

1920

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L. H. Pammel
Iowa State College

C. M. King
Iowa State College

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Recommended Citation

Pammel, L. H. and King, C. M. (1920) "The Germination of Some Trees and Shrubs and Their Juvenile Forms," *Proceedings of the Iowa Academy of Science*, 27(1), 75-80.

Available at: <https://scholarworks.uni.edu/pias/vol27/iss1/9>

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THE GERMINATION OF SOME TREES AND SHRUBS AND THEIR JUVENILE FORMS*

L. H. PAMMEL AND C. M. KING

In our studies of seedlings during the year 1918-1919 there have been included representatives of the following families: Salicaceæ, Urticaceæ, Berberidaceæ, Leguminosæ, Rutaceæ, Vitaceæ, Cornaceæ, Sapotaceæ and Oleaceæ.

SALICALES

Salicaceæ

Populus deltoides Marsh. Cottonwood. See figure 10, A.

Seeds of the cottonwood were flying May 27, 1919. On August 15, 1918, on the borders of the lake upon the Iowa State College campus seedlings were abundantly growing, with five to ten leaves.

Cotyledons still remaining on the seedling, one centimeter in length, one-half centimeter in width; petiolate, smooth; in shape ovate, with cordate base. Rootlets fibrous, abundant. Stem smooth, reddish. First leaves smooth, ovate, lanceolate, nearly entire, petiole short. Succeeding leaves increasing in length and width; fourth and fifth leaves ovate, at base obtuse angled, apex acute angled, pinnately veined, crenate margin; petiole of fourth and fifth leaves longer than first to third. Later leaves approaching deltoid in shape.

URTICALES

Urticaceæ

Ulmus racemosa Thomas. Cork elm. See figure 10, B.

Seeds of this elm were freely falling May 30, 1919, at the Ledges, Boone county. Collections that were made and planted at this time in the greenhouse germinated June 15, 1919.

Germination epigeaeous, the seed coat often being brought to the surface as the seedling grows. Cotyledons two, broadly oval, slightly pubescent above; hypocotyl pubescent. Stem above the cotyledons pubescent. First pair of leaves strongly pinnate veined, doubly serrate. Lower surface of leaf pubescent, especially on the veins; stem densely glandular pubescent.

* Contribution No. 3 on the Germination of Woody Plants.

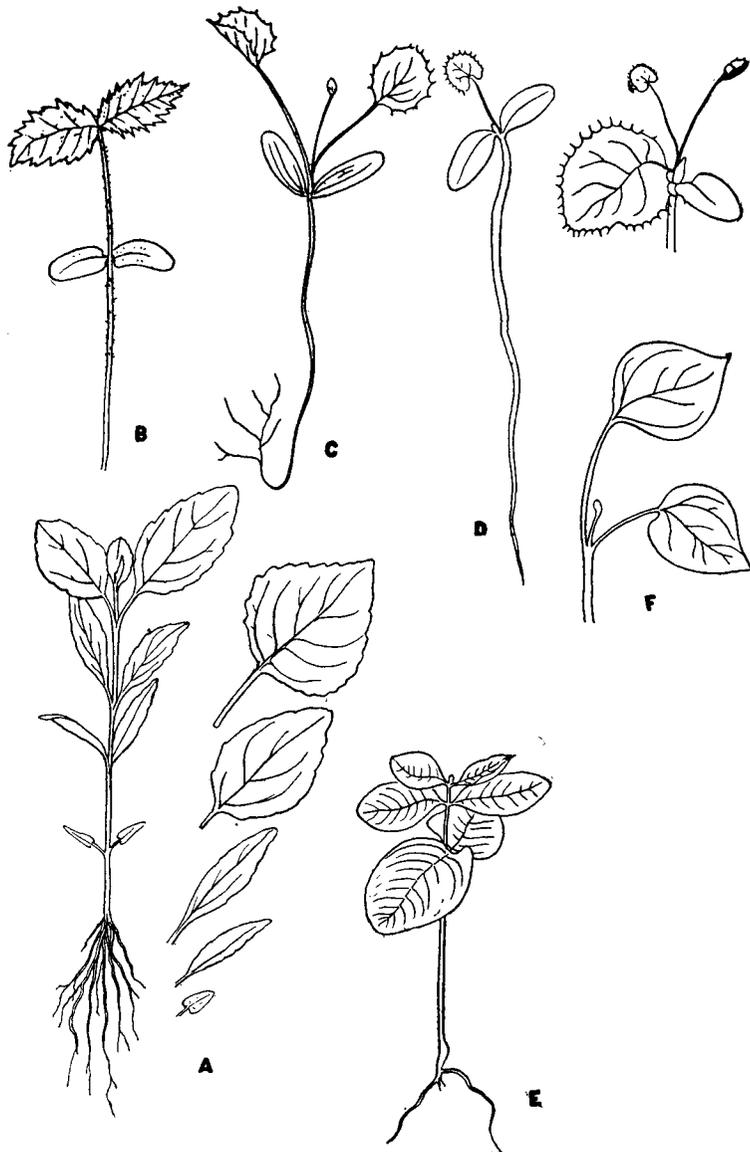


Fig. 10a. *Populus deltoides* Marsh. Cottonwood seedling, showing cotyledons and four subsequent pairs of leaves. Drawn by C. M. King

Fig. 10b. *Ulmus racemosa* Thomas. Cork elm. Seedling showing cotyledons and first pair of leaves. Drawn by C. M. King

Fig. 10c. *Berberis macracantha* ("No. 7" from Sargent, Arnold Arboretum) Barberry. Seedling showing cotyledons and first pair of leaves. Drawn by C. M. King

Fig. 10d. *Berberis laxiflora oblanceolata* ("No. 22," from Sargent). Seedlings, showing cotyledons and first and second pair of leaves. Drawn by C. M. King

Fig. 10e. *Citrus Decumana* L. Grape fruit. Seedling showing the two large cotyledons and two subsequent pairs of leaves. Drawn by C. M. King

Fig. 10f. *Ampelopsis heterophylla*. Blume. Woodbine. Seedling showing cotyledons. Drawn by C. M. King

RANUNCULALES

Berberidaceae

Berberis macrocantha ("No. 7" from Sargent, Arnold Arboretum). See figure 10, C.

Seeds collected, 1918; planted in earth on bench in greenhouse Nov. 20, 1918; germinated April, 1919.

Hypocotyl three-fourths inch above the ground. Cotyledons oblong, fleshy with very short stalk, paler underneath, slightly tinged with purple, a few hairs. First leaf reniform or cordate, spinose-dentate; upper surface conspicuously three-veined, with reticulations, smooth, lower surface pale. Stem smooth, stipules small. Second leaf smooth; petiole one-fourth to five-sixteenths inch in length. Root with yellowish tinge.

Berberis laxiflora oblanceolata ("No. 22," from Sargent). See figure 10, D.

Seeds received fall of 1918; planted in greenhouse Nov. 20, 1918; first seedling appeared April 1, 1919, the second on April 28.

Epigaeous. Hypocotyl erect, terete, one-half to three-fourths inch in length, slightly tinged with purplish green. Cotyledons oblong, obtuse, fleshy, with very short stalk. A few hairs on the cotyledon. First leaves simple, alternate, petioled, stipulate; glabrous, reticulately-veined, spiny, serrate, reniform or cordate, green above, glaucescent underneath. Some spines of the margin directed upwardly. Stem suffused with red. Petioles filiform. Stipules minute, adnate to the petiole. Root and lower part of the stem yellowish.

Citrus Decumana L. Grape fruit. See figure 10, E.

Fresh seed planted January, 1919; germinated March, 1919.

Germinated hypogaeous; cotyledons remaining in the seed; greenish white in color, oblong, obtuse, fleshy. First pair of leaves roundish to ovate, one and one-half inches long, bright green, nearly opposite, fleshy. Stem mottled; a few hairs present. Petiole short, not articulated to the stem, slightly pubescent. Second pair of leaves ovate, bright green, with slight pubescence. Third pair of leaves like the preceding; not articulated. Root long, straight, whitish.

RHAMNALES

Vitaceae

Ampelopsis heterophylla Blume. Woodbine. See figure 10, F.

Seeds collected fall of 1918; planted in greenhouse bedding soil, March 8; germinated April 20, 1919.



Fig. 11a. *Sesbania macrocarpa* Muhl. Pea tree. Seedling showing the large cotyledons and first and second subsequent leaves.

Drawn by C. M. King

Fig. 11b. *Ptelea trifoliata* L. Hop tree. Seedling showing cotyledons.

Drawn by C. M. King

Fig. 11c. *Nyssa sylvatica* Marsh. Black gum. Seedling showing the large cotyledons.

Drawn by C. M. King

Fig. 11d. *Diospyros virginiana* L. Persimmon. Seedlings, showing the unfolding cotyledons and several subsequent leaves.

Drawn by C. M. King

Germination epigealous. Hypocotyl pale. Cotyledons long-stalked, cordate in general outline. Petiole erect, but leaf blades of cotyledons at right angles, prominently veined, smooth. First leaf cordate, coarsely dentate, slightly pubescent below, and on the margin. Root long, slender, whitish; lateral roots long.

ROSALES

Leguminosae

Sesbania macrocarpa Muhl. Pea-tree. See figure 11, A.

Seeds from South Carolina, collected fall of 1918; planted in

greenhouse Nov. 12, 1918; germinated April 1, 1919; second seedling appeared April 20.

Hypocotyl three to six inches in length. Cotyledons thick, fleshy, elliptical. Stem glaucous, smooth. First leaf simple, pinnately veined, smooth, spotted, paler underneath; stipules small, slender, obtuse-pointed; petiole short. Second leaf pinnately compound, odd pinnate, with mucro in place of leaf; petiole short; stipule small, pointed; leaflets entire, elliptical, mucronate. Third leaf abruptly pinnate; leaflets smooth, a few scattered hairs on veins and margins of the leaflets. Rachis channeled, with mucro. Young leaves slightly sensitive.

GERANIALES

Rutaceae

Ptelea trifoliata L. Hoptree. See figure 11, B.

Seeds collected fall, 1918; stratified out of doors; planted in greenhouse, March 8, 1919; germinated May 2, 1919.

Hypocotyl finely pubescent. Cotyledons oblong, obtuse, shortly petiolate, at ends minutely crenulate; deep green; glabrous.

UMBELALES

Cornaceae

Nyssa sylvatica Marsh. Black gum. See figure 11, C.

From Camp Gordon, Georgia. Seeds collected fall of 1918; stratified out of doors; planted in greenhouse, March 8, 1919. Germinated May 1, 1919.

Germination epigeaeus. Hypocotyl slender, reddish green. Cotyledons fleshy, oblong-ovate, short petioled, green above, paler beneath, smooth, margin entire. Size of cotyledon, one inch in length, one-third inch in width. Stem above cotyledon slightly hairy. First leaf hairy above, smooth below, hairy on margin.

In general aspect resembling dogwood.

EBENALES

Sapotaceae

Diospyros virginiana L. Persimmon. See figure 11, D.

Seeds collected near Kansas City, fall of 1918; planted Nov. 12, 1918, in greenhouse; germinated March 25, 1919, 95 per cent.

Seeds collected near Clemson, South Carolina, fall of 1918; stratified out of doors; planted in greenhouse, March 8, 1919. Germinated March 28, 1919, 95 per cent.

Hypocotyl when first appearing, arched, bringing the seed up with it, as it straightens. The cotyledons gradually emerge as the seed coat is thrown off. Growth of seedling rapid, hypocotyl

elongating to six inches or more; in color reddish to purplish green. Cotyledons elliptical, shining, smooth above and below, short petioled, margins incurved. First leaves lanceolate, smooth above, and below, green, nearly opposite. Root long, straight, with a number of lateral roots. Roots all dark-colored.

GENTIANALES

Oleaceae

Fraxinus americana L. White ash.

Seeds collected on campus, Iowa State College, 1918; stratified out of doors; planted in greenhouse, March 8, 1919. Germination percentage low.

Germination epigealous. Hypocotyl smooth, purplish. Cotyledons linear-lanceolate, elongated, lower surface slightly hairy. Epicotyl smooth, purplish, green. First pair of leaves simple, ovate-lanceolate, pale green, somewhat glaucous below, pubescent on midrib, darker green above, margins with hairs, dentate; slightly petioled, buds in axils of each leaf. Stalk between first and second pair of leaves yellowish, resinous. Second pair of leaves petioled, pubescent on margin when they unfold. Third leaves just as they push out, yellowish, granular.

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