

1928

## Germination Studies of Some Trees and Shrubs, 1928

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GERMINATION STUDIES OF SOME TREES AND  
SHRUBS, 1928

L. H. PAMMEL AND C. M. KING

The studies for the spring of 1928 are a continuation of previous work and constitute the eleventh contribution to the series. In the present paper seedlings of twenty-three species of plants are described, the germination periods noted, and the seedlings figured. These plants include both native and introduced forms. The seeds were contributed by Arnold Arboretum and other sources, many being the collections of the senior author in the field.

*Pinaceae*

- Pinus echinata* Mill. Yellow Pine
- Pinus heterophylla* (Ell.) Sudworth, Slash Pine, Cuban Pine
- Juniperus phoenicia* L.
- Notes on other conifers

*Casuarinaceae*

- Casuarina equisetifolia* Forst., Australian Pine

*Salicaceae*

- Salix longipes* Shuttleworth

*Trochodendraceae*

- Cercidiphyllum japonica* Sieb. and Zucc.

*Anonaceae*

- Asimina triloba* Dunal, Papaw

*Berberidaceae*

- Berberis circumserrata* Schneid., Derrah
- Barberry

*Rosaceae*

- Spiraea Henryi* Hemsl., Henry's Spiraea
- Exochorda racemosa* Rehd., Pearl Bush
- Malus Sieboldii* Rehd.

*Leguminosae*

- Parkinsonia aculeata* L., Jerusalem Thorn
- Caragana Borsii* Schneider, Pea-tree

*Celastraceae*

- Celastrus articulatus* Thunb., Japanese
- Bittersweet

*Vitaceae*

- Vitis Berlandieri* Planch., Berlandier's Grape

*Malvaceae*

- Hibiscus syriacus* L., Shrubby Althaea, Rose of Sharon

*Caricaceae*

- Carica Papaya* L., Florida Papaw

*Flacourtiaceae*

- Flacourtia indica* Merr., Batoka Plum

*Rhizophoraceae*

- Rhizophora Mangle* L., Mangrove

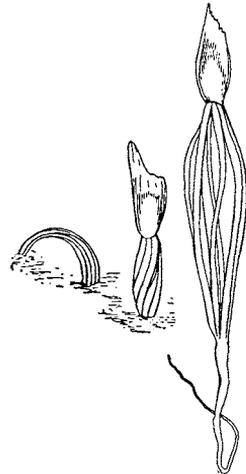


Fig. 1. Seedling of *Pinus echinata* Mill., Yellow Pine, showing emergence of cotyledons. Drawn by C. M. King

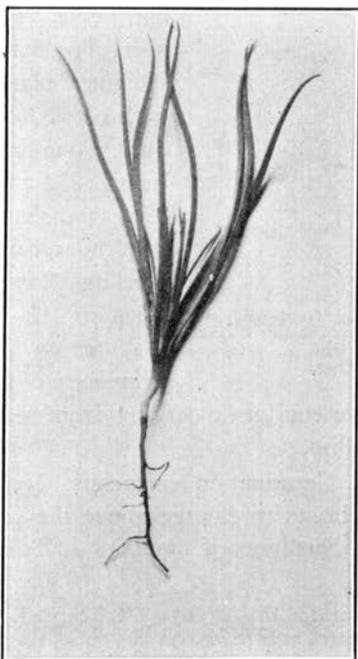


Fig. 2. Seedling of *Pinus echinata* Mill., Yellow Pine. Photo by Photo Section, Ia. Agr. Exp. Sta.

*Oleaceae*

- Fraxinus americana L., White Ash
- Fraxinus nigra Marsh, Black Ash
- Ligustrum acutissimum Koehne

*Verbenaceae*

- Callicarpa japonica Thunb., French Mulberry

*Labiateae*

- Elsholtzia Stauntoni Benth., Elsholtzia

*Solanaceae*

- Solanum Bahamense L., Shrubby Solanum

*Pinaceae*

*Pinus echinata* Mill., Yellow Pine.

Seeds sent by I. E. Forbes, Baton Rouge, February 10, 1928. Planted in the greenhouse February 14, 1928. Germination epigeaeous. Cotyledons rising in a compact cluster from the soil, bringing seed coat up on the tip, March 6. Taking erect position with seed coat on the tip, March 8. Seed coat slipped off March

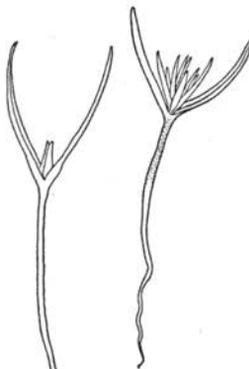
15. Cotyledons seven to nine, glaucous-green. Margins of early leaves furnished with minute trichomes or slightly serrate.

*Pinus heterophylla* (Ell.) Sudworth, Slash Pine, Cuban Pine.

Seeds sent by I. E. Forbes, Baton Rouge, Louisiana, February 10, 1928, and planted in the greenhouse February 14. Germinated April 1, germination epigeaeous. Height of seedling two inches. Cotyledons seven, glaucous-green. Hypocotyl green, slightly darkened by red.



Fig. 3. Seedling of *Pinus heterophylla* (Ell.) Sudw., showing cotyledons. Drawn by C. M. King.



*Juniperus phoenicia* L.

Planted in greenhouse January 9, 1928. March 1, three germinating. Germination epigeaeous. Cotyledons two, vivid dark green,

Fig. 4. Seedling of *Juniperus phoenicia* L. A and b, showing cotyledons and early leaves. Drawn by C. M. King.

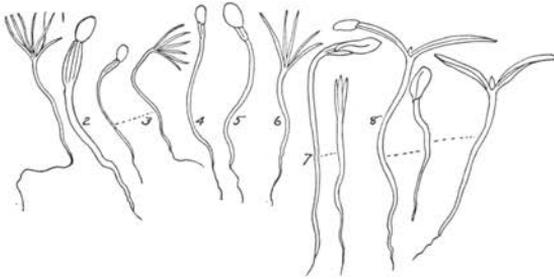


Fig. 5. Seedlings of some Conifers emerging from seed coat. 1. *Picea pungens*; 2. *Pinus ponderosa*; 3. *Picea excelsa*; 4. *Pinus sylvestris*; 5. *Pinus austriaca*; 6. *Abies Douglasii*; 7. *Abies concolor*; 8. *Biota orientalis*. Drawn by C. M. King.

flat, acute. Hypocotyl reddish. Height of plant, with cotyledons only, one-half inch. Early leaves awl-shaped, slender. Succeeding leaves acicular.

*Notes on the germination of*

*some conifers.*—Seedlings of some conifers emerging from seed coats. (Seeds furnished by D. E. Bliss.)

Seeds planted March 27, 1928. Germination epigeaeous. Seedlings of numbers 1, 2, 3, 5 and 6 began to emerge above the soil April 9, continuing until April 23. Seedlings of numbers 4, 7 and 8 were three days later.

<i>Pinus ponderosa</i> Doubl.	germinated in 13 to 26 days ; 6 to 7 cotyledons
<i>P. sylvestris</i> L.	germinated in 17 to 26 days
<i>P. austriaca</i> Höss	germinated in 13 to 26 days ; 6 cotyledons
<i>Abies Douglasii</i> Carr	germinated in 13 to 26 days ; 5 cotyledons
<i>Abies concolor</i> Lindl. and Gord.	germinated in 17 to 27 days ; 6 cotyledons
<i>Picea pungens</i> Engelm.	germinated in 13 to 26 days ; 7 cotyledons
<i>Picea excelsa</i> Link	germinated in 13 to 26 days ; 6 to 7 cotyledons
<i>Biota orientalis</i> L.	germinated in 17 to 27 days ; 2 cotyledons

Note—*Pinus canariensis* C. Smith. Seedling of this pine in one year attained height eight inches; two young lateral shoots have appeared.

*Casuarinaceae*

*Casuarina equisetifolia* Forst, Australian Pine.

Fruits collected at Canal Point, Florida, February 8, 1928, by L. H. Pammel. The seed is compressed, bearing a wing. Planted in the greenhouse February 16, germinated March 1. Germination epigeaeous. Hypocotyl one inch in length, portion above ground bright red. Cotyledons oval, sessile, about one line long, fleshy bright green.

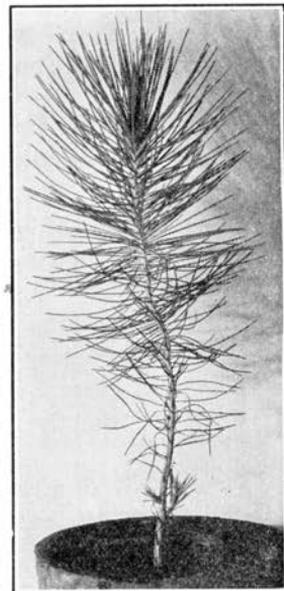
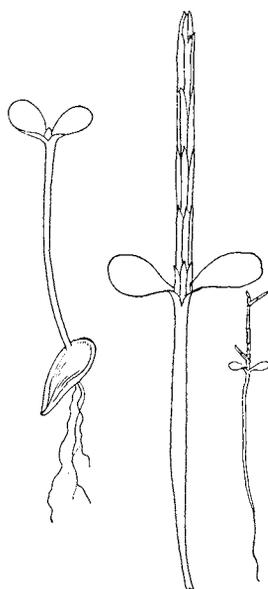


Fig. 6. *Pinus canariensis* C. Smith. One year old seedling, showing branching. Photo by Photo Sect. Ia. Agr. Exp. Sta.



April 20, the plant with five successive whorls of leaves lying close to the stem, blackish at tip. Height one inch. Color dark reddish green. After a series of nodes have developed side shoots appear.

*Description of larger seedling.*— Found in school yard, Canal Point, planted by Prof. Speer. Early stages not seen. Plant six inches high. Root brownish, branches brownish with thin corky ridges ending in pointed scales (resembling *Equisetum*) at the nodes. These scales awl-shaped, greenish turning to brown. These minute scales are the modified leaves in whorls; foliage leaves wanting.

*Salicaceae*

*Salix longipes* Shuttleworth.

Fig. 7. Seedling of *Casuarina equisetifolia* Forst, Australian Pine, showing (a) cotyledons; (b) cotyledons and young shoot; (c) manner of branching. Drawn by C. M. King.

Catkin with ripened seeds immediately following bloom. Seeds collected fifteen miles west of Palm Beach, February 11, 1928. Planted in greenhouse Feb. 28, 1928.

Seedling cotyledons above ground March 1. Germination epigeaeous. Hypocotyl erect pale, three millimeters long. Cotyledons oval-oblong, petiolate, with indistinct midrib, pale, smooth, one line in diameter. Leaves simple, alternate. Seeds germinated readily in wet cotton.

*Germination of Salix longipes* Shuttleworth. — Collected on green plants February 12, 1928, between Belle Glade and West Palm Beach, fifteen miles west of West Palm Beach. Placed in petri dish with peat soil, ordinary room temperature. Germination February 15. Capsules turned from green to black. Germination epigeaeous. Cotyledons slightly curved at first, soon straightening. Cotyledons small, fleshy, green above, paler beneath. Radicle pale in color. Epicotyl paler than cotyledon. Plumule not evident at this stage. Germination free.

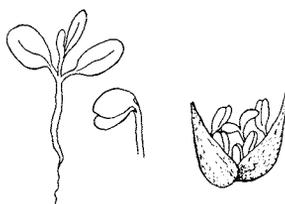


Fig. 8. *Salix longipes* Shuttleworth, seedling at two stages and cluster of germinating seeds within envelope of the old flower. Drawn by C. M. King.

*Temperatures*

Feb. 13 max. 81° min. 61°		Germinations in peat soil, Feb. 18, 9
Feb. 14 max. 83° min. 62°		Feb. 19, 10
Feb. 15 max. 86° min. 66°		Feb. 20, 14
Feb. 16 max. 89° min. 59°		
Feb. 17 max. 87° min. 63°		Plumule appeared Feb. 18, 6 days

Fruits placed in incubator February 12, 1928, and held at temperature below room temperature; placed in moist cotton. One seed only germinated on third day. Capsule became mouldy, interfering with germination. Temperature, maximum 78°, minimum 73°. Germination February 18, 6; 20, 15; 21, 20; 22, 21; 24, 22.

Germination in soil in petri dish: February 21, 17; 22, 18; 23, 22; 24, 22; 27, 22; March 1, 22.

Plumule evident only as a small point. Seedlings appear stronger in peat than in cotton.

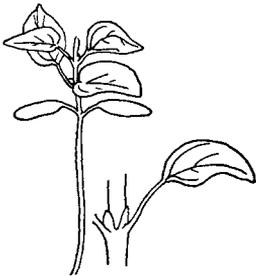


Fig. 9. Seedling of *Cercidiphyllum japonica* Sieb. and Zucc., showing cotyledons and first node. Drawn by C. M. King.

*Trochodendraceae**Cercidiphyllum japonica* Sieb. and Zucc.

An introduced oriental plant. Seeds from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Germinated March 20. Germination epigeaeous. Hypocotyl about three-fourths inch long above the surface, smooth, reddish. Cotyledons narrow elliptical, round, truncate to emarginate, petiolate, bright green above, paler beneath. First and second internodes very short, one-eighth inch. Leaves opposite;

first pair of leaves ovate, cordate at base, obtuse, slightly crenately notched on margins. Smooth, pale on under side. Distinctly pinnately-veined. Second pair of leaves like the first pair, larger; leaves with prominent sheathing stipules pale in color. Successive leaves less cordate. Foliage bright green.

*Anonaceae**Asimina triloba* Dunal, Papaw.

Seeds received from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Germinated April 1. Germination epigeaeous. Hypocotyl reddish brown, swollen at upper end, becoming green. First leaf small, ovate, pointed, entire. Petiole hairy. Leaves alternate. No stipules. Root large and strong.

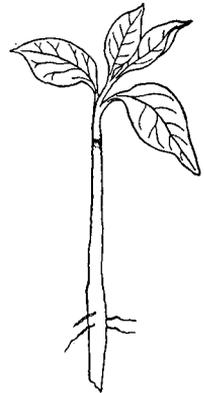


Fig. 10. Seedling of *Asimina triloba* Dunal, Papaw, showing cotyledons and early leaves. Drawn by C. M. King.

*Berberidaceae*

*Berberis circumserrata* Schneid.

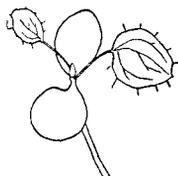


Fig. 11. Seedling of *Berberis circumserrata* Schneid., Derrah Barberry, showing cotyledons and first two leaves. Drawn by C. M. King.

A native of northwest China. Seeds from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Germinated March 1. Germination epigeaeous. Hypocotyl terete. Cotyledons roundish elliptical, narrowed into the petiole. Leaves simple, alternate, stipulate, petiolate. First leaf three-fourths inch in diameter, broadly ovate to roundish spinous-serrate. Petiole about as long as the leaf, broadened at the base.

*Rosaceae*

*Spiraea Henryi* Hemsl. Henry's Spiraea.



Fig. 12. Seedling of *Spiraea Henryi* Hemsl. Henry's Spiraea, showing cotyledons and early leaves. Drawn by C. M. King.

Seeds from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Germinated March 1. Germination epigeaeous. Hypocotyl erect, terete, pale green. Cotyledons small, petiolate, pale green, elliptical, about one-eighth inch in length. Leaves alternate. First leaf simple, cuneate, petiolate, exstipulate; one distinct notch on each side near tip. Second leaf. Second and third leaves cuneate and coarsely serrate toward the tip. Stem becoming wiry or woody. Later leaves ovate, obtuse, doubly serrate, nerves distinct; early leaves trinerved; young seedling makes rapid growth, at two months has woody stem and stands eight inches high.

*Exochorda racemosa* Rehd.

Ornamental introduced from China. Seeds received from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Germinated freely February 5 to 10, 1928. Germination epigeaeous. Hypocotyl terete, reddish above ground, length one and one-half inches. Upper portion pubescent. Cotyledons round oval, one-third inch in length, strongly auricled at base. Narrowing into petiole one-eighth inch in length. Cotyledons green, fleshy, surface slightly rugose. First internode one-sixteenth inch in length. Leaves simple, alternate. First leaf obovate, smooth,



Fig. 13. Seedling of *Exochorda racemosa* Rehd., Pearl Bush, showing cotyledons and early leaves. Drawn by C. M. King.



Fig. 14. Seedling of *Exochorda racemosa* Rehd., showing cotyledons and early leaves. Photo by Photo Section, Ia. Agr. Exp. Sta.

about seven strong serrations on the outer half of the margin. Petiolate with a pair of very slender dark colored stipules. Second leaf as first, length one-third inch, serrate beyond the middle. Succeeding leaves similar, but larger. Height of plant four weeks old, one inch.

*Malus Sieboldii* Rehd.

Seeds from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Germinated February 23. Germination epigealous. Hypocotyl one and one-half inches in length. Part above ground reddish, woody, one-half inch in length. Cotyledons roundish oval, broadly auricled, dark green, smooth, one-third inch in length. Petioles short, flattened.



Fig. 15. Seedling of *Malus Sieboldii* Rehd. showing cotyledons and early leaves. Drawn by C. M. King.

First leaf oval-lanceolate, serrate, smooth, pale beneath, pinnately nerved. Petiole grooved above, stipules slender, small, dark. Leaves alternate. Height of plant one inch, breadth one and one-half inches. Succeeding leaves larger, all leaves deeply three-lobed, margins closely serrate. Foliage dark green, stem and veins reddish.

*Leguminosae*

*Parkinsonia aculeata* L., Jerusalem Thorn.

A small tree from Arizona and Mexico. Introduced into Florida. Escaped at Key West and Belle Glade. Seeds collected February 10, 1928, by L. H. Pammel at Belle Glade. Planted in greenhouse February 15. Germinated March 14.

Germination epigealous. Hypocotyl one inch above soil. Cotyledons oval, about one inch long, fleshy, with well marked veins and very short petiole.

Leaves alternate, pinnately compound. First and second leaves with twelve leaflets, the third with eighteen leaflets. Leaflets oval, nearly sessile, leaf stalk flattened, winged; stipules

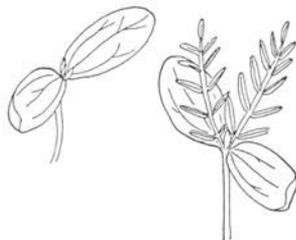


Fig. 16. Seedling of *Parkinsonia aculeata* L., Jerusalem Thorn, showing seed leaves and first two leaves. Drawn by C. M. King.

at base of compound leaf. Foliage dark green. Later leaves bipinnate, with many leaflets. The germination of this species has been described by Francis Ramaley.<sup>1</sup>

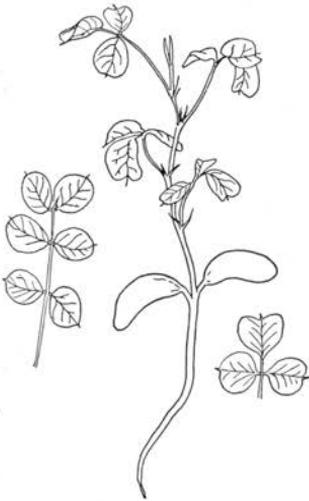


Fig. 17. Seedling of *Caragana Boisii* Schneider, Pea Tree, showing cotyledons and early leaves. Drawn by C. M. King.



Fig. 19. Seedling of *Celastrus articulatus* Thunb., Japanese Bittersweet, showing cotyledons and early leaves. Drawn by C. M. King.

*Caragana Boisii* Schneider, Pea-tree.  
 Seeds from Arnold Arboretum January 10, 1928. Germinated freely January 30. Germination epigealous. Hypocotyl

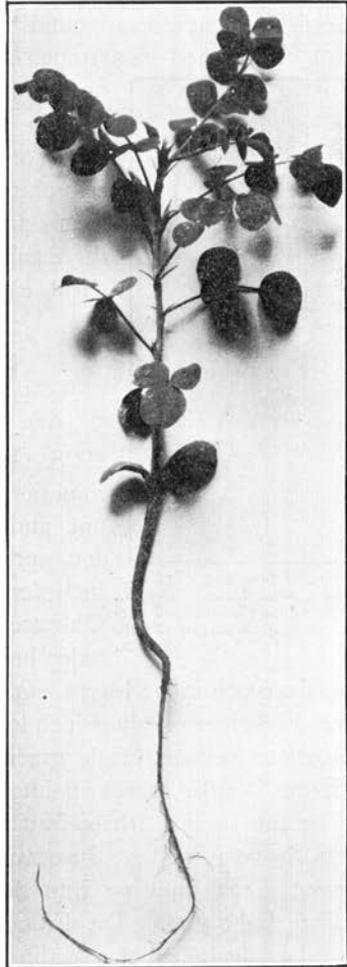


Fig. 18. Seedling of *Caragana Boisii* Schneider. Photo by Photo Section, Ia. Agr. Exp. Sta.

about one and one-half inches long, terete, smooth, pale green above ground. Cotyledons deep green, fleshy, broadly elliptical, one-fourth by one-half inch in size. Short petiolate. The two sides of the cotyledons not quite symmetrical. First internode one-half inch long, pale green, smooth; first three or four leaves compound, three round leaflets, each one-fourth inch across, petiole one-

<sup>1</sup> Seedlings of Certain Woody Plants. Minn. Bot. Studies Pt. II, Feb. 22, 1899, p. 73, pl. I.

half inch long, stipules narrow pointed, slender. Leaflets, one terminal, two lateral; the fourth or fifth leaf with four lateral and one terminal leaflets; fifth or sixth leaves with six lateral leaflets. Successive leaves compound with lateral leaflets only, leaf stalk being terminated in a spine. Leaflets notched, minutely pubescent on margins and veins. Stalklets very short. Midrib ending in slender spine. The third leaf (or fourth in another seedling) with two pairs of lateral leaves, a spine at tip of rachis taking place of a leaf. Fourth leaf three pairs of leaflets. At two months a small shrub eight inches high.

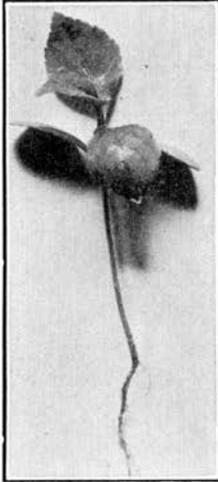


Fig. 20. Seedling of *Celastrus articulatus* Thunb., showing cotyledons and early leaves. Photo by Photo Section, Ia. Agr. Exp. Sta.

*Celastraceae*

*Celastrus articulatus* Thunb.

Seeds from Arnold Arboretum January 5, 1928. Planted in greenhouse, January 10, 1928. Germinated February 23, 1928. Germination epigeaeous. Hypocotyl terete, green, one and one-half inches in length. Cotyledons spreading, leaflike, oblong, three-fourths inch long. Obtuse to slightly emarginate. Obscurely pinnately veined. Smooth, green, paler below. First node of stem very short,

one-sixteenth inch; leaves, simple, alternate. First leaf one-half inch long, ovate, lanceolate, serrate, bright green, smooth. Stipules slender, green, pointed. Height of plant about three-fourths inch; breadth two inches. Successive leaves longer. Leaf tapering into the petiole, foliage light green. Dr. Francis Rameley<sup>2</sup> has described the seedlings of *Celastrus*.



Fig. 21. Seedling of *Vitis Berlandieri* Planch., Berlandier's Grape, showing cotyledons and early leaves. Drawn by C. M. King.

*Vitaceae*

*Vitis Berlandieri* Planch.

Seeds sent from Arnold Arboretum January 5, 1928. Planted in the greenhouse, January 10. First germination March 2; germination epigeaeous. Epicotyl reddish above. Cotyledons obovate, smooth, entire; petiole more than half as long as the leaf. Leaves alternate. First leaf simple, cordate, coarsely dentate,

<sup>2</sup> Minn. Bot. Studies. Second series. Pl. II, p. 76.

palmately veined, veins light in color; leaf lighter beneath. Petiole, lower midrib and margins slightly hairy. Delicate stipules present. Second leaf like the first. The germination of *Vitis* has been described by Francis Ramaley.<sup>3</sup>

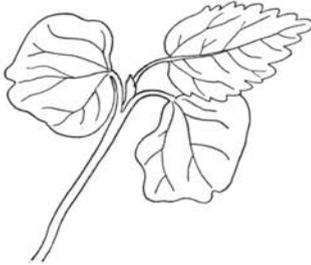


Fig. 22. Seedling of *Hibiscus syriacus* L., Shrubby Althaea, showing cotyledons and first leaf. Drawn by C. M. King.

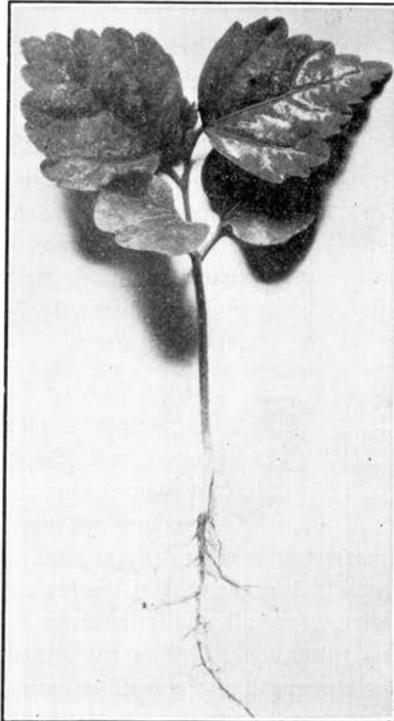


Fig. 23. Seedling of *Hibiscus syriacus* L., showing cotyledons and first two leaves. Photo by Photo Section, Ia. Agr. Exp. Sta.

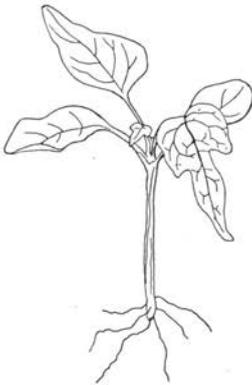


Fig. 24. Seedling of *Carica papaya* L., Florida Papaw, showing cotyledons and first three leaves. Drawn by C. M. King.

*Malvaceae*

*Hibiscus syriacus* L., Shrubby Althaea, Rose of Sharon.

A hardy flowering shrub, originating in eastern Asia. Seeds collected at Lexington, Tennessee, by L. H. Pammel, January 5, 1928. Planted in greenhouse January 10. Germinated freely January 31. Germination epigeaeous. Described February 29. Root system well developed, strong tap root. Hypocotyl, length two and one-half inches, terete, upper portion pubescent, color above ground bright green. Cotyledons orbicular notched at apex, about three-fourths to five-eighths inch across. Smooth, green on under side. Petioles one-third inch long, pubescent. Leaves alternate, simple. First leaf

<sup>3</sup> Minn. Bot. Studies, Second Series. Pl. II, p. 78.

ovate lanceolate, one inch in length, petiole one-half inch in length, pubescent. Margin rather coarsely crenate beyond the first third of the leaf length. Margin and veins, both sides of leaf, pubescent. Later leaves large, general shape triangular, cordate at the base. Petiole and under side of leaves hairy.

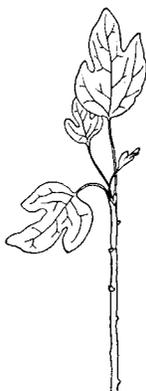


Fig. 25. Young shoot of *Carica Papaya* L., showing scars on stem, where early leaves have dropped off. Drawn by C. M. King.

#### *Caricaceae*

*Carica Papaya* L., Papaw or Papaya.

Seeds collected at Canal Point, Florida, by L. H. Pammel, February 2, 1928. Planted in greenhouse February 16, 1928. Germinated April 1. Germination epigealous. Cotyledons leafy, petioled, pinnate-veined, oval in shape, leaves alternate. First leaf ovate lanceolate, length one inch, margin entire, tip obtuse. Second leaf cordate at base, distinctly 3-lobed or deeply notched. Foliage light green.

*Carica Papaya* L., Florida Papaw.

Young plants picked up in the garden of Prof. Speer, Canal Point, Florida, February 7, 1928. Root white, conical, somewhat fleshy; a taproot. Cotyledons not seen. Stem green, leaves alternate, the earlier ones soon dropping off, leaving a conspicuous scar with a small bud in the axil of the leaf. Seedling seven inches in height. Twelve leaves all small, distinctly 3-lobed, mid-vein and two lateral veins prominent. Leaves smooth above and below. Petiole about the same length as the leaf, smooth. Stem smooth.

#### *Flacourtiaceae*

*Flacourtia indica* Merr., Batoka Plum.

Seeds collected at Canal Point, Florida, February, 1928, by L. H. Pammel. Planted in the greenhouse February 18, 1928. Germinated April 1. Germination epigealous. Epicotyl pale. Cotyledons auricled, fleshy dark green, about one inch each way. Leaves petioled, oval; alternate.

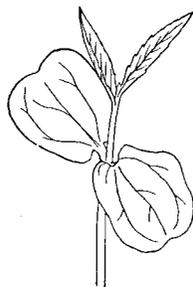


Fig. 26. Seedling of *Flacourtia indica* Merr., Batoka Plum, showing cotyledons and early leaves. Drawn by C. M. King.

#### *Rhizophoraceae*

*Rhizophora Mangle* L., Mangrove.

Germination takes place on the tree. Observed February 7, 1928, fifteen miles north of Palm Beach. The fruit is of brownish color, about one and one-

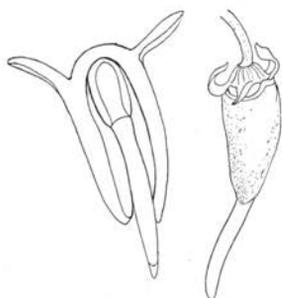


Fig. 27. *Rhizophora Mangle* L., Mangrove fruit, showing emerging radicle; fruit in section, showing early stage of seedling with elongated descending radicle. Drawn by C. M. King and L. H. Pammel.

half inches in length. Calyx tube obovate, with four fleshy persistent sepals. As the embryo develops the radicle pushes out at the apex of the fruit. In seedling observed, this radical was two inches in length. It attains in growth a length of several inches, and upon separation from the fruit the seedling falls and becomes fixed in the soft soil below; the upper portion of the seedling then develops.

*Oleaceae*

*Fraxinus americana* L., White Ash.

Seeds sent from Columbus, Ohio, from J. H. S., January 1, 1928. Planted in the greenhouse January 10. Germinated February 20 to 25. Germination epigeaeous. Hypocotyl terete, two and one-half inches in length, part above ground reddish green. Cotyledons linear, rounded at tip, two inches in length, midvein prominent, bright green above, paler beneath, smooth. Epicotyl line in length, bright green. First pair of leaves opposite, simple, ovate lanceolate, acute serrate, smooth; succeeding leaves the same. Leaves opposite.

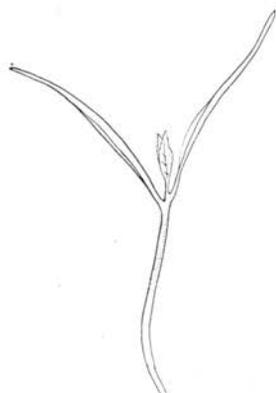


Fig. 28. Seedling of *Fraxinus americana* L., White Ash, showing cotyledons and early leaves. Drawn by C. M. King.

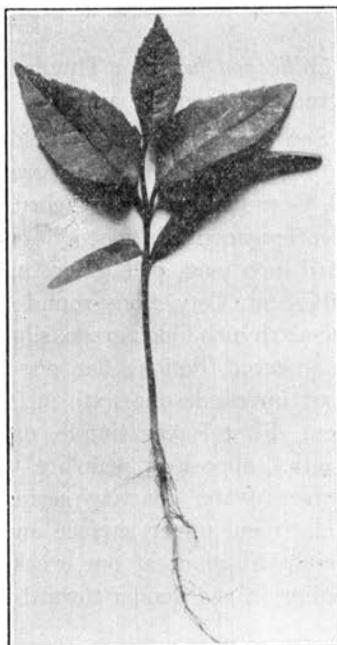


Fig. 29. Seedling of *Fraxinus americana* L., showing cotyledons and early leaves. Photo by Photo Section, Ia. Agr. Exp. Sta.

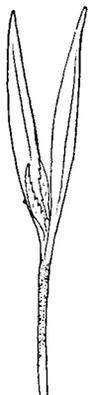


Fig. 30. *Fraxinus nigra* Marsh, Black ash. Drawn by C. M. King.

*Fraxinus nigra* Marsh, Black Ash.

Young seedlings collected in the field, under trees, April 28, 1928, at Ames, by L. H. Pammel. Hypocotyl pale below, reddish green above. Cotyledons about one inch long, narrowly lanceolate, smooth above and below. First two leaves simple, opposite; serrate, ovate. Petioles slightly pubescent.

*Ligustrum acutissimum* Koehne.

Seeds received from Arnold Arboretum January 5, 1928. Planted in the greenhouse January 10. Germinated April 1. Germination epigaeous. Seed coat lifted out of cotyledon.

Hypocotyl smooth, pale. Cotyledons ovate, smooth leathery, one-half inch long. First pair of leaves opposite, entire, obovate, rather fleshy. Stipules not present. Succeeding leaves like the first.

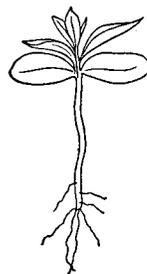


Fig. 31. Seedling of *Ligustrum acutissimum* Koehne, showing cotyledons and early leaves. Drawn by C. M. King.

*Verbenaceae*

*Callicarpa japonica* Thunb., French Mulberry. A shrubby plant introduced from Japan.

Seeds received from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Germination began February 22. Germination epigaeous. Hypocotyl erect, terete, one-third inch long, pale green, upper part slightly pubescent. Cotyledons round ovate, marginate, one-sixth inch long; green, slightly hairy. Faintly 3-nerved. Petioles flat, one-eighth inch long. First internode one-sixth inch in length, pubescent. First leaves simple, one-fourth inch in length, opposite, petiolate, stipules absent. Leaves ovate, coarsely serrate toward lower half, green, upper surface and margins hairy. Height of plant at one week, one inch. Succeeding leaves slender toward the tip.

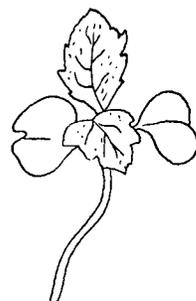


Fig. 32. Seedling of *Callicarpa japonica* Thunb., French Mulberry, showing cotyledons and first two leaves. Drawn by C. M. King.

*Labiatae*

*Elscholtzia Stauntoni* Benth.

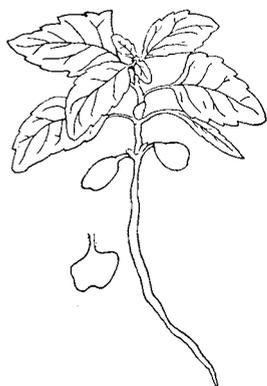


Fig. 33. Seedling of *Elscholtzia Stauntoni* Benth., *Elscholtzia*, showing cotyledons and early leaves. Drawn by C. M. King.

An introduced plant in the southern states, from China. Seeds from Arnold Arboretum January 5, 1928. Planted in greenhouse January 10. Free germination January 30. Germination epigeaeous. Hypocotyl terete, erect, one-half inch in length, tinged with red. Finely pubescent. Stem green, pubescent, soon square. First internode one-fourth inch long. First pair of leaves opposite, ovate, lanceolate, about one-half inch long, margins with three serrations on each side, pubescent, lighter below. Petioles grooved. Second pair of leaves one-half inch in length, leaves distinctly punctate below, pubescent to hairy above, strongly pinnate-nerved. Stipules absent. Leaves have mint-like taste and odor. Height of the plant at six weeks, two inches. Makes rapid growth; at three months plant four inches in height, with woody stem and strong lateral branches, and free bloom of tubular lavender colored flowers.

*Solanaceae*

*Solanum Bahamense* L., Shrubby *Solanum*.

Seeds sent from southern Florida by L. H. Pammel, February 17, 1928. Planted in the greenhouse February 24. Germinated March 20. Germination epigeaeous. Hypocotyl above ground reddish, about three-fourths inch in length. Cotyledons slender, lanceolate, acuminate, tapering toward the petiole. Petiole short. Cotyledons bright green, fleshy, about one-eighth inch long, with hairs on margins and upper midrib, and plumule clothed with colorless glandular hairs. First leaf one inch long, petiolate, ovate acute, hairy. Leaves alternate.

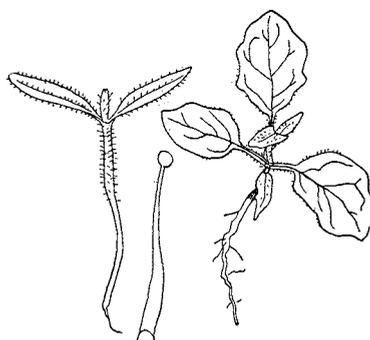


Fig. 34. Seedling of *Solanum Bahamense* L., Shrubby *Solanum*, showing cotyledons, early leaves and glandular trichome. Seedling with several leaves. Drawn by C. M. King.