White Ash, Hackberry, and Yellow-Poplar Seed Remain Viable when Stored in the Forest Litter

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Tree reproduction following several experimental harvest cuttings showed that yellow-poplar (*Liriodendron tulipifera* L.) and white ash (*Fraxinus americana* L.) seeds probably remain viable beyond the normal germinating period. Cuttings in Indiana and Ohio resulted in excellent stands of yellow-poplar seedlings in the absence of a current seed source. In 1958 the white ash seed crop was a complete failure on southern Indiana plots. Yet transect surveys of reproduction revealed that many ash seedlings became established during the 1959 growing season. These seedlings originated from seed stored in the litter. McCarthy (1) cited two cases where yellow-poplar seed remained dormant at least 1 year. Williams and Mony (3) found that yellow-poplar remains viable at least 3 years in nursery stratification pits. Seeds of several ash species are known to remain viable under specific storage conditions (2). The ability of tree seed to remain dormant in the forest litter beyond the normal germinating period could be a valuable asset to the silviculturist. In 1957 a study was begun to find out if seed storage takes place under natural conditions.

Study Methods Simulate Natural Conditions

The original experimental design included only yellow-poplar but in 1959 the study was expanded to include white ash, hackberry (*Celtis occidentalis* L.), and sassafras (*Sassafras albidum* (Nutt.) Nees). The study was designed primarily to simulate natural conditions. The seed "storage" area is in Orange County, Indiana within a fully stocked upland hardwood sawtimber stand having a good accumulation of leaf litter. There were no seed trees of the species studied adjacent to the storage area.

The storage area was fenced with 4-foot, ¼-inch mesh hardware cloth to exclude large animals. However, this enclosure was not rodent, bird, or insect proof. The storage area was divided into 3-foot square subplots. Seedlots of the species tested were broadcast sown directly on the subplots to simulate natural seedfall (fig. 1). Four subplots (replications) were randomly assigned to each year that seed was scheduled for germination tests. On the scheduled dates, loose litter from the designated subplots was carefully removed and discarded. The humus and about ½ inch of the A horizon was collected in containers. This mixture of stored seed, humus, and mineral soil was sown on scarified, germination subplots in a forest opening. Unseeded, control subplots were treated in the same manner to account for volunteer seed in storage and germination subplots. Only a few volunteer seedlings were found throughout the entire study. All sowing was done in the fall and first-year seed was sown directly on the germination subplots.

Seedling counts were made bi-weekly during the normal germination period.

Figure 1.—The seed was broadcast sown on top of the litter in storage subplots.

Cutting tests of the two-seeded yellow-poplar samaras averaged 19.2 filled seed per 100 samaras. One thousand yellow-poplar samaras were sown in each subplot. Soundness tests for the other species were as follows: white ash, 99.5 percent; sassafras, 96 percent; and hackberry, 100 percent. Each storage subplot received 200 white ash, 50 sassafras, and 100 hackberry seeds.

Natural Seed Storage Clearly Demonstrated

After four winters in storage, yellow-poplar seed was still germinating at the rate of 4 seedlings per 100 samaras. The number of seedlings per 100 samaras was: 7.2, 8.4, 3.5, and 4.0 for one, two, three, and four winters in storage. During the course of the study yellow-poplar seedlings were recorded in many of the storage subplots. Evidently some seed lodged in locations favorable for germination. In the undisturbed forest floor seed probably reaches favorable position for germination through the process of litter and humus decomposition. Germination takes place when the seed remains constantly moist for several weeks at the proper temperature. By the time most yellow-poplar seed reaches favorable position for germination it is likely covered by a barrier of fresh-fallen litter. Also, the seed is continuously subject to predation by insects and rodents.

First-year germination for white ash, sassafras, and hackberry was 38, 12, and 34 percent, respectively. After two winters in storage germination was as follows: white ash, 38 percent; sassafras, 0 percent; and hackberry, 20 percent. So sassafras deteriorates rapidly in natural storage but ash and hackberry seeds will remain viable for some time. Ash and hackberry seedlings have been recorded in the storage subplots 2 years beyond the normal germinating period.

The germination percentages merely indicate trends. In nature many factors influence the longevity of a particular seed crop. Viability likely varies widely with the moisture regime of the litter and many things influence litter moisture. The use of forest-opening seedbeds introduced additional natural variation into the study. But, there is little doubt that viable yellow-poplar, white ash, and hackberry seed will accumulate in the forest litter for several years.

Results Useful

Results of this study can be used to improve hardwood silviculture. Knowing that the seed of various species will remain viable for several years, the forester or forest manager should be able to improve composition in the new stand. For yellow-poplar, white ash, and hackberry, the current seed crop does not necessarily dictate the time of cutting. The forest manager has at his disposal a reservoir of seed stored in the forest floor rather than just a fresh layer of seed on top of the litter. There appears to be no good reason to perpetuate the classical seed-tree method of harvest cutting yellow-poplar. While some will argue that seed trees are insurance, it is simply poor business to recommend that valuable trees be left standing to provide an ineffective seed source. Seedbed treatments to increase the amount of yellow-poplar reproduction can be undertaken with more confidence, especially near the perimeter of the effective seeding range of the seed source.

There is a need to find out what happens to seed viability of both desirable and undesirable species. The influence of seed predators and weather conditions on dormant seed needs to be evaluated. While it is the goal of the silviculturist to increase the amount of desirable species in the new stand, he must also consider the density of undesirable species. Without doubt there are unwanted trees and shrubs that produce seed that will remain dormant in the litter. Such species as blackgum (*Nyssa sylvatica* Marsh.), dogwood (*Cornus florida* L.), and redbud (*Cercis canadensis* L.) are prime suspects. If the seed of such species accumulates and remains viable for a number of years, seed sources must be eliminated from the forest stand years ahead of the harvest cut.

This study has served to demonstrate that tree seed, like the seed of many other plants, will remain viable over a period of years under natural conditions. Through careful planning the forester may be able to take advantage of this basic information to improve various forest practices.

Literature Cited

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