Collection date, cone-storage period affect southern pine seed yields, viability

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When slash, loblolly, and longleaf cones were collected over a wide range of dates and stored at air temperature, 5 weeks of storage gave higher seed yields than 1 week. Yields also increased from the earliest to the latest collection. Cone storage for 5 weeks increased germination of slash from all collections and decreased germination of longleaf from early collections.

The 2-to 3-week period during which southern pine cones are usually harvested is inconveniently short, especially when demands for seed are heavy. If collections could start 1 week earlier, the amount of seed harvested could be increased by 30 to 50 percent. The problem: Will cones from early collections caseharden during kilning?

Wakeley (4) reports that cones are mature enough for collection when their specific gravity drops below 0.89. However, in modern extractories some cones with specific gravities in the 0.80's, and almost all in the low 0.90's, caseharden when they are kilned without precuring.

Preliminary studies at Alexandria, La., showed that acceptable seed yields may be obtained by collecting cones early and storing them for several weeks before kilning. This article describes the effects of collection date and length of cone storage on yield and viability.

Methods

Six trees each of slash *(Pinus elliottii* Engelm.), loblolly *(P. taeda L.),* and longleaf (*P. palustris Mill.)* were selected. Weekly collections started 2 to 3 weeks before cones ripened and continued until the first cones began to open on the trees. Collection dates were:

Slash-August 19, 26; September 3, 9, and 16;

Loblolly-September 9, 17, 23, 30; October 7;

Longleaf-September 9, 17, 23, 30; October 7 and 14.

On each date, specific gravity was determined with sample cones from all trees.

Nine cones were collected weekly from each tree, subdivided into three groups of three, and stored in open paper bags at air temperature in-an unheated building. After 1, 3, or 5 weeks, cones were dried for 3 days in a gas-fired kiln at approximately 38° C. Those that casehardened were opened mechanically to obtain seed for germination tests.

The degree of opening for each three-cone sample was estimated by counting the seeds released after kilning. Each sample from a particular tree was assumed to have about the same number of seeds.

Seeds were cleaned to 100-percent soundness, and germination was tested with 100 seeds for each tree, collection date, and storage period. Slash and longleaf seed was not stratified, but loblolly was stratified for 30 days.

Additional cones from all trees and all collection dates were peeled with a sharp knife immediately after collection to remove the green coating. They also were stored at air temperature for 1, 3, or 5 weeks. Other samples, consisting of peeled and unpeeled cones, were stored in polyethylene bags at 5° C for 5 weeks.

Differences in yields and germina-

TABLE 1.—*Seed yields and germination of three southern pines affected by date of collection and length of cone storage*

Date of collection		Specific gravity	Seed yields per cone when stored for: 1 week	3 weeks	5 weeks	Germination when stored for: 1 week	3 weeks	5 weeks
			No.	*No.*	*No.*	*Pct.*	*Pct.*	*Pct.*
				Slash				
Aug.	19	0.97	0	8	58	37	52	68
	26	.95	0	41	63	76	46	63
Sept.	3	.91	22	37	89	38	38	70
	9	.86	26	40	75	69	46	90
	16	.77	27	75	82	49	63	98
				Loblolly				
Sept.	9	.98	0	27	25	96	98	100
	17	.92	11	26	38	92	98	95
	23	.90	19	31	20	97	98	98
	30	.85	21	37	32	100	99	99
Oct.	7	.77	41	34	54	98	99	99
				Longleaf				
Sept.	9	.99	0	38	46	83	58	31
	17	.95	0	10	61	76	59	48
	23	.93	3	30	50	80	60	49
	30	.92	2	70	72	84	70	72
Oct.	7	.88	4	40	72	86	85	83
	14	.83	52	77	77	87	92	90

tion of each species were tested by analysis of variance at the 0.05 level of statistical significance.

Slash Pine

Date of collection and length of storage significantly influenced yields and germination of slash seed. As table 1 shows, number of seeds recovered generally increased with later collection dates; some of the apparently aberrant values in the table resulted because the number of seeds per cone varied with different samples.

Yields from each collection increased substantially with length of cone storage. One week of storage was unsatisfactory for all dates of collection, 3 weeks increased yields, but 5 weeks proved best. Even cones with an average specific gravity of 0.86 yielded only half as much seed after 3 weeks as they did after 5. The key to higher slash yields thus appears to be storage of cones for 5 weeks. Yields were acceptable when cones collected in late August or early September were held for 5 weeks. Cones collected on August 19 with an average specific gravity of 0.97 yielded 58 seeds each after 5 weeks of storage, those collected on September 16 with a specific gravity of 0.77 yielded 82 seeds.

Storage for 5 weeks also increased germinability in most instances. Although germination was poorer than is usually expected, the trend was evident. Results obtained here agree with Matyas' findings (2) for Scotch pine cones harvested early; he reported low viability when extraction was immediate but better germination after 1 month of storage.

While some viability may be sacrificed, collection of slash cones in late August at specific gravities of approximately 0.95, followed by storage at air temperatures for 5 weeks, may be satisfactory when large volumes of seed are needed. If only small quantities are required, collection should be deferred until specific gravities drop below 0.89. Storage for 5 weeks is still recommended, however.

Yield and viability were surprisingly poor after only 1 week of storage, even when cones were collected on September 16 at an average specific gravity of 0.77. In a study conducted the year before, with six trees other than the present ones, viabilities of over 90 percent were attained after 1 week. While the data (summarized in table 2) suggest that cone storage may not always be necessary, other observations at Alexandria substantiate current findings that storage improves viability. Moreover, table 2 corroborates the present study in showing that yields are low when cones are harvested at specific gravities of 0.84 and above, and processed after only 1 week. The dissimilarity of germination results is attributed to differences between trees and years.

Loblolly Pine

Date of collection, length of cone storage, and the interaction between these two factors influenced yields of loblolly significantly. The average number of seeds released per cone tended to increase with later collection and longer storage. In addition, storage had a proportionately greater effect on yields from early cones than on those from later collections.

Acceptable yields of 38 seeds per cone were obtained from the September 17 collection (specific gravity 0.92) after 5 weeks of storage. but the maximum yield was not attained until the October 7 collection (specific gravity of 0.77). As with slash pine, if the number of trees with a collectable crop is not limited, harvesting of large quantities may begin in middle to late September, when specific gravity reaches the low 0.90's. These cones should be stored for at least 3 weeks or preferably for 5

TABLE 2.—Yield and viability of slash pine seed when cones were held 1 week before kilning

Date of collection	Specific gravity	Seeds per cone	Germination
		Number	*Percent*
August 21	0.93	0	88
August 28	.88	0	91
September 5	.84	47	94
September 11	.80	61	98
September 18	(opening)	87	99

weeks. For optimum yields, however, collection should be deferred as long as possible.

Germinability ranged from 92 to 100 percent regardless of date of collection or length of storage. Other studies have established that collection dates and handling procedures for loblolly are less critical than those for slash or longleaf (1).

Longleaf Pine

Yields of longleaf seed also increased from early to late collections and with increasing periods of cone storage. As with loblolly, 3 or 5 weeks of storage increased yields more for the first five collections than for the last one.

After only 1 week, all cones except those from the October 14 collection (specific gravity 0.83) yielded practically no seed. Longer storage increased yields from early cones but also decreased germinability. For example, cones in the September 30 collection released two seeds after 1 week's storage and 70 after 3 weeks, but germination dropped from 84 percent to 70 percent.

With longleaf, the safest course apparently is to collect after cones reach a specific gravity of 0.90 or below and to store them from 3 to 5 weeks. Again, the longer that collection can be deferred the better. Fortunately, although the collection period is more critical for longleaf than for the other two species, the seed is also in less demand. An adequate amount can usually be supplied by collecting late in the season.

Previous research has shown that initial viability of longleaf seed is unaffected by storage of mature cones for up to 60 days. If seed is to be kept for use in future years, however, cones should not be held longer than 5 weeks before processing (3).

Peeling and Cold Storage of Cones

Peeling the cones appeared to have no practical value. It increased yields from some cones, especially from those that were collected early and kilned without storing, but it had little or no effect on cones that were stored or collected when fully mature. Since cones collected early should not be kilned immediately, peeling cannot be recommended.

Storing cones in moistureproof polyethylene bags at 5° C reduced yields drastically but did not impair :viability. The overall yield from unpeeled longleaf held in cold storage averaged only one seed per cone; the average yield was 63 seeds from cones stored in paper bags at air temperature. Yields of slash were reduced by 90 percent, and yields of loblolly were reduced by 50 percent.

Literature Cited

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2. Matyas. von Csaba.
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3. McLemore. B. F.
   1961. Prolonged storage of longleaf cones weakens seed. U.S. Dept. Agric. For. Serv. South. For. Exp. Stn. South. For. Notes 132, p. 3.
4. Wakeley, P. C.
   19.54. Planting the southern pines. U.S. Dept. Agr.. Agr. Monog. 18. 233 p.

NEW PUBLICATIONS

(Continued front p. 18)

McQuilkin. Robert A.

1974. Site index prediction tables for black, scarlet, and white oaks in southeastern Missouri. North Cent. For. Exp. Stn., St. Paul, Minn. 8 p. USDA For. Serv. Res. Pap. NC-108

Site index prediction tables for black, scarlet, and white oaks for southeastern Missouri are presented based on site index/height regressions of data from 741 sectioned trees. Formulae for site index conversion between species and confidence intervals for mean stand site index estimates are also presented.

Williams. Robert D.

1974. Planting methods and treatments for black walnut seedlings. North Cent. For. Exp. Stn., St. Paul, Minn. 12 p. USDA For. Serv. Res. Pap. NC-107.

Neither planting method nor stock treatment had any appreciable effect on survival and growth of black walnut, but survival and growth were significantly affected by the planting site and site preparation.

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There was no seedling mortality in treatments not exposed to PCP

fumes, but captan-treated seedlings showed considerable amount of in

jury: 47 percent curled seedlings for jack pine and 64.3 percent for red

pine, compared with 4 and 1.3 percent respectively where no treatment

was used. The data also suggested that

the PCP treatment combined with captan seed treatment resulted in

fewer curled seedlings than captan

seed treatment alone. This cannot be proven because seedlings could have

been curled before mortality occurred.

It is recommended that pentachlorophenol should not be used for treating wooden trays in which containerized seedlings are grown and and that captan should not be used as a seed treatment in similar programs.

Literature Cited

1. Belcher. J. and L.W. Carlson.
1968. Seed-treatment fungicides for control of conifer damping-off: laboratory and greenhouse tests. 1967. Can. Plant. Dis. Surv. 48(2): 47-52.

2. Cavford. J.H. and R.M. Waldron.
1967. Effects of captan on germination of white spruce, jack and red pine seed. For. Chron. 43(4): 381-384.

3. Ferguson. E.R.
1959. Wood treated with penta can damage pine nursery seedlings. Tree Planters' Notes 38(1960): 21-22.

4. Griffith. A.L.
1957. Use of wood preservatives on transplant bores. Rep. E. Afr. Agric. For. Res. Organ. 1955-56.

5. Kanfert, F.H. and K.A. Loerch.
1955. Treated lumber for greenhouse use. Minn. For. Notes 36.

TABLE 1.—Effects of pentachlorophenol and captan on red pine

Treatment	Dead	Curled	Seedlings observed
	Percent	*Percent*	
PCP	77.8 a[1]	2.4 b	533
PCP and captan	27.6 b	51.7 a	498
Captan	0 c	64.3 a	484
No treatment	0 c	1.3 b	517

[1]The small letters indicate Duncan's multiple range groupings of treatments which do not differ significantly at the 5 percent level.

TABLE 2.—Effects of pentachlorophenol and captan on jack pine

Treatment	Dead	Curled	Seedlings observed
	Percent	*Percent*	
PCP	84.4 a[1]	1.5 b	702
PCP and captan	53.9 b	33.6 a	626
Captan	0 c	47.1 a	605
No treatment	0 c	4.0 b	688

[1]The small letters indicate Duncan's multiple range grouping of treatments which do not differ significantly at the 5 percent level.

New Publications

(Continued front p. 26)

Boldt, Charles E., and James L.

Van Deusen
1974. Silviculture of Ponderosa pine in the Black Hills: the status of our knowledge. Rocky Mt. For. Range Exp. Stn., Ft. Collins, Colo. 52 p. USDA For. Ser. Res. Pap. RM124

This paper. intended as a guide

for professional foresters. describes major silvicultural conditions likely to be encountered in the Black Hills. reasonable treatment options, and probable results and implications of these treatments. It also describes silvical characteristics and behavior of Black Hills ponderosa pine, and a variety of proven silvicultural tools.

Skilling. Darroll D., and Thomas H.

Nicholls.
1974. Brown spot needle disease biology and control in Scotch pine plantations. North Cent. For. Exp. Stn., St. Paul, Minn. 19 p., illus. USDA For. Serv. Res. Pap. NC-109
An application section briefly describes and illustrates the symptoms. hosts, life history of the brown spot needlecast fungus (Scirrhia acicola), and recommends chemical and cultural control methods. A documentation section details the research on the biology and control of the fungus.

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