

**STORAGE AND STRATIFICATION
RECOMMENDATIONS FOR PECAN AND
SHAGBARK HICKORY**

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Pecan and shagbark hickory nuts should be stored at 3° C and 5-percent seed moisture. Fresh and stored pecans should be stratified for 30 to 60 days. Fresh shag bark hickory nuts and those stored up to 2 years need 90 to 120 days of stratification; stratification should be reduced to 60 days for nuts stored over 2 years.

The Woody-Plant Seed Manual (5) and Seeds of Woody Plants in the United States (3) recommend a temperature of 5° C, closed containers, and a relative humidity of 90 percent for storing nuts of any *Carya* species 3 to 5 years. The letter book also suggests that seeds of some *Carya* species require shorter stratification periods when they have been stored 1 or more years than when they are fresh. Seed handling procedures usually call for dry storage (below 10-percent moisture), but some trees, such as oaks, require high moisture (2). The present study was initiated to test the viability of pecan and shagbark hickory nuts stored under wet and dry conditions during 4 years and to see if length of storage decreased stratification time.

Materials and Methods

Nuts of two common hickories, shagbark hickory (*Carya ovata* (Mill.) K. Koch) and pecan (*C. illinoensis* (Wangenh.) K. Koch), were collected from the ground in 1969 in Oktibbeha County, Mississippi. The nuts were put in water to remove trash and empty nuts, and stored in cans at 3° C for about 60 days. Lots were then divided, treatments were imposed, and nuts were placed in a walk-in cooler at 3° C.

All combinations of the following conditions were tested:

1. initial seed moisture content-high and low.
2. stratification period - 30, 60, 90, 120, and 150 days.
3. length of storage - 1, 2, and 4 years.

To raise seed moisture content for the high-moisture treatments, nuts were soaked in tapwater for 48 hours at room temperature (23° C). For low-moisture treatments, the nuts were spread on laboratory benchtops and dried for 48 hours. Actual moisture contents at the beginning of storage were determined gravimetrically from

three samples of 10 nuts each per species for each moisture level. The samples were oven dried at 86° C for 44 hours. The moisture contents were:

	High Level	Low Level
	----- Percent -----	
Pecan	18.7	5.1
Shagbark	22.0	5.4

Each treatment combination was replicated twice in a factorial design. Each replicate was composed of 25 nuts in a polyethylene bag that was 4 mils thick. At the end of the storage periods, nuts were soaked in tapwater at room temperature for 48 hours, excess water was drained off and the nuts were stratified at 3° C in the bags they were stored in. Germination was tested on

Table 1.—Germination response to fresh nuts to different stratification periods

Species	Length of Stratification (days)					
	0	30	60	90	120	150
	Germinative Capacity					
	-----Percent-----					
Pecan	69.6	80.0	98.0	98.0	95.7	88.9
Shagbark hickory	23.3	78.3	87.2	91.3	93.5	93.8
	Peak Value					
Pecan	1.3	2.0	2.6	4.4	6.1	6.0
Shagbark hickory	0.6	2.2	3.7	4.2	6.0	7.0

moist cellulose wadding in a cabinet germinator for 60 days under an alternating day-night temperature regime of 20^o-30^o C as prescribed in AOSA Rules (1). Germination capacities and peak values (4) were determined for each species and treatment. Peak value is a measure of germination rate expressed in terms of the highest germination percent in relation to number of days from the start of the test.

Unstratified and stratified fresh nuts were tested by the same procedures as stored nuts.

Results and Discussion

Fresh seeds of both species, especially shagbark hickory, benefited from stratification (table 1). In terms of germination capacity, 60 days of stratification was sufficient for pecan and 90 days for shagbark. Longer stratification periods gave faster germination but no appreciable gain in capacity.

Both species stored better when their moisture contents were low than when they were high, and pecan stored better than shagbark hickory (tables 2 and 3). Pecan stored for 2 years under high-moisture conditions averaged less than 10 percent germination; pecan stored under low-moisture conditions averaged 83.6 percent. Shagbark hickory nuts lost about one-third of their germination capacity the first

Table 2.- Germination response of pecan

Moisture Level	Storage Period	Length of Stratification (days)					Mean
		30	60	90	120	150	
percent	year						
Germinative Capacity							
-----percent-----							
5.1	1	71.4	80.0	78.3	91.7	77.1	79.7
	2	78.0	82.0	0	88.0	80.0	83.6
	4	52.9	30.0	39.2	30.0	12.2	32.8
	Mean	67.4	64.0	69.1	69.9	56.4	65.3
18.7	1	61.3	60.5	34.1	26.1	37.5	43.9
	2	14.0	0	14.0	4.0	14.0	9.2
	4	0	0	4.0	0	0	0.8
	Mean	25.1	20.1	17.3	10.0	17.1	17.9
Peak Value							
5.1	1	1.5	2.8	2.4	4.0	3.8	2.9
	2	2.2	2.5	3.3	4.4	4.8	3.4
	4	1.2	1.0	1.1	0.8	0.7	0.9
	Mean	1.6	2.1	2.2	3.2	3.1	2.4
18.7	1	6.0	5.4	3.6	2.0	4.6	4.3
	2	0.6	0	1.3	0.5	2.8	1.0
	4	0	0	0.8	0	0	0.1
	Mean	2.2	1.8	1.9	0.8	2.4	1.8

year of storage and germination capacity and peak values declined each succeeding year. Neither species stored well beyond 2 years.

Stratification had no significant effect on either completeness or speed of germination of pecan for

any storage condition (table 2). Because stratification benefited fresh nuts (table 1), storage apparently reduces the stratification requirement of pecan. To insure full imbibition at planting time, however, seeds stored under low moisture should be stratified for about 30 days.

Table 3.—Germination response of shagbark hickory

Moisture Level	Storage Period	Length of Stratification (days)					Mean
		30	60	90	120	150	
percent	year	<u>Germinative Capacity</u>					
		-----percent-----					
5.4	1	56.0	69.0	68.8	81.6	54.2	65.9
	2	58.0	56.0	70.0	70.0	48.0	60.4
	4	24.0	42.0	20.0	10.0	21.6	23.5
	Mean	46.0	55.6	52.9	53.8	41.2	49.9
22.0	1	85.4	50.0	69.8	74.4	51.1	66.1
	2	64.0	52.0	38.0	33.3	8.0	39.0
	4	16.0	14.0	0	4.0	4.0	7.6
	Mean	55.1	38.6	35.9	37.2	21.0	37.5
		<u>Peak Value</u>					
5.4	1	1.4	1.8	2.6	3.8	1.7	2.3
	2	1.1	1.2	2.2	2.0	1.0	1.5
	4	0.5	0.9	0.4	0.3	0.6	0.5
	Mean	1.0	1.3	1.7	2.0	1.0	1.4
22.0	1	9.8	6.4	5.4	6.0	4.6	6.4
	2	6.6	4.8	3.1	3.0	0.8	3.7
	4	0.4	0.8	0	0.3	.4	0.4
	Mean	5.6	4.0	2.8	3.1	1.9	3.5

A significant interaction of storage period and length of stratification was observed for shagbark hickory. High-moisture contents weakened stored seeds and caused germination to decline as length of stratification increased. At the low-moisture

level, the highest germination capacities were obtained with 120 days of stratification after 1 year of storage, 90 days after 2 years, and 60 days after 4 years (table 3). Comparison with fresh nuts, however, indicates that decreases in the stratification requirement from storage are negligible in the first 2 years. Nuts stored 4 years

should be stratified for only 60 days.

The relative humidity recommendation of 90 percent for *Carya* storage (3) is too high. Shagbark nuts stored at 3° C and 95 percent relative humidity will reach equilibrium with the atmosphere at a moisture content of about 15 percent; much too high for effective storage. Refrigeration at 1°-5° C produces relative humidities around 90 percent unless dehumidifying equipment is used. *Carya* seeds should be stored at about 5 percent moisture contents, and if stored under humid conditions, must be kept in moisture-proof containers.

Literature Cited

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*Unpublished data of the author.