

SEED FORMATION, GERMINATION, AND POST-GERMINATION DEVELOPMENT IN CERTAIN CICHORIEAE

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ABSTRACT

Part I. Fruit Development—Parthenogenesis. Hundreds of flower heads of *Taraxacum officinale* Weber, *Chichorium intybus* L. and *Lactuca ludoviciana* (Nutt.) Riddell were castrated by means of a razor blade so as to remove the anthers and stigmas. Castrations were made between 6 and 7 A. M. before the one-day flowers opened. Removing stamens and stigmas of *Chichorium intybus* with the fingers was the best method of castration.

Seeds of castrated and normal flowers were germinated at 26.66°-32.22°C. and 9°C. At 9°C. 25% of the *Taraxacum* seeds germinated while 45% germinated at room temperature. Seeds of castrated *Chichorium intybus* and *Lactuca ludoviciana* did not germinate at room temperature but normal fertile seeds gave from 4-18% and 16-56% germination respectively.

Conclusions:—1. The results of Stork, Raunkiear, Sears, Ikeno, Osawa, and others in producing parthenogenesis in *Taraxacum* has been confirmed. Parthenogenesis is the normal manner of seed development in many species of *Taraxacum*. 2. Parthenogenesis apparently does not exist in *Lactuca ludoviciana* or *Chichorium intybus*.

Part II. Seed Germination.—It has been found by a number of investigators that the seeds of different species of cultivated lettuce are affected in different ways by light, oxygen, moisture, temperature, and chemical factors before and during germination. It was the object of these experiments to determine the factors influencing seed germination and dormancy in *Lactuca scariola* L. and *Lactuca ludoviciana* (Nutt.) Riddell seeds. Seeds of various ages were treated by germinating at various temperatures, germinating under different moisture conditions, exposing to artificial light and sunlight, mutilating seeds, and soaking

in chemical solutions. Treated seeds were placed on clay germination blocks made for this purpose by the Ceramics Department of the University of Illinois or between filter paper in Petri dishes. Air-dry seeds used in these experiments were 12 months, 10 months, 8 months, and 2 to 24 days old. Controls were used for seeds germinated at temperatures of 7°-8°C., 8°-20°C., 23°-25°C., 26°-30°C., and 36°-50.5°C. Eight months-old seeds of *L. ludoviciana* in water and air-dry were placed at -7°C. for 2, 5½, 8, and 24 hours. They were germinated at 15°-24°C. The same age seeds were soaked in the dark for 5, 22, 48, and 77 hours at 3°-7°C. then germinated at 18°-24.5°C. The same age seed were soaked in the dark for 5, 15, 24, and 30 hours at temperatures of 8°-23°C., 15°-20.5°C., 18°-22°C., and 42°-51.5°C. then germinated at 18°-24.5°C. The longer the seeds were soaked at -7°C. the lower the percentage of germination. The longer the seeds were soaked at 3°-7°C. the higher the percentage of germination, increasing from 30%-65% for the 5 and 77 hours soaked. Seeds soaked at 8°-23°C. and germinated at 18°-24.5°C. averaged 66% for all hours soaked. Eight month old seeds of *L. scariola* were soaked 24 hours at 8°-20°C., 15°-22°C., 23°-24.5°C., and 40.5°-48°C. then germinated at the same temperature. With the exception of those germinating at 15°-22°C. all were exposed to diffused light during soaking and germination. The same age seeds were placed in an oven at a temperature of 36°-50.5°C. for 1, 2, 3, and 5 days, then germinated at 15°-22°C. The percentage of germination was inversely proportional to the temperature. Both dry and soaked seeds germinated 70% at the lowest temperature.

Exposure to sunlight for five minutes increased the percentage of germination of 24 day old *L. ludoviciana* seeds that had been soaked 2 hours.

Eight months-old seeds of both species of wild lettuce were exposed in water and dry to a 75 watt Mazda bulb at a distance of 3 feet for 5, 10, 20, 40, and 60 minutes. An aluminum reflector was used above the bulb and an electric fan was directed upward on the bulb to dispense with as much heat as possible. The seeds were placed on clay blocks for germination at a temperature of 24°-32°C. The increase in exposure to light did not seem to increase the percentage of germination but germination was increased from 0-30% for *L. ludoviciana* seeds in water. *L. scariola* were not definitely affected by this treatment.

Ten month-old seeds of *L. scariola* were soaked for 1, 2, 3, 4, 5, and 6 hours. Forty seeds were placed on a clay block in the germinator each hour and half of these were covered with a strip of filter paper dipping into the water. The germination temperature was 23°-25°C. The same age seeds were soaked 3, 6, 9, and 18 hours, then germinated at the same temperature. It is evident that the seeds imbibe enough water for germination within an hour and additional soaking decreases the percentage of germination from 7-3% over a period of 6 hours.

Thirteen day-old, 10 month-old and 12 month-old seeds were soaked a half hour and the rounded ends cut off. After 12 hours the seed coats were removed from other seeds and all were placed on sand depths of 2, 3, 4, and 4½ inches in an apparatus designed by Prof. C. F. Hottes for maintaining a constant amount of water in each depth of sand. The percentage of water varied from 7.85-14.05 and was inversely proportional to the depth of sand as was the percentage of germination. On two-inch sand substratum 85% of the seeds with rounded ends cut off germinated while 35% of the seeds with testas removed germinated.

A hundred 10 month-old air-dry seeds of *L. scariola* were placed on a clay block at 23°-25°C. for germination. Only 3% germinated in 13 days. The seed coats of 20 of these seeds were removed at the end of 13 days and returned to the clay block. At the end of 29 days the seed coats of 20 more seeds were removed and returned to the clay block. None of the remaining seeds germinated but 80% of the naked embryos germinated. Fresh seeds of *L. scariola* were placed on a clay block at 23°-25°C. The seed coats of 20

seeds were removed on the 2nd, 4th, 7th, and 9th days. The same treatment was given 12 month-old seeds of *L. scariola* and *L. ludoviciana*. 90% of the 12 month-old *L. scariola* seeds germinated when the testas were removed at the end of 2 days on a clay block but only 50% germinated when the testas were removed on the 7th day. Only 5% of the control germinated in the two species. Fresh *L. scariola* seeds were soaked in water for 4, 6, 8, 10, 12, 14, 16, 18, and 20 hours. 40 seeds were removed at the end of each period. Testas were removed from 20 seeds and all were placed at 23°-25°C. Seeds imbibed enough water for maximum germination, 30%, after soaking 4 hours and removing testas. An after-ripening period seems necessary before complete germination occurs. The average for the controls of this age seed was 11.6%. The rounded ends of 8 month-old air-dry seeds of both species were cut off and placed on a clay block at 15°-24°C. 30% of the *L. scariola* germinated while 10 month-old seeds treated in the same manner gave a 95% germination at 23°-25°C. 45% of the *L. ludoviciana* germinated as compared with 5% for 10 month-old seeds at the same temperature. Fifteen day-old seeds of *L. scariola* germinated 5% and *L. ludoviciana* 2% at 23°-25°C. after the ends were cut off. It is evident that 10 month-old *L. scariola* seeds are not dormant but that the testas inhibit germination. It is evident that the 15 day-old seeds are dormant.

Ten month-old seeds of *L. scariola* were soaked from 9½-18 hours in solutions of Hormodin varying from .25cc. of Hormodin per 100 cc. of water to .046875 cc. per 100 cc. of water. They were germinated at 23°-25°C. on clay blocks. Seeds soaked for 9½ hours in .09375 cc. of Hormodin per 100 cc. of water gave the highest percentage of germination, 25%. In general the percentage of germination was inversely proportional to the hours soaked. Fourteen tests resulted in no germination in 18 days.

Five month-old seeds of *L. scariola* and 7 month-old seeds of *L. ludoviciana* were shaken in a vial with Rootone then placed on a clay block at 19.5°C. The average germination for *L. scariola* was 11% while the controls averaged 22%. Treated seeds of *L. ludoviciana* gave a 10% germination while the control showed a 5% germination. Hormodin

and Rootone decrease germination of wild lettuce seed rather than increasing it as some investigators have found for various seeds.

Conclusions.—1. Freshly harvested seeds of *Lactuca scariola* are dormant. The removal of seed coats does not alter their dormancy. The embryos evidently must experience a period of after-ripening before they can germinate. 2. The embryos of *L. scariola* seeds lose their dormancy within 8 to 12 months after the seeds are produced and are then capable of germination. 3. Eight month-old *L. scariola* seeds give a higher percentage of germination than older or freshly harvested seeds at the same temperature. 4. Prechilling at 3°-10°C. causes an increase in the rate and percentage of germination of *L. ludoviciana* and *L. scariola* seeds at higher temperatures, 20°-30°C. Freezing temperatures caused a decrease in the percentage of germination of *L. ludoviciana* seeds. 5. Temperatures between 10°-20°C. are more favorable for germination of air-dry *L. scariola* and *L. ludoviciana* seeds of various ages. 6. Probably moist fresh *L. ludoviciana* seeds are affected more by exposure to light than older seeds. 7. Moist and dry seeds of *L. scariola* are evidently not influenced by exposure to light. 8. The growth promoting substances, Hormodin and Rootone, did not show evidence of increasing the rate or percentage of germination of seeds of *L. ludoviciana* and *L. scariola*.

Part III. Photoperiodism.—On February 25, seeds of *L. scariola* with the ends opposite the radicle cut off were placed in each of 12 pots of earth. Four of these pots were placed on a clinostat under electric lights of 3000 watts, providing continuous light. The second group of four pots were allowed only 7 hours of daylight. The other four pots were used

as a control under the same conditions but allowed normal daylight. The temperature averaged 20°C. during the winter and never went above 35°C. during the spring and summer.

Two months after the seeds were planted the continuous-light plants ranged in height from 8-26¾ inches and had 4-10 well developed leaves. Short-day plants did not have stems but merely a rosette of leaves that varied from 1½-3 inches in length. The normal-day plants had larger rosettes with leaves 3½-5 inches long but no stems. All of the short-day plants died within 4½ months. The continuous-light plants grew to a height of 34-50 inches, flowering 3 months after planting, with seeds maturing 15 days later. Normal-day plants ranged from 8-20 inches in height in 5 months, with flowers 10 days later and seeds matured in 15 days. The internodes of the continuous-light plants averaged 2½ inches while those of the normal-day plants averaged ¾ inch in length. The continuous-light plants did not form a rosette as was the case in short and normal-day plants.

Conclusions:—1. *Lactuca scariola* matures and produces seeds in a shorter time under continuous light than under normal daylight in a greenhouse. 2. Under normal light *L. scariola* remains in a vegetative condition longer than under continuous light. 3. *L. scariola* is a long-day plant.

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