Light in Relation to Seed Germination of Blueberries, Strawberries, and Rubus

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Irregular germination and delayed emergence of blueberry, strawberry, blackberry and raspberry seedlings have been noted by various investigators. Seed treatments such as after-ripening (1) and acid scarification of strawberry seed (2) improved rapidity of germination, but neither treatment fully overcame the delay in seed germination. In a study with blueberry seed, after-ripening did not improve germination (2). Sporadic germination and delayed emergence of seedlings complicates a breeding program when uniform size of seedlings is desired.

In preliminary trials with strawberry seed, germination was more rapid when seed was planted on the surface of sphagnum, compared with that covered lightly by sphagnum. These results suggested light as a factor in germination of the seed and seedling emergence.

In the present study blueberry, strawberry and *Rubus* seeds were stored dry in a refrigerator at 40°F from time of harvest. Six-month-old blueberry seeds from five controlled crosses were used. Non-after-ripened strawberry seeds from five controlled crosses, 2 to 6 years old, were used in one experiment (Table 2). Seeds that had been after-ripened for 3 months at 40 to 45°F, from three of the same crosses, were used in another experiment (Table 4). Blackberry and raspberry seeds were one year old from controlled pollinations of Austin Thornless x self and AR-1 x NC 223, respectively.

Individual plots in these experiments consisted of composition boxes 4″ x 6″, filled with milled sphagnum, on the surface of which 100 seeds were sown (Fig. 1). The plots were arranged on a greenhouse bench in a randomized block design with five replications. Each replication of blueberry and strawberry had two plots of seed from each cross. One plot received light after planting and the other did not. Four treatments in the *Rubus* test were as follows: 1) exposed on surface of sphagnum and after-ripened, 2) covered lightly with

Table 1. Mean germination of blueberry seed under two light treatments, 1966.

Seed treatment	Germination at specified times from date of planting (weeks)				
	6 %	9 %	11 %	13 %	16 %
1. Exposed to light immediately after planting	39.0a	39.0a	39.0a	39.0a	40.7a
2. In dark 6 weeks after planting then exposed to light	2.3c	2.3c	29.3b	38.2a	43.6a

Means in the same row followed by different letters differ significantly at the 1% level.

Table 2. Mean germination of non-after-ripened seed of strawberry under two light treatments four weeks after seeding, 1966.

Progeny	Age of seed	Germination in light %	Germination in dark %
Surecrop x Md-US 2590	1960	84.6a	8.6d
Vesper x Md-US 2650	1961	61.6b	1.0d
Surecrop x NJ 357	1962	38.2c	2.6d
Midland x Stelemaster	1963	37.2c	0.0d
Md-US 2359 x Md-US 2713	1964	9.8d	0.0d
		46.3	2.4

Means followed by different letters are significantly different at the 1% level.

Table 3. Mean germination of non-after-ripened strawberry seed at four times under two light treatments, 1966.

Seed treatment	Germination at specified times from date of planting (weeks)			
	4 %	6 %	8 %	12 %
1. Exposed to light immediately after planting	46.3b	66.1c	69.1c	78.0d
2. In dark 4 weeks after planting then exposed to light	2.4a	37.3b	67.2c	78.2d

Means followed by different letters are significantly different at the 1% level.

Table 4. Mean germination of after-ripened seed of strawberry under two light treatments two weeks after placement in greenhouse, 1966.

Progeny	Age of seed	Germination in light %	Germination in dark %
Vesper x Md-US 2650	1961	92.1a	62.2d
Surecrop x NJ 357	1962	77.8b	66.8bc
Midland x Stelemaster	1963	95.2a	28.4e
Mean		88.4	52.5

Means followed by different letters are significantly different at the 1% level.

Table 5. Mean germination of blackberry and raspberry seed at end of three-month germination period in four treatments, 1967.

Seed treatment	Germination Blackberry %	Germination Raspberry %
1. Exposed on surface of sphagnum; after-ripened	21.6a	31.2a
2. Covered with sphagnum· after-ripened	1.8b	9.8b
3. Covered with black polyethylene; after-ripened	1.6b	0.0c
4. Exposed on surface of sphagnum; not after-ripened	0.6b	2.4c

Means followed by different letters are significantly different at the 1% level.

sphagnum and after-ripened, 3) covered with black polyethylene and after-ripened, and 4) exposed on surface of sphagnum and not after-ripened. Seed was after-ripened at 35° to 40°F in moist condition for three months.

Plots to be maintained in the dark were immediately enclosed in black polyethylene bags to exclude light. Paper was laid over the polyethylene bags to prevent sunlight from striking the polyethylene and creating a high temperature within the bags. The surface of all plots was kept moist by use of intermittent mist.

First blueberry germination counts were made six weeks after planting, when the polyethylene bags were removed. First germination counts with strawberries were made at two weeks or four weeks after placing the seed trays in the greenhouse, when the polyethylene bags were removed. *Rubus* germination counts were made at the end of three months.

Greenhouse temperatures from January through March fluctuated between 70° and 80°F during the day and held fairly constant at nights at 65°. Greenhouse temperatures in July fluctuated between 80° and 105° in the day, and at night 65° to 75°F. Temperatures on the surface of the sphagnum, inside and outside of the black polyethylene bags, were indicated to be the same by thermocouple temperature points.

Blueberry: Seed sown in light had an average germination of 39% at the end of six weeks with no additional germination up to 16 weeks. Seed that received no light during the six weeks after planting germinated about 2%; but by the end of 13 weeks (six weeks in dark and seven in light) germination was equal to that of seed held for 13 weeks in light (Table 1). Seeds held for six weeks in the dark, and then exposed to light, required still another six to seven weeks for germination.

Blueberry seeds do not germinate in the dark. Exposure to light causes germination of most seeds, but does not completely overcome a delay in germination.

Strawberry: Seed without after-ripening maintained in light germinated 46.3% after four weeks, whereas those held in dark germinated 2.4% (Table 2). The oldest seed lots had the highest germination. At six weeks after planting, seed in the light had germinated 66.1%, and that held four weeks in the dark plus two weeks in light germinated 37.3%. By the end of eight weeks total germination was the same for both treatments.

Strawberry seed after-ripened for three months at 40 to 45° germinated rapidly in both light and dark in the greenhouse (Table 4). Seed in light germinated 88.4%, compared with 52.5% for dark-held seed. The lowest germination (28.4%) occurred with dark-held seed of the youngest lot.

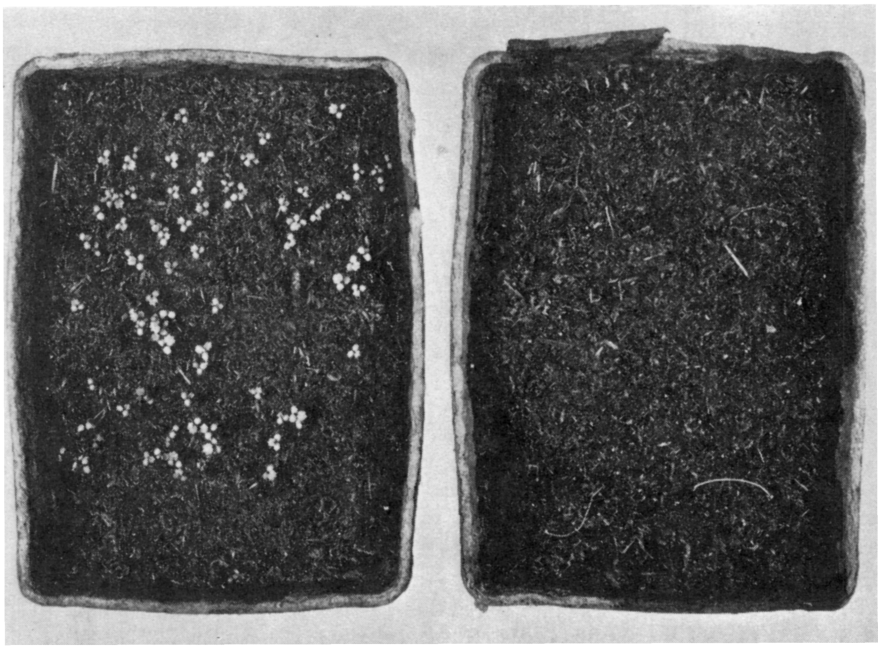

Figure 1. Germination of strawberry seed in light (left) and dark (right) 4 weeks after seeding.

Rubus: Blackberry seed exposed to light and after-ripened had a mean germination of 21.6%, whereas seed covered with sphagnum and black polyethylene to exclude light germinated only 1.8% and 1.6% respectively (Table 5). Raspberry seed exposed to light and after-ripened germinated 31.2%, but seeds covered with black polyethylene to exclude light gave no germination. When seeds were covered with sphagnum 9.8% germinated compared with 31.2% for fully exposed seed. Non-after-ripened seeds of blackberries and raspberries gave low germination, which agrees with previous reports.

Literature Cited

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Growth Response of Several Rootstocks to Soil Water[1]

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Eleven apple clones and a seedling source of Red Delicious (*Malus sylvestris* Mill.) were grown in one-gallon containers in the greenhouse to evaluate growth responses to soil water. All clones and seedlings were nongrafted and these are listed in Table 1.

Uniform one-year-old plants of these clones and seedlings were planted in non-preforated one-gallon metal containers in a uniform soil mixture of one-half silt loam and one-half peat moss. The containers with the plant and moist soil were weighed to a uniform seven pounds per unit. Then water was added to bring the low water level to seven and one-half pounds and the high water level to eight and one-half pounds. The high water level was estimated to be equal to field capacity of soil water. Each clone and each treatment was replicated ten times.

Subsequently, water was added when the plants under low water level showed signs of wilting at which time

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