Breaking Dormancy of Longleaf Uniola Seeds[1]

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Highlight

Both speed and completeness of germination of longleaf uniola (*Uniola sessiliflora*) were raised to acceptable levels by prechilling caryopses at 2 C for 4 to 6 weeks, then germinating them in constant darkness with alternating temperatures of 20 and 40 C. Constant temperatures with or without illumination were less effective than alternating temperatures and constant darkness. Dormancy was not substantially reduced by preheating, freezing, removing bracts, soaking in water, moistening seeds with a KNO_3 solution, or puncturing seedcoats.

Longleaf uniola is an important grass beneath the pine-hardwood forests of the Upper Coastal Plain in the Southern United States. These forests are often managed for both forage and timber production. Longleaf uniola is a particularly valuable species because it is better able to survive beneath the moderately dense canopies favored for timber production than are its principal associates, bluestems (*Andropogon* spp.) and panicums (*Panicum* spp.). Also unlike its associates, it produces considerable forage during the winter. On most ranges, however, longleaf uniola is relatively sparse and yield is inadequate to balance the yearlong supply of forage. Exploratory studies to increase production revealed that without treatment most seeds of longleaf uniola remain dormant for a considerable time after maturity. The study of methods to decrease dormancy reported here is one of a series designed to find ways to increase the amount of longleaf uniola beneath pine-hardwood stands.

[1]Received April 7, 1969; accepted for publication May 31, 1969.

Methods

A sample of mature caryopses was collected November 13, 1967, from each of four habitats on a loblolly-shortleaf pine-hardwood range in central Louisiana:

1. Upland site moderately shaded by pine overstory.
2. Upland site heavily shaded by pines and hardwoods.
3. Lowland site moderately shaded by pines.
4. Lowland site heavily shaded by pines and hardwoods.

The freshly harvested samples were placed in paper bags and stored at about 22 C.

The lemmas and paleae were attached to caryopses during all germination tests, except as otherwise noted in results.

Caryopses were placed in covered clear-plastic boxes 12.8 × 13.1 × 3.2 cm. One box, containing 100 caryopses randomly drawn from one habitat sample, constituted a replication. All treatments were replicated four times, once for each of the four habitats. The substrate for all boxes was a commercial germination paper. Tapwater or a moistening agent was added to the substrate as needed. Percent germination was determined after 7, 14, 21, and 28 days, after which all tests were terminated.

Four separate experiments are reported in this paper. The first measured the effects of germination environment on response of untreated caryopses. The conditions evaluated included three temperatures, continuous 20 C, continuous 30 C, and alternating 20–40 C, and two light regimes, constant darkness and a 16-hr daily photoperiod. When temperature was varied, 20 C was maintained for 16 hr (1600–0800), and 40 C for 8 hr (0800–1600). Half of the caryopses assigned to each temperature were exposed to a 16-hr daily photoperiod and half were kept in constant darkness. A light intensity of approximately 120 ft-c was provided with fluorescent bulbs. Darkness was maintained by placing caryopses in black, lightproof, cloth bags. Reflectors were placed over the bags to maintain the same temperatures as those of samples exposed to illumination. During experiments, bags were opened only under a 15-w safe-green light.

Experiment 2 evaluated six possible methods for breaking dormancy: puncturing seedcoat, preheating for 7 days at 35 C, soaking in a large volume of water for 24 hr, moistening with a 0.2% aqueous solution of KNO_3, freezing for 24 hr at –3 C, and removing bracts. Germination was tested at 20–40 C alternating temperatures in constant darkness.

Experiment 3 was originally designed to assess effects of 1 to 6 weeks of prechilling at 2 C. Data from the first three tests suggested that 6 weeks might be insufficient for maximum germination. Therefore, an 8-week prechill was added in the final test. Germination was tested in constant darkness at 20–40 C alternating temperatures.

Experiment 4 evaluated the effects of germination environment on response of seeds prechilled for 6 weeks at 2 C. Temperature and light conditions were the same as in Experiment 1.

In experiments which included prechilling or prefreezing, caryopses were placed in germination containers on moistened substrate and stored at the respective temperatures. To avoid confounding with age of caryopses, pretreatments were timed to end on the first day of the germination period.

All treatments, except those in Experiment 4, were repeated successively to determine the effect of caryopsis age on germination. Caryopsis age at the beginning of each germination test is shown with the results.

Data were transformed to arc sines of square roots of germination percentages before analyses of variance. The design of Experiments 1 and 4 was a split plot, with temperatures comprising major treatments, and light intensities minor treatment. Data from the randomized block design of Experiments 2 and 3 were analyzed by Tukey's *w* procedure. Differences at the 0.05 level were considered significant. Means presented in tables were transformed back into percentages.

Results and Discussion

Experiment 1.—Germination of untreated caryopses 17 to 157 days after harvest was low regardless of temperature or light treatment. In four of the five tests, germination occurred only after 21 days. The maximum 28-day germination was only 1.1%.

In tests which began about 2.5 weeks after harvest, germination was significantly affected by a temperature × light interaction. Germination in constant darkness occurred only with alternating temperatures; results for the 16-hr photoperiod were not affected by temperature.

Treatments did not influence germination of seeds that were between 45 and 129 days old. Alternating temperatures significantly reduced dormancy at the end of the test for 129-day-old seeds.

A high proportion of the caryopses were dormant in all age classes, and all responses to light and temperature treatments were low. Westra and Loomis (1966) reported similar findings for sea oats (*Uniola paniculata*).

Experiment 2.—None of the six chemical or physical treatments greatly reduced dormancy. The maximum 28-day germination in any test was only 3.1% (Table 1).

Removing bracts consistently speeded germination. Values after this treatment significantly exceeded those for controls at both 14 and 21 days. Soaking in water was the only other treatment that increased germination within 21 days, and this improvement was confined to 73-day-old seeds. Both bract removal and soaking in water slightly improved 28-day germination in some age classes.

The results indicate that bracts may contain a germination inhibitor. Evenari (1949) reported that bracts of oats (*Avena sativa*) contain an inhibitor, and Elliott and Leopold (1953) found that washing oat caryopses increased germina-

Table 1. Germination at 20–40 C in constant darkness, by physical or chemical treatment (Experiment 2).

Age of seeds (days)	Length of test (days)	Treatment						
		Control (%)	Puncture seedcoat (%)	Heating (%)	Soaking (%)	KNO_3 (%)	Freezing (%)	Bract removal (%)
45	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	14	0.0B[1]	0.0B	0.0B	0.0B	0.0B	0.0B	1.1A
	21	0.0B	0.0B	0.0B	0.1AB	0.0B	0.1AB	1.6A
	28	0.1A	0.1A	0.0A	3.0A	0.8A	0.1A	1.6A
73	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	14	0.0B	0.0B	0.0B	0.0B	0.0B	0.0B	1.9A
	21	0.0B	0.0B	0.0B	1.5A	0.0B	0.0B	2.3A
	28	0.0B	0.0B	0.0B	2.4A	0.6AB	0.0B	3.1A
101	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	14	0.0B	0.0B	0.0B	0.0B	0.0B	0.0B	1.1A
	21	0.0B	0.2AB	0.1AB	0.2AB	0.0B	0.0B	1.3A
	28	0.0A	1.1A	0.5A	1.7A	0.1A	0.0A	1.5A
129	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	14	0.0B	0.0B	0.0B	0.0B	0.0B	0.0B	1.9A
	21	0.0B	0.0B	0.0B	0.0B	0.0B	0.0B	2.6A
	28	0.1B	0.0B	1.0AB	0.9AB	0.2AB	0.7AB	2.8A

[1] Germination values within each row having a common letter are not significantly different at the 0.05 level.

Table 2. Germination at 20–40 C in constant darkness, by 0- to 8-week prechill treatments (Experiment 3).

Age of seeds (days)	Length of test (days)	Weeks of prechill							
		0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	8 (%)
45	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--
	14	0.0C[1]	0.0C	0.0C	0.1C	3.5B	10.9B	28.6A	--
	21	0.1E	0.0E	3.7D	12.4C	54.0B	60.0B	78.1A	--
	28	0.2E	0.6E	12.0D	25.7C	62.9B	68.0B	82.8A	--
73	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--
	14	0.0B	0.0B	0.0B	0.1B	8.6A	4.1A	4.5A	--
	21	0.0D	0.0D	6.5C	24.9B	55.5A	56.6A	59.6A	--
	28	0.1D	0.1D	19.4C	47.0B	70.8A	74.4A	74.6A	--
101	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--
	14	0.0D	0.0D	0.0D	10.2C	12.1BC	21.6AB	33.7A	--
	21	0.0C	0.0C	0.7C	45.7B	52.8B	56.3AB	69.0A	--
	28	0.0C	0.0C	2.0C	57.3B	62.6AB	65.3AB	75.4A	--
129	7	0.0A	0.0A	0.0A	0.0A	0.0A	0.0A	0.0A	0.4A
	14	0.0C	0.0C	0.0C	7.8B	14.4B	18.6B	11.6B	52.2A
	21	0.0D	0.0D	3.6C	37.0B	48.3B	53.6B	49.1B	74.0A
	28	0.1D	1.6D	13.8C	47.7B	63.4B	63.9B	65.2AB	81.6A

[1] Within a row, percentages followed by a common letter do not differ significantly at the 0.05 level.

tion. Wiesner and Kinch (1964) reported that removal of bracts reduced dormancy of green needlegrass (*Stipa viridula*) seeds. In the present study, however, these treatments did not improve germination sufficiently to warrant their use.

Experiment 3.—Prechilling materially increased 28-day germination. Values for caryopses prechilled 3 weeks or more were significantly greater than for caryopses treated for shorter periods (Table 2).

With 2 weeks or less of prechilling, germination was not observed during the first 14 days. Caryopses treated for 3 to 6 weeks always began germinating during the second week; those treated for 8 weeks started during the first week of testing. At 14 days, germination of samples prechilled 4 weeks or more was consistently greater than that of samples prechilled for shorter periods. Eight weeks of prechilling were significantly better than shorter periods in terms of 14- and 21-day germination, but at 28 days 8 weeks were not superior to 6 weeks.

Similar results have been reported for other species. Toole and Toole (1941) noted that the proportion of smooth crabgrass (*Digitaria ischaemum*) and hairy crabgrass (*D. sanguinalis*) caryopses resistant to germination decreased as period of prechill lengthened. Ahring et al. (1963) reported that prechilling interrupted dormancy of sand lovegrass (*Eragrostis trichodes*), but noted that treating for more than 14 days gave little additional improvement.

Prechilling for 6 weeks affected germination less as caryopses aged. A similar result was reported by Toole and Toole (1941) for hairy crabgrass seeds.

Rate of germination varied with length of prechill. Germination rate was consistently greatest during the third or fourth week for seeds prechilled 3 weeks or less, whereas the rate was generally greatest during the second and third weeks for treatments of 4 weeks or longer.

Experiment 4.—This experiment, in which all caryopses were prechilled for 6 weeks, demonstrated that germination at 14, 21, and 28 days was significantly greater with 20–40 C alternating temperature than with constant temperatures of either 20 C or 30 C (Table 3). Ahring et al. (1963) and Westra and Loomis (1966) also found that alternating temperatures promoted germination of prechilled seeds better than constant temperatures.

Table 3. Germination of 129-day-old caryopses after prechilling for 6 weeks (Experiment 4).

Length of test (days)	20 C		30 C		20-40 C	
	16-hr photoperiod (%)	Constant darkness (%)	16-hr photoperiod (%)	Constant darkness (%)	16-hr photoperiod (%)	Constant darkness (%)
7	0.0	0.0	0.0	0.0	0.0	0.0
14[1]	4.8	0.2	0.2	0.1	0.1	11.6
21[1]	13.0	0.2	4.5	0.1	1.7	49.1
28[2]	17.1	0.2	6.0	0.1	9.2	69.2

[1] Germination percentages at the different temperatures differed significantly from one another, and temperature × light interaction significantly influenced germination.

[2] Germination percentages with alternating temperatures differed significantly from constant temperatures, and temperature × light interaction significantly influenced germination.

There was a statistically significant interaction between temperature and light in the present study. With a 16-hr daily photoperiod, germination was moderate at 20 C, and fair at both 30 C and 20–40 C. Constant darkness sharply increased germination at 20–40 C, while decreasing it at constant temperatures.

Although Colbry et al. (1961) noted that light supplied for a few hours daily stimulated germination of most freshly harvested grass seeds, complex reactions to light have been found previously. Bass (1954) reported that illumination became less essential for good germination as Kentucky bluegrass (*Poa pratensis*) seeds aged. Westra and Loomis (1966) reported that light failed to improve germination of sea oat caryopses ranging in age from 130 to 160 days. Light effects on germination have been studied and reviewed in detail by Toole et al. (1955) and Evenari (1965).

In the current experiments, alternating 20–40 C temperatures combined with constant darkness and prechilling were best for breaking dormancy of longleaf uniola seeds. This combination provided at least 60% germination of mature seeds harvested 45 to 129 days before the tests. Up to 129 days after harvest, germination of untreated caryopses was generally less than 1%, and increased to only about 5% 287 days after harvest. Although benefits diminished as caryopses aged, prechilling for at least 4 weeks always reduced dormancy.

Stands of longleaf uniola suitable for intensive investigation can be established now that a procedure for breaking dormancy has been found. Research already underway will determine methods for increasing yields of this grass beneath pine-hardwood stands.

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