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Germination of common milkweed (*Asclepias syriaca* L.) seeds

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BASKIN, J. M., and C. C. BASKIN (Sch. Biol. Sci., Univ. Kentucky, Lexington 40506). Germination of common milkweed (*Asclepias syriaca* L.) seeds. Bull. Torrey Bot. Club 104: 167–170. 1977.—Intact seeds of common milkweed (*Asclepias syriaca* L.) were innately dormant at maturity in October. Stratification was effective in overcoming dormancy, and nondormant seeds germinated in both light and darkness. One week of stratification was effective in overcoming dormancy in some of the seeds; seeds stratified in light and then incubated in darkness at 30/15 C germinated to 75.3%. Seeds stratified in light or darkness for 2 and 3 weeks and then incubated in light or darkness germinated to 68% or more at thermoperiods of 35/20 and 30/15 C but germinated to 20% or less at 20/10 C. Seeds stratified for 9 weeks also germinated to high percentages (70% or more) at 20/10 C. Seeds planted in a nonheated greenhouse in October germinated the following spring and most of the germinatoin occurred between 4 April and 5 May, when the mean maximum and minimum daily temperatures were 20.5 and 9.1 C, respectively.

Common milkweed (*Asclepias syriaca* L.) is a native North American perennial found on prairies, alluvial bottoms, meadows, fields, roadside and railways. Ranging from New Brunswick to Manitoba south to Georgia and Oklahoma (Woodson 1954), this species has become an increasingly troublesome weed in pastures, cultivated fields, railroad rights-of-way and roadsides of north central and northeastern United States and Canada (Evetts and Burnside 1972; Rasmussen and Einhellig 1975). Bhownik and Bandeen (1976) recently have summarized the published information on the biology of common milkweed, with particular reference to its weedy nature in eastern Canada, especially southern Ontario and Quebec.

Several studies have been done on the germination requirements of common milkweed. Intact seeds are dormant at maturity, but dormancy can be broken by a short period of moist, low-temperature treatment (stratification) (Evetts and Burnside 1972; Jeffery and Robison 1971; Oegma and Fletcher 1972), dry laboratory storage (Groh 1943; Evetts and Burnside 1972), removing the seed coat (Oegma and Fletcher 1972) and treatment with gibberellic acid or kinetin (Evetts and Burnside 1972; Oegma and Fletcher 1972). Evetts and Burnside (1972) found that stratified seeds germinated to high percentages at a daily alternating temperature regime of 30 C for 8 h in light and 20 C for 16 h in darkness.

One purpose of this study was to determine when seeds germinate if they are exposed to natural temperature regimes during autumn-winter and spring and what the temperatures are when germination occurs. A second purpose was to investigate the germination responses of seeds stratified in light and darkness for various periods of time and then incubated in light and darkness at four alternating temperature regimes representative of those which occur in the field from early spring to summer.

Materials and methods. Mature seeds were collected from a population of common milkweed plants growing in Washington County, Kentucky on 4 October 1974. The seeds were separated from the tufts of silky hairs and then were allowed to dry for 7 days. All experiments were started on 11 October 1974, and seeds were considered to be 0 weeks old on that date. In all experiments radicle protrusion was the criterion for germination.

GERMINATION AT NATURAL TEMPERATURES. Two replications of 300 seeds each were planted on greenhouse potting soil in large flats and placed in a nonheated greenhouse in Lexington, Kentucky. The

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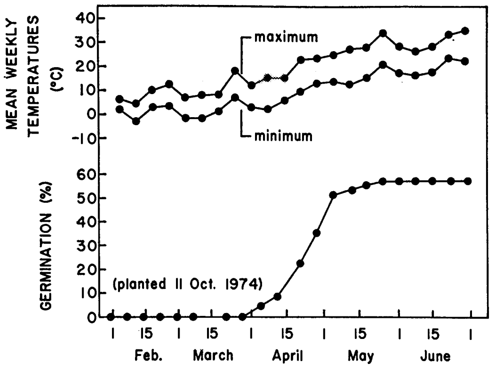

Fig. 1. Germination of common milkweed seeds planted on soil in a nonheated greenhouse in Lexington, Kentucky.

windows in this greenhouse were open during the entire experiment and temperatures were near those out-of-doors. Mean weekly maximum and minimum daily temperatures were calculated from continuous thermograph records made in the greenhouse. The soil in the flats were watered daily to keep it near field capacity. The flats were examined at about 1-week intervals, and each time they were examined germinated seeds were counted and removed.

GERMINATION RESPONSES OF STRATAFIED SEEDS. Seeds of common milkweed were placed on moist, quartz sand in Petri dishes (50 seeds in each of 240 dishes) and stratified at 5 ± 2 C for 1, 2, 3, 6, and 9 wks. One half of the seeds was stratified in constant darkness, and the other half was stratified in light (14 h of 1,620 lux of cool white fluorescent light each day). All Petri dishes were wrapped with Saran wrap to retard loss of water, and with aluminum foil to provide constant darkness. At the end of the various stratification periods seeds were transferred to four alternating temperature regimes (15/6, 20/10, 30/15, and 35/20 C). These temperature regimes approximate the average daily thermoperiods that occur near the soil surface in spring and summer in central Kentucky (Unpublished data, Jerry Hill, Advisory Agricultural Meteorologist, National Weath Service). At each temperature, seeds stratified in light and darkness were incubated in light and darkness, and seeds stratified in darkness were incubated in light and darkness. Nonstratified seeds (0 wks of stratification) were placed in light and darkness at each temperature regime on 11 October 1974 at the beginning of the experiment. Seeds incubated in light received 14 h of 2,100 lux of cool white fluorescent light each day. The high and low temperatures were maintained for 12 h each day, and the photoperiod extended from 1 h before the high temperature period began to 1 h after the low temperature period began. Three replications (dishes) of seeds were used for each treatment. Germination percentages were determined for all seeds 15 days after they were placed at the alternating temperature regimes.

Results. GERMINATION AT NATURAL TEMPERATURES. Germination began between 28 March and 4 April 1975 (Fig. 1), and during this time the mean maximum and minimum daily temperatures were 14.5 and 4.3 C, respectively. Most of the seeds germinated between 4 April and 5 May. During this interval the mean weekly maximum daily temperatures ranged from 15.4 to 25.2 C, and the mean weekly minimum daily temperatures ranged from 2.0 to 14.0 C. The mean maximum and minimum daily temperatures from 4 April to 5 May were 20.5 and 9.1 C, respectively.

GERMINATION RESPONSES OF STRATIFIED SEEDS Freshly matured, nonstratified seeds (0 wks) germinated to low percentages (16.7% or less) in both light and darkness at 30/15 and 35/20 C, but there was no germination at 20/10 and 15/6 C (Fig. 2). After 1 wk of stratification, germination at 30/15 and 35/20 C was greatly improved, especially for seeds incubated in darkness, but there was no germination at 20/10 and 15/6 C. Regardless of whether seeds were in light or darkness during stratification or during incubation at the alternating temperatures, seeds receiving 2 wks of stratification germinated to 68% or more at 30/15 and 35/20 C, and to 8.7% or less at 20/10; no seeds germinated at 15/6 C. Seeds that received longer stratification periods (3, 6, and 9 wks) showed an increase in ability to germinate at 20/10, 30/15, and 35/20 C. After 9 wks of stratification, regardless of whether seeds were in light or darkness during and/or after stratification, seeds germinated to 94% or more at 35/20 and 30/15 C, to 70% or more at 20/10 and to only 0.7% at 15/6 C.

Discussion. When seeds of common milkweed are dispersed in October, there

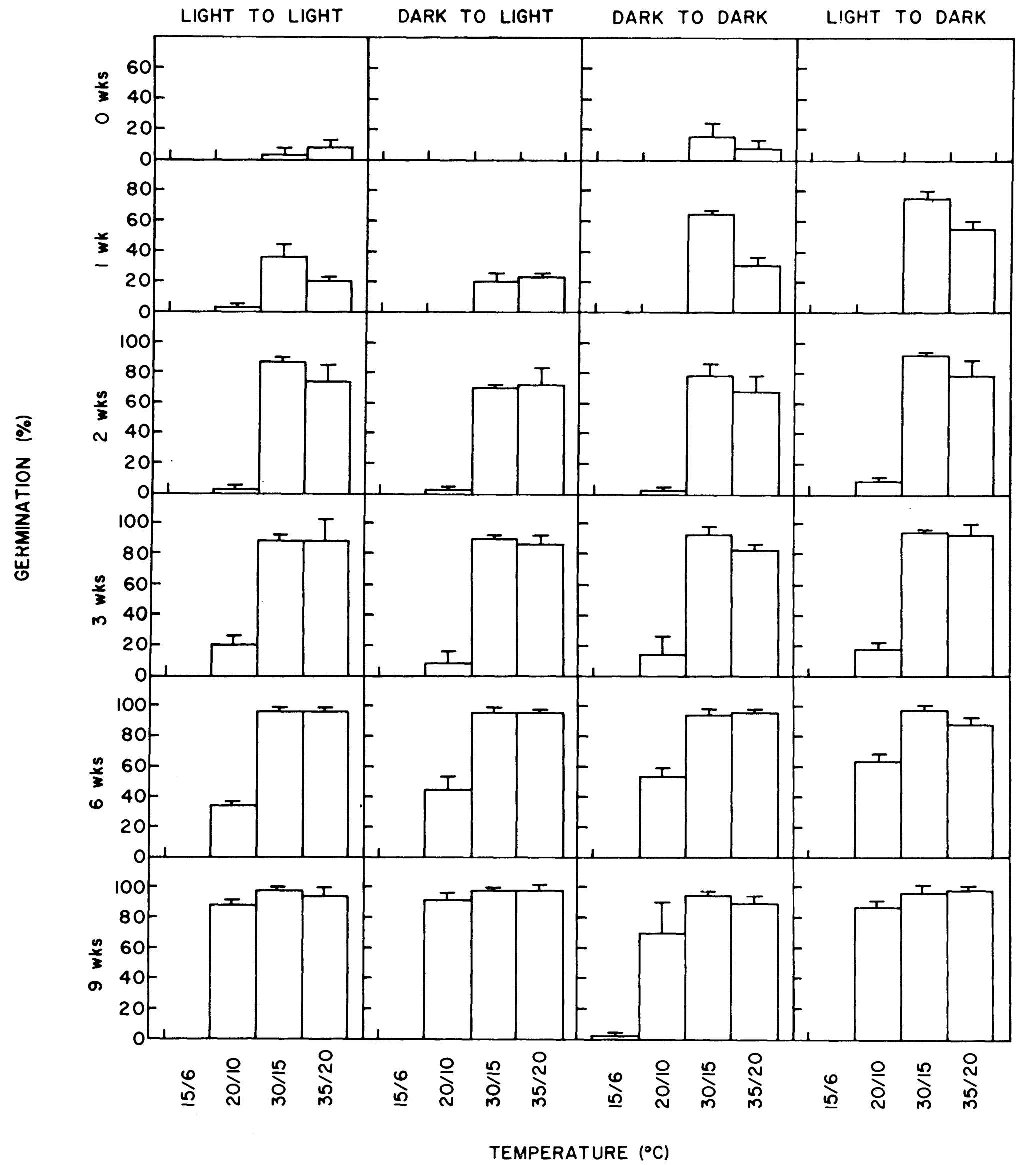

Fig. 2. Germination of common milkweed seeds after 0, 1, 2, 3, 6, and 9 wks of stratification. Seeds stratified in light were incubated in light and darkness, and seeds stratified in darkness were incubated in light and darkness. Vertical bars represent one standard deviation.

is no germination, although a small percentage of the seeds is nondormant. These nondormant seeds have a high temperature requirement for germination (35/20 and 30/15 C) (Fig. 2) and can not germinate in nature because temperatures are too low. The mean maximum and minimum daily temperatures (2.5 cm below bare soil and 5.0 cm above bare soil) for October in central Kentucky from 1968 to 1973 were 21.8 and 10.7 and 22.1 and 7.5 C, respectively (Unpublished data, Jerry Hill, Advisory Agricultural Meteorologist). As the seeds begin to afterripen during winter, they gain the ability to germinate to high percentages at temperatures representative of late June and early July (30/15 and 35/20 C), but germination is prevented because temperatures of the environment are too low. With further afterripening the

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seeds become capable of germinating if subjected to lower temperatures (20/10), but temperatures of the environment are still below those required for germination. Germination is delayed until spring when temperatures of the environment increase and correspond to those required for germination. Seeds subjected to natural, low winter temperatures in the nonheated greenhouse germinated in April when mean maximum and minimum daily monthly temperature were about 20 and 10 C, respectively (Fig. 1).

In the early stages of afterripening (after 1 wk of stratification) seeds germinated better when incubated in darkness than in light (Fig. 2). As the seeds became more fully afterripened, however, they germinated equally well in light or darkness, regardless of whether or not they received light during stratification. Thus, seeds that overwinter in the field can germinate in darkness in spring if they become buried in either autumn or spring. Jeffery and Robison (1971) found that seeds germinated better when planted 1 or 2 cm deep than when planted on the soil surface. One possible reason for low seed germination in their study was the fact that they used open pots, causing high surface evaporation and low water availability to seeds.

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A vascular flora of the forested portion of Cunningham Park, Queens County, New York, with notes on the vegetation

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GRELLER, A. M. (Dept. Biology, Queens College, Flushing, N.Y. 11367). A vascular flora of the forested portion of Cunningham Park, Queens County, New York, with notes on the vegetation. Bull. Torrey Bot. Club 104: 170-176. 1977.—This paper records the vascular flora of mature forests, young woods, kettle ponds, and clearings in Cunningham Park, and includes plants of adjacent parks on the Harbor Hill end moraine. Major habitat and a subjective measure of commonness are noted for each species. Phytosociological and phenological observations are made on the floral elements in the vegetation. Listed are 82 families, 205 genera, and 332 species. Families with the greatest number of species are (in order of decreasing numbers): Compositae, Rosaceae, Gramineae, Liliaceae, Cyperaceae, Polygonaceae, Polypodiaceae (*sensu lato*), and Ericaceae.

Cunningham Park, a 326-acre (131.9 hectares) tract of municipal (New York City) parkland, is located mainly on the Harbor Hill end moraine in Queens County, N.Y., at the western end of Long Island. The end moraine is characterized

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