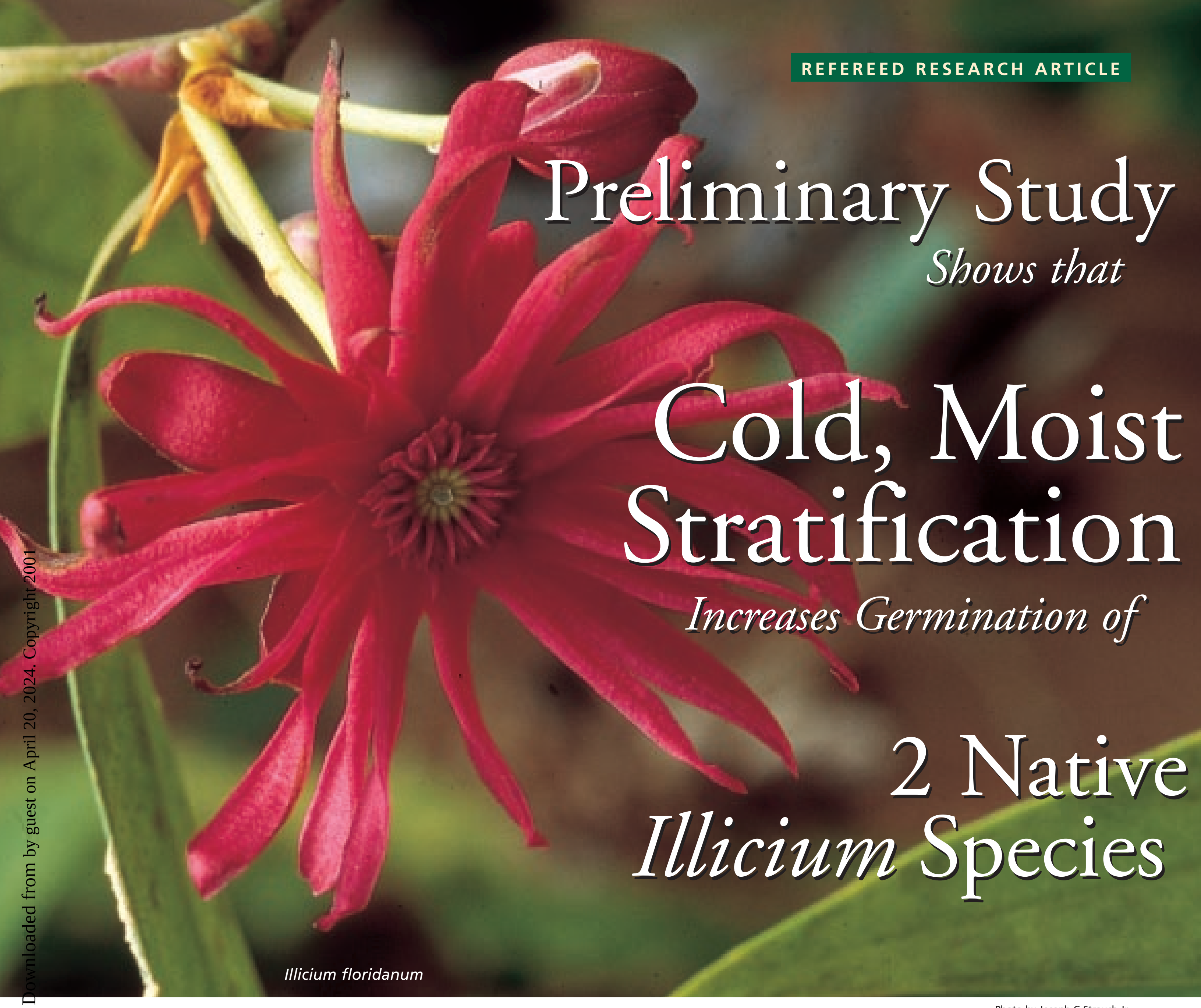
# Preliminary Study *Shows that* Cold, Moist Stratification *Increases Germination of* 2 Native *Illicium* Species



*Illicium floridanum*

Photo by Joseph G Strauch Jr



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## ABSTRACT

Although current literature suggests *Illicium* seeds germinate without pretreatment, we found that 2 native species, *I. parviflorum* and *I. floridanum*, responded well to a cold, moist stratification treatment. *Illicium parviflorum* germinated without stratification (30%), however, best germination occurred with a 90-d cold, moist stratification treatment (81%). *Illicium floridanum* had 10% germination without cold, moist stratification and 20% germination after 30-d of cold, moist stratification. Best germination of *I. floridanum* occurred with the 60-d cold, moist stratification treatment (75%). Days to 50% germination improved for both species as the stratification period increased. We suggest that nursery growers and propagators treat both *I. parviflorum* and *I. floridanum* seeds with cold, moist stratification before sowing.


**KEY WORDS:** Illiciaceace, *Illicium floridanum*, *Illicium parviflorum*, seed dormancy, morphophysiological dormancy

**NOMENCLATURE:** Flora of North America (1997)

Photo by Richard T Olsen

*Figure 1 • Maturing follicetum of* Illicium parviflorum. *Mature fruit of* I. floridanum *is similar in size and appearance.*



*Illiciums*, or "anise trees," have become increasingly popular as ornamental plants, leading to more species and new cultivars being grown for landscape use. The genus *Illicium* (Illiciaceace [de Candolle] A.C. Smith) is native to subtropical and temperate regions of southeastern Asia, the Malay archipelago, the southeastern US, Mexico, and the Caribbean (Smith 1947; Qi 1995). About 8 species have been cultivated in the US (Hopkins 1972; McNamara 2000). Of these, the 2 most commonly used in landscapes of the southeastern US are the Florida-anise, *I. floridanum* Ellis and the yellow or small-flowered anise, *I. parviflorum* Michx. ex Vent. *Illicium floridanum* occurs in low-lying, wet areas and swamps from northwest Florida to eastern Louisiana. *Illicium parviflorum* is endemic to several counties in central Florida along the St John's River.

Cuttings are the usual means of propagation, with firm-wooded cuttings rooting in high percentages during most of the year (Dirr and Heuser 1987). However, the accessioning of species new to cultivation from seed exchanges and development of new hybrids require protocols for seed propagation. *Illicium* seeds have been described as requiring no pretreatment (Dirr 1986; Dirr and Heuser 1987; Raulston and Tripp 1995; Hartmann and others 1997) although data supporting this statement are lacking. Furthermore, Dirr (1987, 2000) has lacked success germinating seeds of *I. floridanum* without pretreatment. Hopkins (1972) noted, without a formal study, that seeds of *I. floridanum* planted in the fall germinated the following spring. Seeds of woody temperate plants which ripen in fall, overwinter in moist leaf litter and germinate in the spring are indicative of seeds showing intermediate or deep physiological dormancy (Hartmann and others 1997). Seeds with this type of dormancy usually require a cold, moist stratification period for improved germination. Our informal survey of nursery professionals attending the 1999 Southern Region International Plant Propagators Society meeting yielded only 1 person who had germinated seeds of *Illicium* taxa: Jenkins (1999) successfully germinated cold, moist stratified seeds of *I. floridanum*. Thus, our study objective was to investigate effects of cold, moist stratification on seed germination of 2 commonly cultivated, native *Illicium* species: *floridanum* and *parviflorum*.

**TABLE 1**

*Mean days to 50% germination, final germination percentage, peak value, and germination value for control and cold-stratified seeds of* Illicium parviflorum. *Values in parenthesis represent standard deviations*

| Treatment (days) | Days to 50% [a] | Germination (%) [b] | Peak value | Germination value |
|---|---|---|---|---|
| 0 (Control) | 150 (±8) | 30 (±14) | 0.20 (±0.10) | 0.05 (±0.04) |
| 30 | 113 (±3) | 42 (±21) | 0.34 (±0.14) | 0.11(±0.09) |
| 60 | 100 (±12) | 63 (±17) | 0.57 (±0.22) | 0.26 (±0.15) |
| 90 | 72 (±4) | 81 (±20) | 1.08 (±0.30) | 0.60 (±0.26) |
| **Dunnett's Comparisons** [c] | | | | |
| 30 versus Control | * | NS | NS | NS |
| 60 versus Control | * | NS | NS | NS |
| 90 versus Control | * | * | * | * |

[a] Days to 50% of final germination.
[b] Arcsin transformed for means comparison, and re-transformed for table presentation.
[c] Nonsignificant (NS) or significant (*) at alpha = 0.05 level.

## MATERIALS AND METHODS

### Seed collection

An *Illicium* fruit is an aggregate of single-seeded follicles, termed a follicetum (Figure 1). We collected maturing folliceta of *I. floridanum* and *I. parviflorum* from landscape plants on the University of Georgia campus, Athens, Georgia, beginning in late September and ending in October 1999. Low fruit set required harvesting folliceta from multiple plants of each species. Because seeds of *Illicium* species are forcibly expelled at the time of dehiscence, we placed folliceta in paper bags at room temperature, 24 ± 2 °C (75 ± 4 °F), to collect expelled seeds.

### Seed viability

A modified float test was conducted on seeds of *I. floridanum* (Bonner and others 1994). *Illicium* seeds will float when placed in water due to surface tension and a hydrophobic response to the oily seed coat (Thien and others 1983). Seeds of *I. floridanum* are obliquely ellipsoid, about 6 to 8 mm (0.25 in) in length, have a light brown, hard, shiny seed coat and range in weight from 0.035 to 0.050 g per seed (Roberts and Haynes 1983; Godfrey 1988). Our seeds of *I. floridanum* ranged from 5 to 8 mm (0.2 to 0.3 in) in length with a mean seed weight of 0.032 g (31,250 seeds per kg [14,175/lb]). We placed 60 seeds in 500 ml of deionized water and stirred once each day for 5 d. Seeds which sank after 5 d in water were considered viable. Because of insufficient seed for *I. parviflorum*, a viability test was not performed. Seeds of *I. parviflorum* are similar in exterior appearance to *I. floridanum*.

### Treatments

Treatments consisted of 30-, 60-, and 90-d cold, moist stratification periods and a control (0-d stratification). Seeds were placed in plastic bags containing slightly moist Jiffy Mix Plus (1:1 [v:v] Canadian sphagnum peat:vermiculite; Jiffy Products of America Inc, Batavia, Illinois). Each treatment was placed in separate bags and stored in a walk-in cooler at 5 °C (41 °F). The control seeds were sown and treatments initiated on 22 October 1999. The respective treatments were removed from the cooler and sown every 30 d thereafter. Seeds were sown horizontally (6 mm [0.25 in] deep and covered) into 72-celled trays filled with Jiffy Mix Plus, 1 seed per cell, with a total of 40 seeds per tray. Extra cells were filled with substrate. Trays were randomly placed on a greenhouse bench under extended photoperiod and watered as needed. Greenhouse temperatures were set at 21 °C (70 °F) for day and 15.5 °C (60 °F) for night. Studies were concluded on 21 June 2000.

### Measurements

Germination, defined as complete cotyledon emergence, was noted daily, with final germination percentages and days to 50% germination calculated at the conclusion of the experiment. Mean daily germination, peak values, and germination values were calculated following Czabator (1962). Czabator's test is good for seeds of woody perennials in which

**TABLE 2**

*Mean days to 50% germination, final germination percentage, peak value, and germination value for control and cold-stratified seeds of* Illicium floridanum. *Values in parenthesis represent standard deviations*

| Treatment | Days to 50% [a] | Germination (%) [b] | Peak value | Germination value |
|---|---|---|---|---|
| 0 (Control) | 212 (±20) | 10 (±0) | 0.05 (±0.01) | 0.01 (±0.01) |
| 30 | 150 (±47) | 20 (±14) | 0.12 (±0.09) | 0.01 (±0.02) |
| 60 | 100 (±5) | 75 (±6) | 0.60 (±0.02) | 0.30 (±0.02) |
| 90 | 92 (±5) | 50 (±8) | 0.47 (±0.07) | 0.16 (±0.05) |
| **Dunnett's Comparisons** [c] | | | | |
| 30 versus Control | * | NS | NS | NS |
| 60 versus Control | * | * | * | * |
| 90 versus Control | * | * | * | * |

[a] Days to 50% of final germination.
[b] Arcsin transformed for means comparison, and re-transformed for table presentation.
[c] Nonsignificant (NS) or significant (*) at alpha = 0.05 level.

germination is slow (Hartmann and others 1997). Mean daily germination is the final germination percentage divided by the number of days to reach final germination. Peak value, an index of vigor, is determined for each day of measurement by dividing the cumulative germination percentage by the number of days since the beginning of the study. Peak value is also the point which divides the germination curve between the initial rapid and eventual slow germination phases. Germination value, an expression of speed and completeness of germination, is the product of the peak value and mean daily germination.

### Statistical Analysis

Species were analyzed seperately. Each treatment was replicated 4 times with 10 seeds per replication. Final germination percentages were arcsin transformed to increase homogeneity of variance prior to analysis. Data were analyzed using analysis of variance (SAS® Institute Inc 1996) and Dunnett's mean separation test.

## RESULTS

### *Illicium parviflorum*

Some seeds (30%) germinated without stratification (Table 1). A trend existed for higher percentages of germination and quicker germination with increased stratification period. The 90-d cold, moist stratification treatment was the only treatment different from the control for germination percentage and calculated values. For all treatments, stratification decreased the number of days to 50% germination.

### *Illicium floridanum*

By the fifth day of stirring seeds in water, 100% of the seeds had sunk, thus indicating good viability of the seeds. Nonstratified seeds of *I. floridanum* had poor germination (Table 2). Both the 60- and 90-d stratification treatments resulted in improved germination compared to the control. Although Dunnett's test does not allow for a comparison between treatments, the 60-d treatment produced observably higher calculated values than the 90-d treatment. For all treatments, stratification decreased the number of days to 50% germination.

## DISCUSSION

Seeds containing underdeveloped embryos with morphophysiological dormancy have been reported in the family Illiciaceae (Baskin and Baskin 1998). Seeds with morphophysiological dormancy germinate when the underdeveloped embryos reach a species-specific size and their physiological dormancy is broken (Baskin and Baskin 1998). Seeds of both species germinated over a long period of time (23 to > 150 d), resulting in relatively low germination values as compared to values found in the literature for other species (Dosmann and others 2000; Schrader and Graves 2000). Underdeveloped embryos and long germination periods are often found in genera of tropical origin (Baskin and Baskin 1998), like the Illiciaceace (Qi 1995).

Differences within the control and treatments for *I. parviflorum* and *I. floridanum* may indicate insufficient development of embryos before stratification began. Thus, embryos would not have reached the critical mass necessary for stratification to break physiological dormancy; assuming that embryo maturity is required before dormancy can be alleviated. Stratification of both species, although unnecessary for some germination, did improve germination speed and uniformity (Table 1).

*Illicium floridanum* and *I. parviflorum* had similar days to 50% germination and final germination percentages with the 60-d stratification treatment. This supports the previous reports of poor germination for untreated seeds (Dirr 1986) and the success of cold-stratified seeds (Hopkins 1972; Jenkins 1999). Stratification not only increased final germination percentages but decreased the number of days to 50% germination, thus making stratification more economically feasible for commercial growers.

## CONCLUSION

We suggest nursery professionals cold, moist-stratify seeds of both *I. parviflorum* and *floridanum* before sowing. Although unnecessary for some germination, 90-d stratification produced greater and faster germination in *I. parviflorum*. Without stratification, *I. floridanum* had poor germination, while 60-d stratification resulted in the highest observed germination values among treatments. Stratification decreased the number of days to 50% germination and increased germination percentages for both species. Future research should investigate effects of warm, moist stratification to induce embryo development followed by cold, moist stratification to relieve dormancy on seed germination of cultivated *Illicium* species.

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