Babes of the Woods—Woody Plant Seedlings

By E. LAURENCE PALMER

This is the seventy-fifth of NATURE MAGAZINE'S *special educational inserts.*

AT FIRST it was planned to make this spring insert a general seedling number. Then it developed that there were so many interesting seedlings that some division was to be desired. Accordingly, we favored writing this number on the seedlings of woody plants, or the babes of the woods, leaving to a later number similar treatment of the seedlings of herbaceous plants. It is possible that this number may stimulate some readers to learn for themselves how the seedlings of their native herbaceous plants look. With the coming of this spring both the reader and the writer of this article can start systematically more seriously to study this aspect of Nature.

There are a few good publications dealing with the seedlings of plants, but the best one concerned with woody plants is undoubtedly Miscellaneous Publication Number 654, prepared by the Forest Service of the U.S. Department of Agriculture. Its title is *Woody Plant Seed Manual*, and we have leaned heavily on this publication in the preparation of this insert. Because of the expense, and because of its technical nature, it is unlikely that many readers of *Nature Magazine* would have access to this book. This insert may serve as a substitute, in part at least.

We do not intend here to say much about the technical characters of seeds and of seedlings, but we must point out that many of the current high school texts indicate that the authors do not understand the differences between seeds and fruits. When we eat string beans we eat fruits. When we eat lima beans we usually eat only seeds. The basis of a fruit is usually the pistil of the flower, while the basis of the seed is the ovule. According to this, despite what you may read in some texts, a kernel of corn is a fruit and the often-studied bean that we bake is a seed. One can hardly draw homologies between two structures so different as a fruit and a seed.

To help keep the record straight, in this insert we have started off with each unit by stating whether the reproductive unit that breaks from the mother plant to start a new individual plant is a seed or a fruit. According to this, the reproductive unit of maple, elm, hackberry, cherry and ash are all fruits, while the reproductive unit of horse chestnut, witch hazel and catalpa are true seeds, or either in the case of the horse chestnut. It seems to be more usual for woody plants to have a fruit rather than a seed as the reproductive unit despite the fact the term seed is commonly applied to the fruit by many foresters, naturalists and Nature writers.

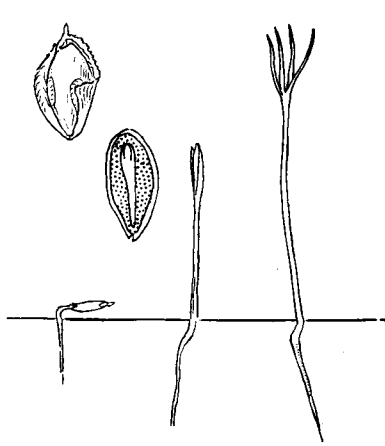
A major difference in seeds may lie in the presence of food inside the seed but outside the embryo. The next few pages will show how greatly plants vary in this respect. The food outside the embryo is normally considered as endosperm, but we avoided use of this word in treating the individual plants. The embryo plant in the seed may be straight, coiled, folded or even twisted, and these variations help in describing seeds accurately.

The embryo plant may be conspicuous because of what some call the seed-leaves, or cotyledons. Usually these structures look somewhat like leaves, but more commonly carry stored food that gives the young plant a lift in its early days. As the plant gains independence these cotyledons tend to disappear, either by dropping off or by being considerably reduced in size and importance. The number of cotyledons may have some significance. In most of our broad-leaved trees there are two cotyledons, while in the pines and their relatives there are more. There are relatively few woody plants in which the seed has but one cotyledon. Palms and sweet brier, which are monocotyledonous, are not here treated. The shape and thickness of the cotyledons may sometimes help to identify a seedling. The deeply lobed cotyledons of basswood are most easily recognized. Many seedlings look much like other seedlings, but in the early stages the old seed coat frequently may be found. Under these circumstances one should examine a seedling with great care before attempting to decide what it may be. We admit that our illustrations sometimes show little differences between closely related species. The likenesses may be as significant as the differences in the study of plants in their early stages.

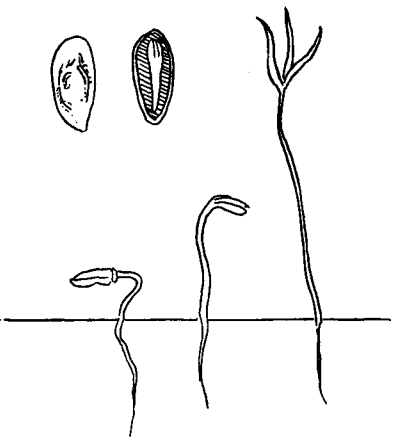
Some readers may wish to make controlled studies of the germination of the seeds of various common woody plants. If the seeds are wrapped in damp cloths and kept where it is normally reasonably warm one may expect a seed to germinate. Then you can see for yourself what the nature of the differences may be.

Because of heavy seed coats some seeds germinate poorly. If the seeds are soaked a short time in sulphuric acid, or in hot water, germination may be hastened. Again, if a hard seed coat is scratched with a file, or even by a sand blast, germination may be hastened by helping air and water to get to the young plant inside the seed.

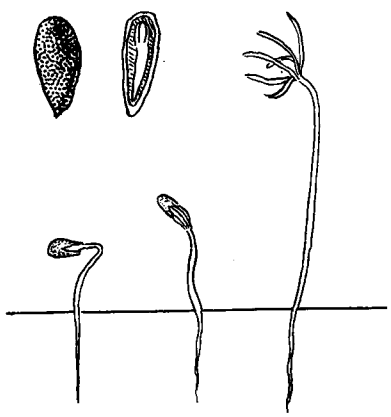
Even after germination, which may be low, there is usually a high mortality rate in the earlier stages of our trees. Shade, thinning, watering, and control of fungi and of insect pests, may hold an interest for many students of seedlings. Even man recognizes a unique food value in the seedlings of some plants. Bean sprouts are favorites in Chinese dishes, for example. In a sense a seedling is the last gasp of the preceding generation to start a new generation. The food stored in the cotyledons of the embryo plant, or in the endosperm outside the embryo but inside the seed, was developed by the preceding generation and most of this strength is exhausted in giving the new seedling the ability to survive.



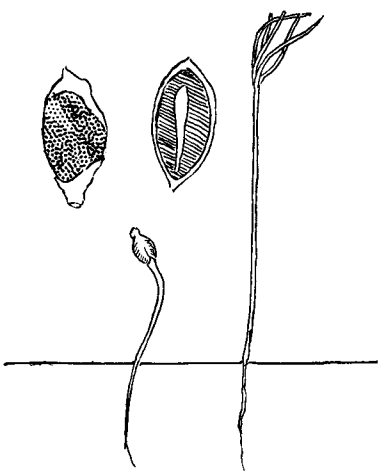
BALSAM FIR, Seedlings after two, five and seven days.



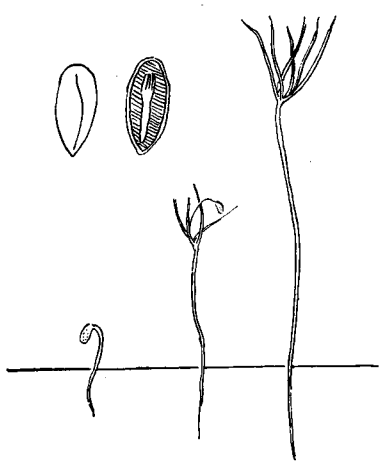
HEMLOCK, Seedlings after two, four and seven days.



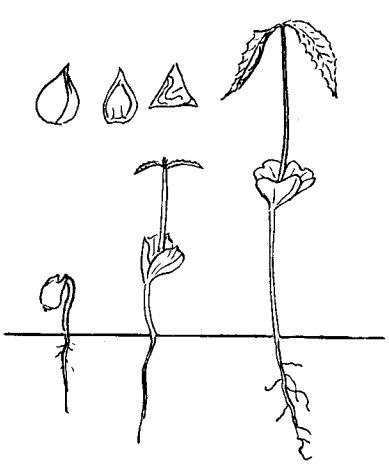
SPRUCE, Seedlings after two, five and seven days.



LARCH, Seedlings at one and eight days.



RED PINE, Seedlings after one, seven and thirty days.



BEECH, Seedlings after two, five and seven days.

BALSAM FIR

Abies balsamea

Reproductive unit: Seeds, about 1/5-inch long, with wings from fruit tissue, shed by wind in September to November; about 60,000 per pound of cleaned seed. Good crop every 2 to 4 years. Some food stored outside embryo.

Germination: Practice to stratify in sand at 41°F. for 3 months. May be fall-sown, or, if stratified, in spring. Germination begins in 10 to 35 days at to 33% if spring-sown. Needs protection, and thinning to 60-80 per sq. ft.

Seedling: Seed above ground. Seedling to 1 inch at 2 days; to 1½ inch, in 1 week. About 4 cotyledons show.

HEMLOCK

Tsuga canadensis

Reproductive unit: Seeds, about 1/5-inch long, with wings from fruit tissue, shed by wind, September through winter, with good crop every 2 to 3 years; about 180,000 per pound. Some food stored outside the embryo.

Germination: Practice to stratify and spring sow or to broadcast in fall. Germination about 30% in 2 to 3 months, if stratified in moist sand at 41°F. Should be shaded, at least at first. Few diseases, but may damp-off.

Seedling: Seed above ground. Seedling to 1 inch at 2 days; to 2 inches, at 1 week. Three or more cotyledons show.

COLORADO SPRUCE

Picea pungens

Reproductive unit: Seeds, about ⅛-inch long, with small wing from fruit tissue, shed by wind in fall and winter, with good crop usually each year; about 100,000 per pound. Some food stored outside the embryo.

Germination: Usually broadcast in fall or drilled to yield 75 usable seedlings per square foot, buried about ¼ inch; about 73% germination 2 weeks after spring planting.

Seedlings: Need protection from rodents and birds, and soil should be treated with sulfuric acid or aluminum sulfate to limit damping off. Seed above ground. Seedlings to 1 inch in 2 days; to 1½ inch, in 1 week; with 6 or more cotyledons.

AMERICAN LARCH

Larix laricina

Reproductive unit: Seeds, about 1/5-inch long with wing from fruit tissue, wind distributed after September, with good crop every 5 to 6 years; about 300,000 per pound. Food stored abundantly outside the embryo.

Germination: Stored in dark in sealed containers at 32-50°F. seeds live 3 to 4 years, or even to 6, with average germination about 50%; sown in fall, should be covered with burlap and to ¼ inch of soil, thin to 50-75 per sq. ft.

Seedlings: Bring seed above ground and show 5-6 cotyledons, reaching to 2 inches in about 1 week.

RED PINE

Pinus resinosa

Reproductive unit: Seed, to under 1/5-inch long, oval but pointed at one end. Seeds shed from fall through following summer, with good crops every 3 to 7 years; about 50,000 per pound. Food stored outside embryo.

Germination: Usually germinate easily without special treatment at about 75%, usually sowing about 6 ounces per 100 square feet of seed bed, with germination in 10 to 40 days in spring sowing, or may delay 2 years.

Seedlings: May be attacked by a European needle disease. Seed well above ground as shown. Many cotyledons.

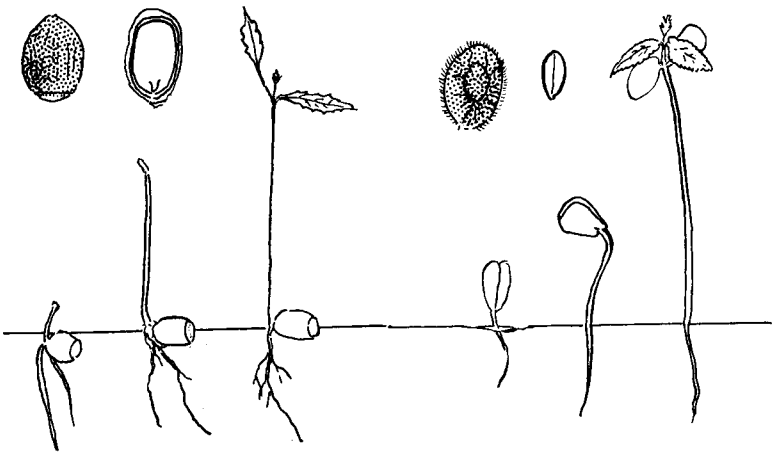
BEECH

Fagus grandifolia

Reproductive unit: Small nut, a fruit, to ¾-inch long, 3-sided, light brown, shining, averaging 1600 per pound. Shed after first heavy frost, with major crops every 2 to 3 years. No food outside the embryo, which is folded.

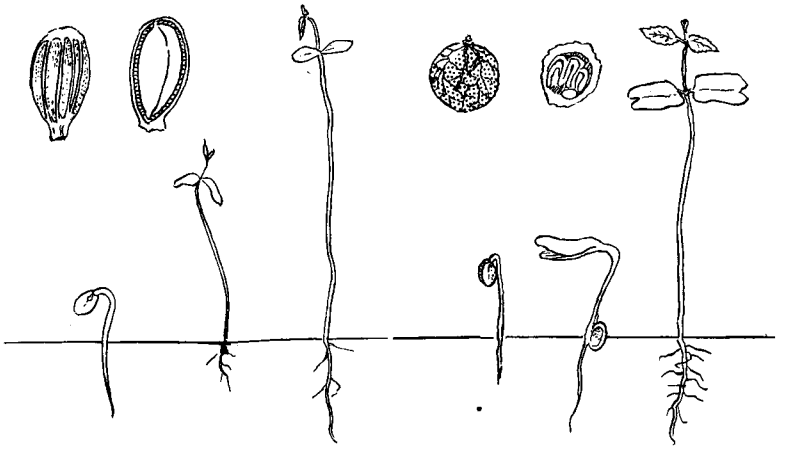
Germination: Stored in sealed containers at 34°F. to 41°F., remain alive through winter, with average germination of about 40% after about 5 months, but capable with treatment of to over 90%. Need protection against rodents.

Seedlings: With seed above ground, with fluted cotyledons broad and notched and to 6 inches high in 1 week.



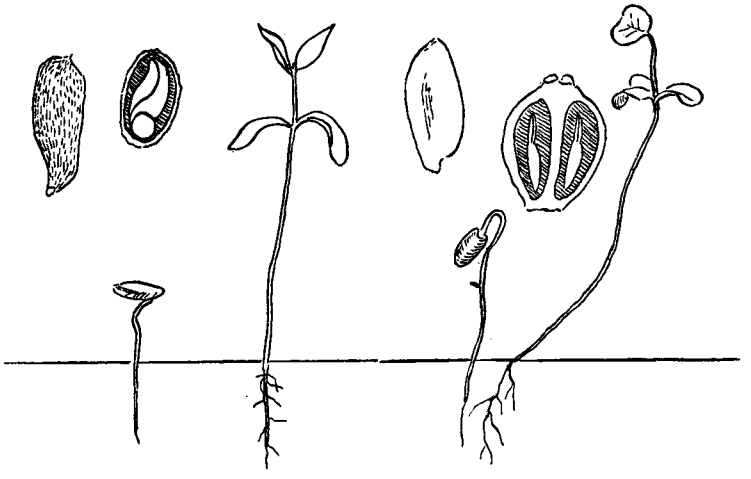
MOSSY-CUP OAK, Seedlings after one, five and twelve days.

ELM, Seedlings after one, three and twenty-one days.



HOP HORNBEAM, Seedlings after two, twenty-two and twenty-seven days.

HACKBERRY, Seedlings after one, two and five days.



OSAGE ORANGE, Seedlings after one and eight days.

JAPANESE BARBERRY, Seedlings after one and ten days.

MOSSY-CUP OAK

Quercus macrocarpa

Reproductive unit: Acorn, a fruit containing 1 seed, to 2 inches long and 1½ inches wide, shed in August and September, with good crops every 2 to 3 years; about 75 per pound, 2 years to mature. No food outside embryo.

Germination: Need protection from animals. Germination may begin a month after reaching ground, and averages 45%, but with treatment may be increased.

Seedlings: Seed remains at or just under ground surface. Vigorous tap-root. Shoot may reach height of 4 inches 2 weeks after germination begins, with a pair of true leaves reasonably developed. Cotyledons remain hidden.

AMERICAN ELM

Ulmus americana

Reproductive unit: Winged fruit, a samara, with wing surrounding seed-bearing portion, shed by wind, maturing from March to June, 1 month after flowering, with good crops each year; 68,000 per pound. No food outside the embryo. Eaten by birds and rodents.

Germination: Average 60%, but may be raised to over 90%. May germinate 1st or 2nd springs. May damp-off.

Seedlings: May reach to 2½ inches in 3 weeks. Two blunt, broad cotyledons with slightly shallowly notched tip. First leaves much like those of mature trees.

HOP HORNBEAM

Ostrya virginiana

Reproductive unit: One-seeded fruit, a nutlet, to 1/3-inch long and to ⅛-inch wide, contained in a bladder, usually one of a group forming hop-like cluster, shed usually August through early winter. About 30,000 per pound, with about 2 pounds per bushel of bladders. No food outside embryo.

Germination: Stored over winter at 41°F. Germination may be to 90% if stored in moist sand 2 months at about 70°F., 6 months at 50-77°F. and 3 months at 41°F.

Seedlings: Seed borne above ground. Two broad cotyledons becoming narrow but broadest near tips, to 1/3-inch long. Seedlings, to 2½ inches high in 4 weeks, when leaves show.

HACKBERRY

Celtis occidentalis

Reproductive unit: Egg-shaped, thin-fleshed, cherry-like fruit, contain ng bony nutlet containing 1 seed, with folded cotyledons and little food outside embryo. About 2000 per pound of fruits; 4000 per pound of cleaned seed.

Germination: Fall-sown seeds may germinate at 40% following spring, more quickly if surrounding pulp is crushed and if stored in moist sand at 41°F. for 2-3 months.

Seedlings: Seed remains at ground level but 2 folded cotyledons are raised high, showing notched tips. Cotyledons, to 1 inch long; seedlings, to 5 inches in 1 week.

OSAGE ORANGE

Maclura pomifera

Reproductive unit: About 80 orange-sized green fruits to a bushel, yield about 24,500 seeds weighing about 14,000 to the pound. A small amount of food material surrounds the folded embryo. Fruits are shed in fall and winter.

Germination: Stored in sealed, air-tight containers at 41°F. cleaned seeds may live 3 or more years, but usually germination takes place first spring at about 58%.

Seedling: Cotyledons borne above ground, with seedling reaching height of to 4 inches in a week. In nurseries, are grown in rows 1 foot apart. Strong taproot.

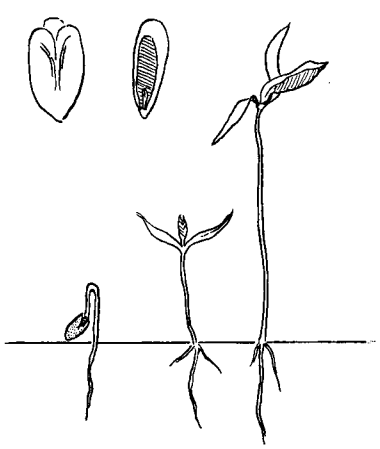
JAPANESE BARBERRY

Berberis thunbergii

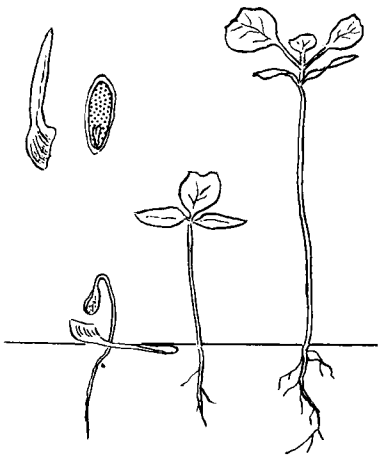
Reproductive unit: Fruit bearing 1 to 2 seeds, a bright red berry ripening in late summer and dropping through fall and winter. Cleaned seeds weigh about 27,000 to the pound. Abundant food stored outside straight embryo.

Germination: Begins first spring on dry soil, with about 90% germination to be expected in germinators kept at about 55°F. for nights and 75°F. for days for 40 days.

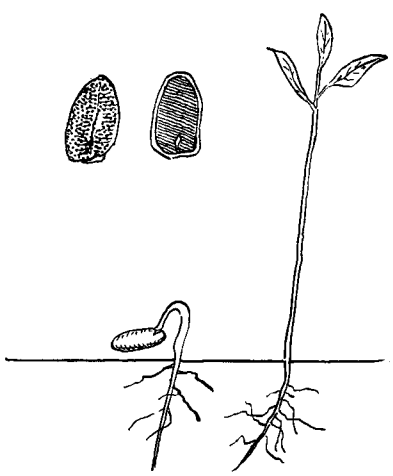
Seedling: May suffer from damping-off disease Cotyledons borne high above ground, rather broad and blunt. Seedling reaching to 4 inches in 2 weeks normally.



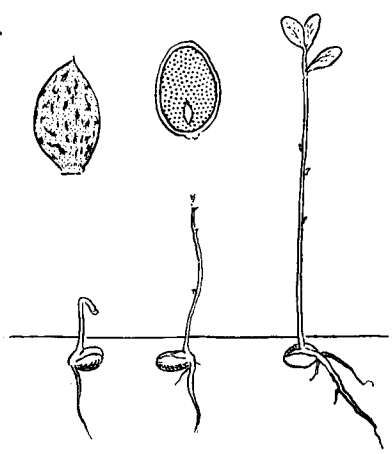
MAGNOLIA, Seedlings after one, thirteen and thirty-one days.



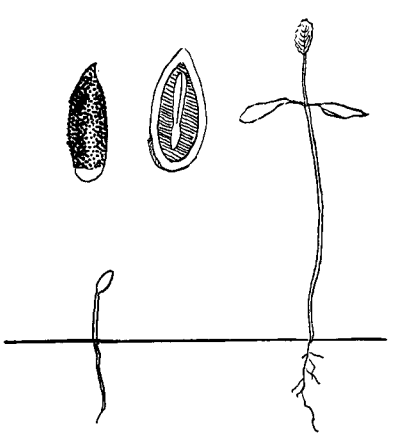
TULIP TREE, Seedlings after one, eighteen and forty-six days.



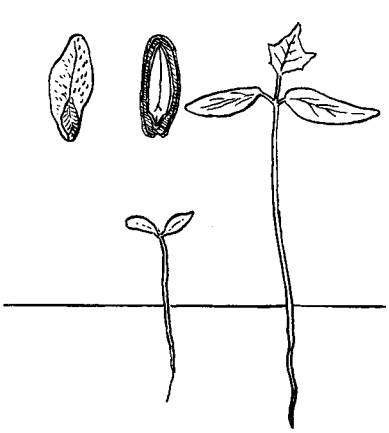
PAWPAW, Seedlings after nine and eighteen days.



SPICEBUSH, Seedlings after two, three and ten days.



WITCH HAZEL, Seedlings after one and twenty-one days.



SWEETGUM, Seedlings after two and thirty days.

MAGNOLIA

Magnolia acuminata

Reproductive unit: Dark red, smooth, 1/3-inch fruit bearing seeds about ½ inch long that are somewhat cherry-like with soft oily outer portion. About 4600 cleaned seeds to the pound. Much food outside embryo.

Germination: With special care to prevent freezing and stored 5-6 months germination may be to 40% or slightly higher on average. Live scratched seeds show green scratches in 2-3 days if kept on moist blotting paper.

Seedling: Seed borne above ground, releasing rather long cotyledons (to 1 inch). Height, to 3 inch in 1 month.

TULIP TREE

Liriodendron tulipifera

Reproductive unit: A winged fruit (samara) with wing at angle to seed-bearing portion, a part of a conelike fruit. About 100 units per cone weighing 14,000 to the pound. Abundant food stored outside small straight embryo.

Germination: Dry stored seeds average about 5% in germinative ability due probably to low fertility and viability. In nursery, seeds sown at 50-75 per linear foot.

Seedling: Cotyledons borne above ground, to about ⅔-inch long, rather bluntly pointed, to 3 inches high in 4 weeks. First leaves broad and notched at tip.

PAWPAW

Asimina triloba

Reproductive unit: Brown to black fleshy berry to 6 inches long and to 1½ inches wide, bearing several flattened, 1-inch long, shining, brown seeds weighing, when cleaned, about 700 per pound. Much food outside small embryo, which is inverted.

Germination: Begins late summer of year following ripening of fruit, or year later with average of treated seeds about 60%. Stratification in moist sand at 50°F. for 100 days may stimulate.

Seedling: Seed borne above ground and dropped at 2 weeks. Height, to 5 inches in 3 weeks.

SPICEBUSH

Lindera benzoin

Reproductive unit: Fruit, cherry-like, 1-seeded, red, maturing September-October. Cleaned seed about 4500 to the pound, with 100 pounds of fresh fruit yielding 15-20 pounds of seed. Abundant food outside small embryo.

Germination: Stored in moist sand at 77°F. for 2-4 weeks, followed by 3-4 months at 41°F. produced seeds that should germinate 75% in 2-3 weeks.

Seedling: Seed remains under ground yields seedling 1-inch high in 2 days; 2 inches, in 3, and to 5 inches, in 10 days.

WITCH HAZEL

Hamamelis virginiana

Reproductive unit: Shining black seeds with light areas at larger end expelled in late fall following previous year's flowering. Seeds weigh about 10,000 to the pound. Abundant food stored outside slender, straight embryo.

Germination: Germination may be 1st or 2nd spring following shedding of seeds. Good results from stratifying 2 months nights at 68°F. and days at 86°F. may yield to 80% germination.

Seedling: At 3 weeks, cotyledons may be to 1 inch long and seedlings to 3 inches high.

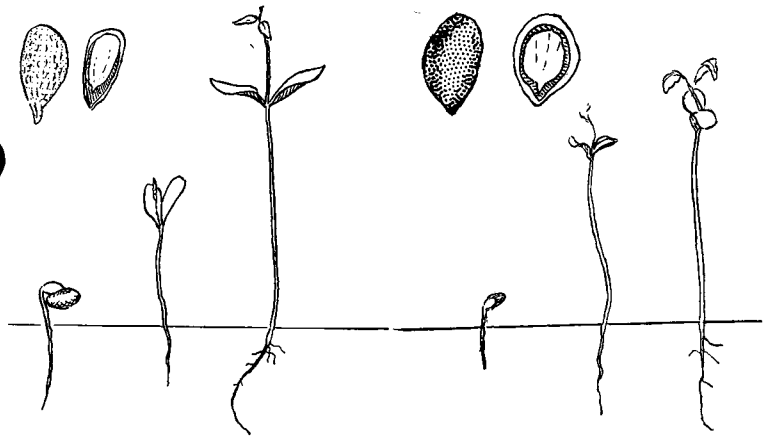
SWEETGUM

Liquidambar styraciflua

Reproductive unit: Brown, spherical clusters to 1½ inches through, expel long-winged wafers to¼-inch long the wing adding another ¼ inch. Seeds are shed September-November with good crop about every 3 years. 82,000 cleaned seed per pound. Some food outside embryo.

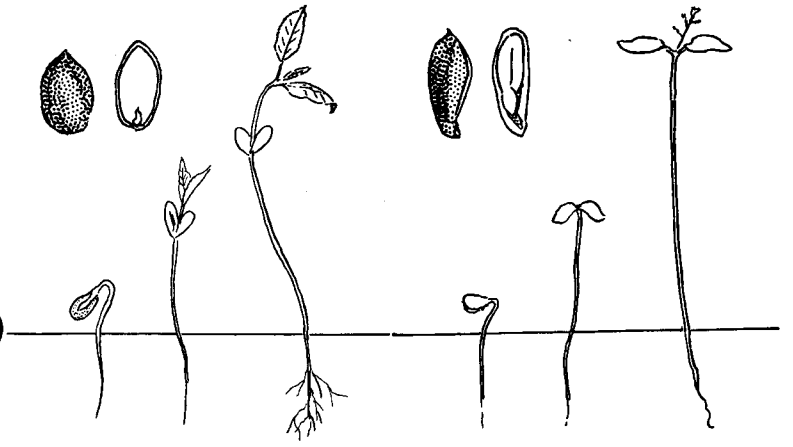
Germination: 7-8 seeds per fruit, may be stored year at low temperatures. Germination about 70%, but in practice may be 50% in 20 days in South in winter.

Seedling: Two cotyledons, each about 1 inch long. Seedling, to 3 inches high in 1 month with first leaves.



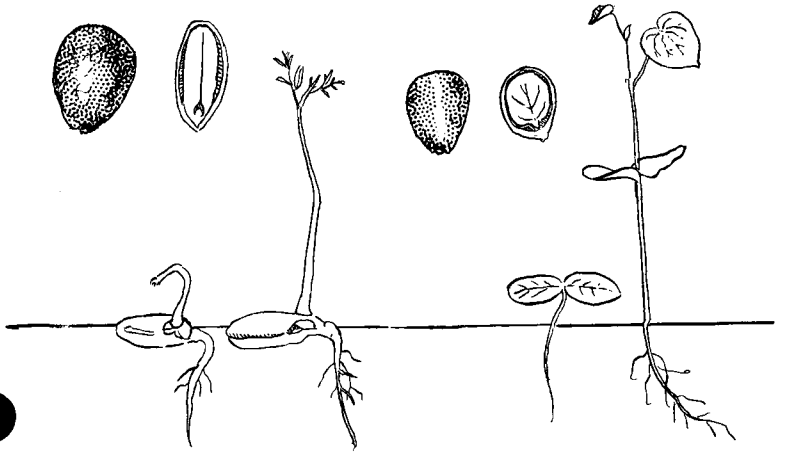
PEAR, Seedlings after one, three and twelve days.

APPLE, Seedlings after one, nine and sixteen days.



CHOKECHERRY, Seedlings after one, three and eleven days.

MOUNTAIN ASH, Seedlings after one, three and twenty-nine days.



KENTUCKY COFFEE TREE, Seedlings after two and five days.

REDBUD, Seedlings after four and thirty days.

PEAR

Pyrus communis

Reproductive unit: Well-known fleshy fruit yielding pointed seeds, to about ½-inch long, weighing cleaned seeds at 15,000 per pound, with 100 pounds of fruit yielding about 1 pound of seed. Some food outside large embryo.

Germination: Seed stratified in moist sand 45 days at 50°F. may average 65% germination while untreated may be about 1%. Ordinarily difficult to germinate.

Seedling: Seed and cotyledons forced above ground and in 1 week seedling may be to 2 inches high with 1st true leaves showing. Cotyledons persist 2 weeks.

APPLE

Pyrus malus

Reproductive unit: Well-known fleshy fruit bearing in core pointed brown seeds, 4-10 per fruit. About 20,000 cleaned seeds per pound, with 100 pounds of fruit yielding under 1 pound of seeds. Some food outside the embryo. Embryo large and straight.

Germination: Dormant seeds may be revived in moist sand at 32-50°F. for 1-3 months with this varying in related species.

Seedling: Seed raised above ground becoming free of cotyledons in about 2 days. Height of seedling to 3 inches in 2 weeks when true leaves have appeared.

CHOKE-CHERRY

Prunus virginiana

Reproductive unit: Well-known cherry with hard pit and soft surrounding flesh, which disintegrates or may stimulate food value affecting preservation. Fruits cleaned down to pit weigh nearly 6000 to the pound. Little food outside large embryo.

Germination: Common practice to stratify seeds from 3-5 months at 41°F. giving an average germination of 43%, but plant not commonly cultivated.

Seedling: Seed lifted above ground to a height of 3 inches in 3 days, when true leaves appear. May reach 6-inch height in 10 days.

MOUNTAIN ASH

Sorbus americana

Reproductive unit: Juicy red fruit maturing early fall and shed fall and winter. Seeds stout, horn-shaped, about 130,000 to the pound. Some food outside the embryo, which is large, straight, with root towards pointed end of seed.

Germination: Forced germination by stratification in moist sand at 41°F. for 3 months may yield to 33% germination after 11 months.

Seedling: Seed and cotyledons above ground, with 1st leaves showing in 3 weeks at height of 2 inches.

KENTUCKY COFFEE TREE

Gymnocladus dioica

Reproductive unit: Stout pods, to 10 inches long, bearing 3-6 seeds to ¾ inches long, dull, dark brown and hard. Matures in fall, but on tree until spring. 100 pounds of pods yields 30-50 pounds of cleaned seeds weighing 275 per pound. Small amount of food outside embryo.

Germination: Storage cold and dry for over year is recommended. 5 minutes in hot water at 195°F. and scratch with file may yield 75% germination in 1 month.

Seedling: Seed remains at surface of earth and seedling may reach 4-inch height in 5 days.

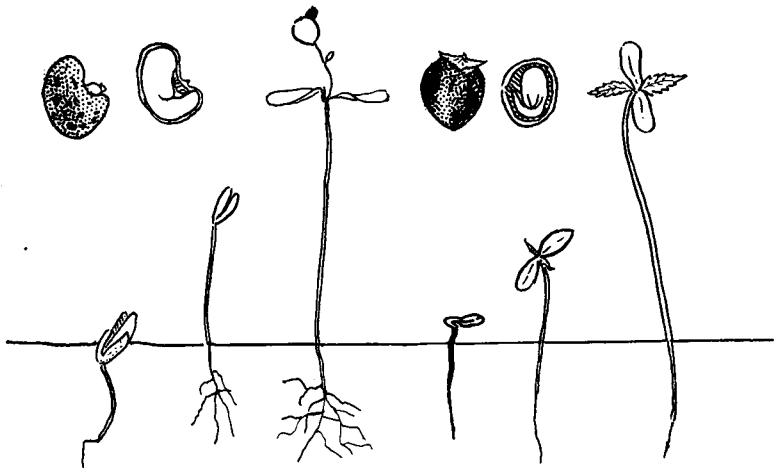
REDBUD

Cercis canadensis

Reproductive unit: Thin, 3-inch pods, shed in fall of blooming year, with heavier crops in alternate years yield small, hard, dark seeds at 25 pounds of seed to 100 pounds of pods, or 18,000 seeds per pound. Rather abundant food outside embryo.

Germination: Seed soaked in hot water, or scratched, or 30 minutes in sulfuric acid followed by 2 months' stratification at 41°F. may yield 75% germination.

Seedling: Broad cotyledons, to 1-inch long borne above ground. 1-month seedling about 3 inches high.

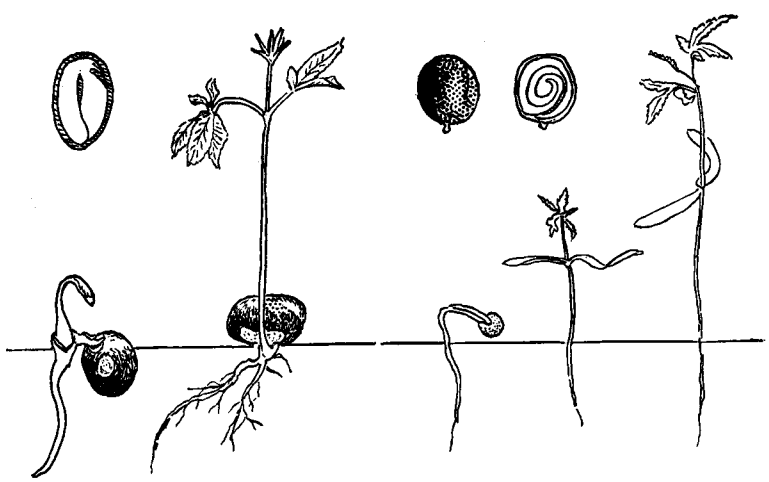


BLACK LOCUST, Seedlings after one, three and eight days.

STAGHORN SUMAC, Seedlings after two, four and seventeen days.

BITTERSWEET, Seedlings after one, five and thirty-nine days.

SUGAR MAPLE, Seedlings after one, seven and forty-three days.



HORSE CHESTNUT, Seedlings after two and four days

VARNISH TREE, Seedlings after one, three and five days.

BLACK LOCUST

Robinia pseudoacacia

Reproductive unit: Flat pods bearing many hard seeds shed seeds in fall and winter. 100 pounds of fruits yield about 20 pounds of seeds averaging 25,000 to the pound and bearing no food outside the embryo.
Germination: Germination of about 70% can be effected by soaking in hot water, or sulfuric acid, the water at 212°F for to 5 minutes and acid to 2 days at 70°F.
Seedlings: Cotyledons above ground to 1 inch high in 1 day and to 2 inch high with 1st leaves at 1 week. Cotyledons broad, blunt and becoming thin.

STAGHORN SUMAC

Rhus typhina

Reproductive unit: Red, sour, hairy, cherry-like unit containing 1 hard seed. Usually distributed by animals in fall and winter. 30,000 fruits per pound yielding seeds at 53,000 per pound. No food outside embryo to any great extent.
Germination: Soaked in sulfuric acid for an hour or scratched may increase germination to 40%, but it may be as low as 4% normally or abnormally up to 90%.
Seedling: Seed and cotyledons borne above ground, with seed coat on one cotyledon. Cotyledons, to 1 inch.

BITTERSWEET

Celastrus scandens

Reproductive unit: Fruits ripen in fall, freeing red seeds 4-8 per fruit, weighing nearly 30,000 per pound and borne in reasonable abundance each year. Some food stored outside straight, large-cotyledoned embryo.
Germination: Stored 20 months in sealed jar at 41°F. gave 9% germination spring of first year and .2% in fall. Potential germination to 90%. Sow seed in winter.
Seedling: Seed and cotyledons borne above ground, to 3 inches high at 10 days and first leaves at 1 month at 4-inch height.

SUGAR MAPLE

Acer saccharum

Reproductive unit: Winged fruit, a samara, bearing a single seed shed in late fall abundantly every 3-7 years. Cleaned seeds not fruits average about 22,000 per pound. Little food outside wrinkled embryo.
Germination: Stratified in moist sand at 40°F. for 2 months germination may be about 40%, but a month at 68°F. by night and 86° by day is recommended for tests.
Seedling: Wrinkled and folded cotyledons bear seed above ground and become free in about 1 week, when 1st leaves appear. May reach 5-inch height in 6 weeks.

HORSE CHESTNUT

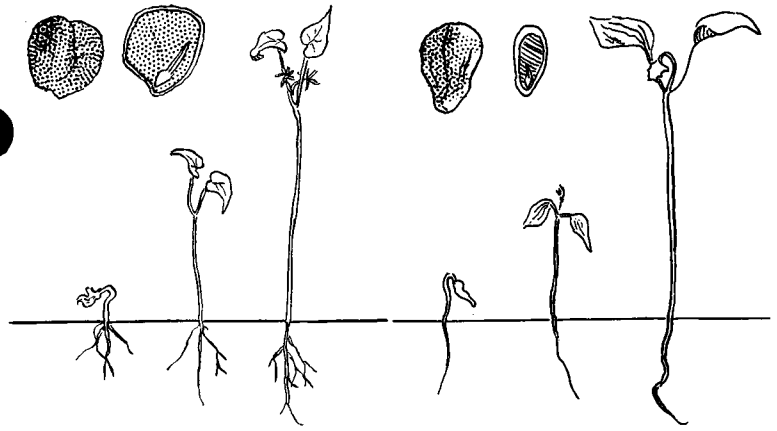
Aesculus hippocastanum

Reproductive unit: A soft, coarsely spined fruit that breaks in fall to free 2-3 seeds, which are to over 1 inch in diameter, dark brown, with large light scar. About 100 seeds to the pound. Little food outside the coiled embryo.
Germination: Seeds do not survive drying but stored at 40°F. at low humidity viability may drop from 90 to 29% in 5 months. Better to seal and keep at about 32°F.
Seedling: Seed and cotyledons remain at ground surface, appearing in early spring and by 4 days may reach height of 4 inches and show 2 sets of true leaves.

VARNISH TREE

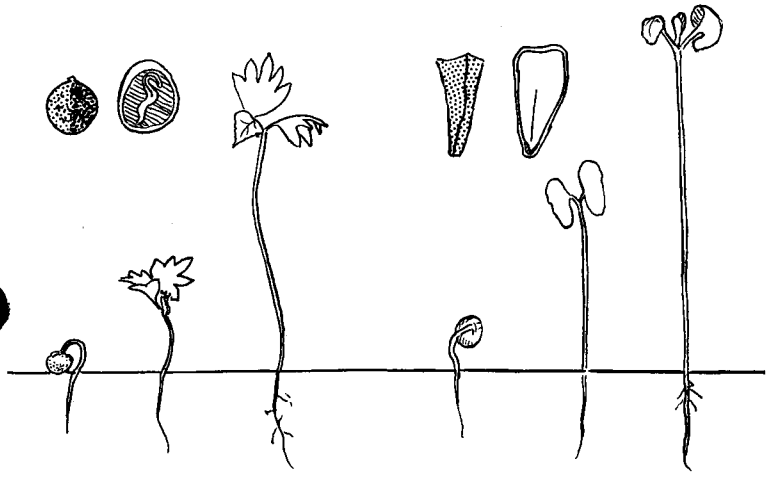
Koelreuteria paniculata

Reproductive unit: Bladdery capsules borne in abundance each year bear 3 round black seeds that number about 3000 to the pound. Should be collected in September and October. Little food outside coiled embryo.
Germination: Seeds stored in sealed jars at 40° to 90°F. showed 15% germination at end of 10 years. Normally treated with sulfuric acid 1 hour or with hot water and scratched may in moist sand show 41% in 90 days.
Seedling: Seed borne aloft on uncoiled cotyledons to 1 inch at 1 day; to 4 inches, at 3 days when true leaves appear.



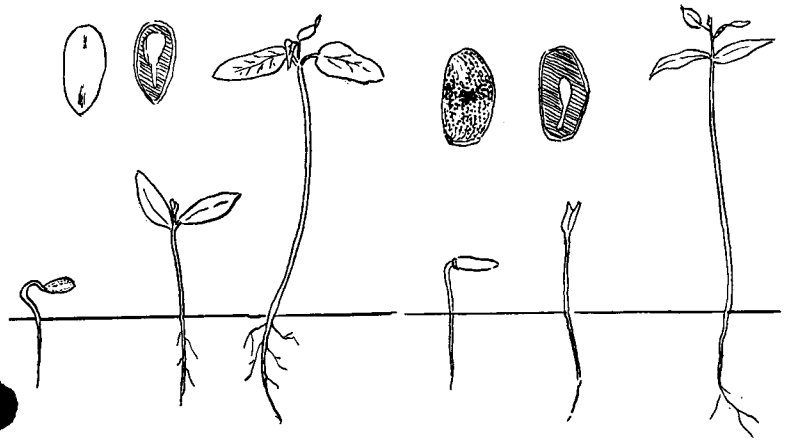
WOODBINE, Seedlings after one, three and twenty-two days.

WILD GRAPE, Seedlings after two, four and seventeen days.



BASSWOOD, Seedlings after one, three and nineteen days.

EUCALYPTUS, Seedlings after one, eight and forty-two days.



FLOWERING DOGWOOD, Seedlings after three, eight and thirty-one days.

PERSIMMON, Seedlings after four, six and eight days.

WOODBINE

Parthenocissus quinquefolia

Reproductive unit: Blue, berry-like fruits, ¼ inch in diameter bearing 1-3 seeds ripening in fall. 100 pounds of fruit yield 25 pounds of seeds averaging 19,000 to the pound. Small straight embryo and abundant food outside.

Germination: Takes place spring following falling of fruit or may be delayed. Stratification in moist sand for 2 months at 41°F. may hasten the average 70% germination.

Seedling: Seed and cotyledons borne above ground. Cotyledons somewhat heart-shaped. Seedling height to 3 inches in 3 days and true leaves appear in about 3 weeks.

WILD GRAPE

Vitis riparia

Reproductive unit: A blue berry, juicy and sour, ripened from September to November and shed through fall and winter, to 3/8 inches in diameter and bearing to 4 seeds. 100 pounds of fruit yield to 12 pounds of seed averaging 15,000 per pound. Food outside large embryo.

Germination: Little loss of life in seeds stored 26 months at 41°F. with average germination 82% if seeds are stratified 4 months in sand at 41°F. Sow in fall.

Seedling: Seed and seedlings borne above ground by seedling that at 4 days may bear leaves at 2-inch height.

BASSWOOD

Tilia americana

Reproductive unit: Fruit, a wing-borne bunch of spherical nut-like capsules that contain 1-4 seeds. 100 pounds of fruit yield 75 pounds of clean seed averaging 5000 to the pound. Contorted embryo embedded in much yellow food.

Germination: Stored at room temperatures and kept dry will remain alive 2 years or at lower temperatures longer. Average germination 30% tested 2 months in sand at 65°F.

Seedlings: Seed and cotyledons borne above ground. Cotyledons deeply 5-lobed. At 3 days, seedling-is to 2 inches high; at 2 weeks, 2½ inches with first leaves.

EUCALYPTUS. BLUE-GUM

Eucalyptus globulus

Reproductive unit: Woody capsule, to 1 inch through yields from 3-6 valves small, angular brown seeds weighing 138,000 to the pound in spring. Embryo with twisted cotyledons. Without food outside embryo.

Germination: Stratified seed in moist sand to 2 weeks at 65°F. should yield 75-80% germination.

Seedling: Seed and broad-blunt cotyledons borne above ground, reaching in 1 week height of to 4 inches and 1st true leaves in about 6 weeks from start of germination.

FLOWERING DOGWOOD

Cornus florida

Reproductive unit: Cherry-like fruit, to ¼-inch in diameter, usually containing 2 seeds, borne to ripen in fall, with good crop every other year. 100 pounds of fruit yield 37 pounds of clean seed to 4500 per pound. Embryo, t aight, well surrounded with food.

Germination: 10-12 weeks in damp sand at 41°F. recommended treatment. In tests, germination may be about 35%. Seeds sown in fall or stratified and sowed in spring usually.

Seedling: Seed and cotyledons borne above ground, reaching height of 3 inches in a week and to 4 inches in a month when true leaves have appeared.

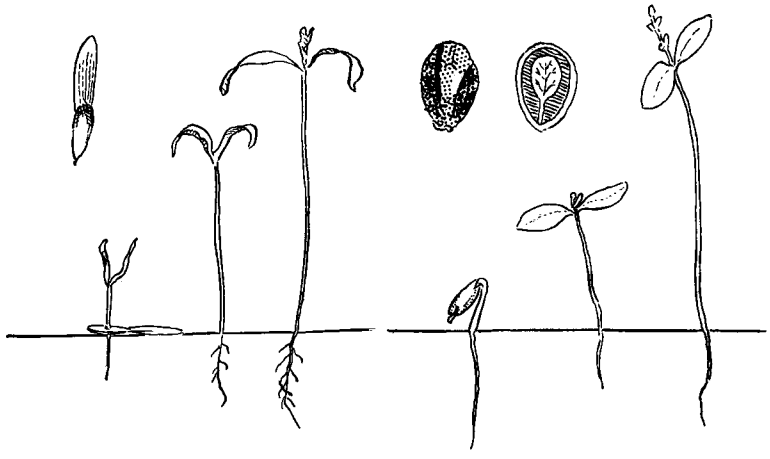
PERSIMMON

Diospyros virginiana

Reproductive unit: An orange to yellow to black berry containing 3-8 flattened ½ inch, roughened, light brown seeds maturing in fall and being shed in winter. 100 pounds of fruit yield 20 pounds of seed averaging 1200 to the pound. Straight embryo and abundant surrounding food.

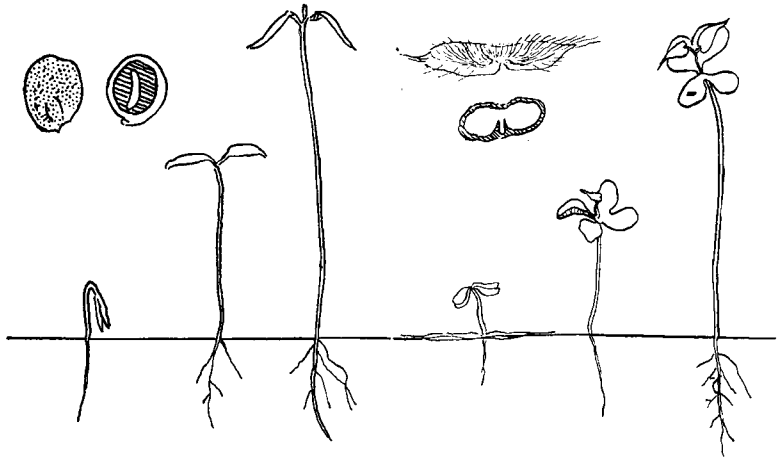
Germination: Normally germinate first spring but stratified in moist sand at 50°F. for 2-3 months may average to 60% but usually lower in plantings.

Seedling: Seed and cotyledons borne above ground reaching 6 inch height and showing first leaves at about 1 week.



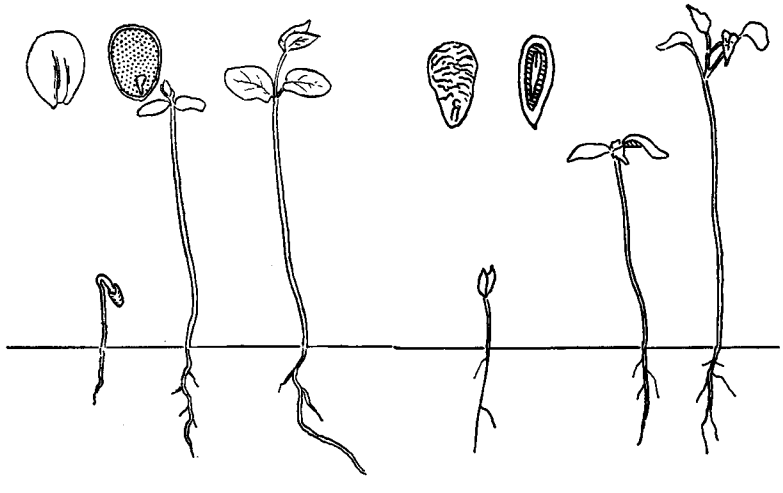
BLACK ASH, Seedlings after one, eight and fourteen days.

PRIVET, Seedlings after one, fifty and one hundred and thirty-two days.



BITTER NIGHTSHADE, Seedlings after one, six and twelve days.

CATALPA, Seedlings after one, eight and twenty days.



HONEYSUCKLE, Seedlings after one, thirteen and thirty-one days.

ELDERBERRY, Seedlings after two, thirty-three and forty-five days.

BLACK ASH

Fraxinus nigra

Reproductive unit: Fruit, a winged samara, to 1½-inch long, bearing single seed. Cleaned seed run about 8000 to the pound. A rather small embryo is well surrounded with abundant food in the seed.

Germination: Seed may be treated 1-3 months at 41°F. Germination low and may average only 20% in tests, but when sown in drills to 1 foot apart may germinate to 75%. Relatively free from fungous attack.

Seedling: Seed remains at ground surface but cotyledons are borne above, wrinkled at first. In 1 week, to 2 inches high with first leaves appearing 2nd week.

PRIVET

Ligustrum vulgare

Reproductive unit: Black berry-like or cherry-like fruit bearing 1-4 seeds, ripening in fall and persisting through winter. About 20,000 seeds to the pound. Embryo straight and well surrounded with food in seed.

Germination: Usually in practice stratified in moist sand to 3 months at 32-50°F. but germination is as low as 27%. Usually sowed broadcast in fall.

Seedling: Seed and cotyledons borne above ground reaching to 1 inch in 5 days. 1st leaves appear at 7 weeks after germination.

BITTER NIGHTSHADE

Solanum dulcamara

Reproductive unit: Brilliant red berry, about ½-inch long, ripening in late summer and fall, bearing seeds 1/16-inch long, like flattened disks and weighing about 350,000 to the pound. Small straight embryo with much surrounding food.

Germination: Normal germination of about 46% in 3 weeks without treatment but with stratification and temperature control may be brought up to 87%. Rather high germination.

Seedling: Seed and cotyledons raised above ground to 1½ inch in 1 week and to 2 inches in 2 weeks when leaves begin to show.

CATALPA

Catalpa bignonioides

Reproductive unit: Double-winged wafer freed from long, pod-like fruits through winter. 100 pounds of fruits yield about 35 pounds of seeds, which number 20,000 to the pound. Little if any food outside embryo.

Germination: Stored dry remains alive at least 2 years. Germination rather high averaging nearly 80% w th little management.

Seedling: Seed remains at ground surface but doubly lobed cotyledons raised above ground to 3 inches in 1 week. 1st leaves appear by 2nd week.

HONEYSUCKLE

Lonicera tatarica

Reproductive unit: Orange-red berries, each containing many seeds, maturing late summer. 100 pounds dried fruit yield 30 pounds cleaned seed which weigh 140,000 to the pound. Small embryo surrounded by great amount of food in seed.

Germination: Usual natural germination the first spring but may take place late fall of first year. Average germination is about 66% in cared for seeds. Constant temperature of 50°F. slows up germination.

Seedling: Seed and cotyledon above ground. Height, to 1 inch in 3 days. 1st leaves at about 1 month.

BLACK-BERRIED ELDER

Sambucus canadensis

Reproductive unit: Black, juicy berries each with 3-5 1-seeded nutlets that ripen in summer. 100 pounds fresh fruit yields about 12 pounds of cleaned seed weighing 286,000 to the pound. Straight embryo surrounded by food.

Germination: May germinate after 2 years if stored in glass jars at 41°F. Normal germination about 60% but treated seed may germinate better and more quickly.

Seedling: Seed and cotyledons above ground reaching 1-inch high in 2 days and first leaves showing about 1 month after germination starts.