been depleted by active transpiration and evaporation. Growth was resumed each year following the first good rains in August but gradually slowed as the end of the growing season approached. The capacity of these native junipers to cease active growth soon after moisture conditions are unfavorable and resume growth when moisture again becomes available may account for their ability to survive on dry, exposed sites. Seasonal growth fluctuations may also account for the formation of false rings which are characteristic of the wood of the Southwestern junipers.

The beginnings and endings of leader elongation for both growing seasons were apparently determined by soil temperature. Incomplete data for the beginnings of growth indicated that elongation began when the soil temperature warmed to approximately 50° F. Rate of elongation steadily increased as soil temperature increased and then slowed as moisture became critical. During both growing seasons when the soil temperature was in excess of 60° F., increases in precipitation were reflected in increased rates of elongation. Toward the end of the growing seasons as soil temperature decreased below 60° F., elongation rates decreased and ultimately became zero when a temperature of approximately 50° F. was reached. This pattern of decreasing elongation rates occurred even though moisture was seemingly sufficient to sustain a good rate of growth.

Some additional phenological phenomena for the four species of juniper were observed in 1940. Table I shows a number of events with their dates of occurrence.

TABLE I. Phenological observations for four Arizona junipers, 1940 (date of occurrence)

Phenological stage	Juniper species			
	Utah	One-seed	Rocky Mountain	Alligator
Bark begins to slip	Mar. 25	Mar. 25	Apr. 8	Apr. 1
Pollen shedding and ♀ flowers open	Mar. 25	Mar. 25	Apr. 15	Apr. 8
Approximate start of leader elongation	Apr. 20	Apr. 20	Apr. 20	Apr. 20
First conspicuous formation of ♂ flowers	Aug. 19	Aug. 19	Aug. 26	Aug. 19
Bark begins to stick	Sept. 15	Sept. 15	Sept. 15	Sept. 15
Leader elongation ceases	Oct. 19	Oct. 26	Oct. 19	Oct. 19

Unfortunately dates of fruit ripening and seed dispersal were not observed. However, some information about these phenomena is available in other publications.[2]

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[2] *E.g.*, Woody-plant seed manual. U. S. Dept. Agric. Misc. Publication 654, June, 1948, p. 206.

RELATION OF SAW-PALMETTO TO LONGLEAF PINE REPRODUCTION ON A DRY SITE

In a study of longleaf pine (*Pinus palustris* Mill.) reproduction on a dry ridge in southern Mississippi, seedlings were found only near clumps of saw-palmetto (*Serenoa repens* (Bartr.) Small).

The soil on this particular ridge is Norfolk sand. The openings between the saw-palmetto clumps (Fig. 1) have a sparse vegetation dominated by slender bluestem (*Andropogon tener* (Nees) Kunth), little bluestem (*A. scoparius* Michx.), sage (*Clinopodium coccineum* (Nutt.) Kuntze), and prickly pear (*Opuntia vulgaris* Mill.). There are also some bluejack oaks (*Quercus incana* Bartr.), blackjack oaks (*Q. marilandica* Muench.), and scattered longleaf pines up to 15 inches in diameter.

The distribution of longleaf pine seedlings was studied in 10 openings ranging from 7 to 28 feet in diameter. Most of the seedlings were 5 years old and none had started height growth.

The 10 plots had a total of 165 seedlings, or the equivalent of about 4,000 per acre. Instead of being evenly distributed, however, the seedlings were concentrated in the outer portions of the plots—*i.e.*, near the palmetto. In the average opening (15.2 feet in diameter), 59 per cent of them were within one foot of the base of a palmetto plant, or in the outer 25 per cent of the open area. Eighty-eight per cent were within 2 feet of the palmetto or in the outer 46 per cent of the area; and 95 per cent were within 3 feet, or in the outer 63 per cent. This is very significantly different from a uniform distribution and is a pattern that remains about the same regardless of the size of opening. Sixty-two per cent of the seedlings were found in the southern half of the openings.

Why are most of the seedlings found near the palmetto. It does not seem probable that more seed lodged there nor that predators would have eaten only the seed in the center of the openings. More likely, the shade of the palmetto protects the seedlings from lethal temperatures and improves water relations. The survival of planted longleaf pine seedlings on this site was distinctly improved by partial shading (Allen 1954).

An additional observation was made on all of the longleaf pine saplings growing on several acres of this sandy ridge. There were only 9, but 7 of them were within 2 feet of the palmetto and only one was more than 3 feet away.

REFERENCES

Allen, R. M. 1954. Shade may improve longleaf survival. U. S. Forest Serv., South. Forest Expt. Stat., South. Forestry Notes 90: 3-4.

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FIG. 1. *Above:* Typical small opening in the saw-palmetto. *Below:* The longleaf pine seedlings, marked by white cards, are found in the shade near the palmetto.