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DWARF TREES

THE growing interest in horticulture has led to a greater demand for dwarf trees which can be grown in a limited space. Dwarf fruit trees have long been grown in the home gardens of Western Europe, and dwarf ornamental trees are a characteristic feature of Japanese gardens. Dwarf trees have many advantages. For ornamental purposes they are well adapted to the small garden where space is not adequate for standard sized trees. For the home orchard dwarf trees require less space, they are easier to spray and prune, and several varieties will provide enough fruit throughout the season for the average family.

There are many ways of producing dwarf trees. Trees grown in pots can be restricted in root development and with some judicious pruning can be restricted to a few feet in height even when they are more than a hundred years old. An excellent collection of these Japanese dwarf trees was given to the Arnold Arboretum by the late Mrs. Larz Anderson, and are on display in a lath house near the Arboretum greenhouses.

Occasionally dwarf trees are obtained by mutation or by genetic segregation. The dwarf conifers are good examples of "sports" derived from standard trees by mutation. An excellent collection of these dwarf conifers may be seen in the Arboretum collection. Such mutants can be perpetuated by grafts or cuttings. Species hybrids often produce dwarf segregates. One such segregate is a dwarf forsythia with leaves only an inch long. Among our apple hybrids there is one tree which at the age of ten years is less than five feet tall, with a compact, almost globular form.

The dwarfing of fruit trees by grafting on appropriate rootstocks has long been known in Europe. Graves (1), in a recent review of the art of grafting, has shown that the techniques were well known and practiced in the sixteenth century. Bradley (2), in 1726, not only refers to dwarfing stocks for apples and pears, but describes upside down grafts. Horticulturists in England have recently standardized the clonal stocks for apples, and these are referred to as "Malling" stocks. The most dwarfing rootstock is "Malling #9," but the root system is weak and the grafted tree must be staked. "Malling #7" makes a better root system, but is only semi-dwarfing.

The Malling rootstocks are propagated by layering—an expensive process—because most apple varieties do not come true from seed. We have found, however, that many of the Asiatic species of apple do breed true from seed, and we are testing these as rootstocks for both ornamental crabs and commercial varieties. *Malus sikkimensis* seems to be a good semi-dwarfing rootstock. "McIntosh" budded on *M. sikkimensis* seedlings have produced semi-dwarf spreading trees. A 10-year "McIntosh" is shown in Figure 1, which bore more than 250 apples last summer. The rootstock causes the low spreading growth habit. The graft union is excellent with some overgrowth of the rootstock characteristic of dwarfing rootstocks (Figure 2). *Malus florentina*, a species from north Italy, is too dwarfing and a three-year old "McIntosh" budded on this rootstock is only about 2 feet tall. The Sargent Crab seems to be a good dwarfing stock, but different varieties vary greatly in growth when budded on *Malus sargenti.*

Another method of modifying the growth of apple trees is by upside down budding or grafting. More than 25 years ago I budded one-year apple whips, placing the buds where the permanent branches were wanted, but the buds were inserted upside down. This work has been repeated and a photograph of such a tree is shown in Figure 3. The buds start growing towards the ground, and the branches gradually grow upward to form a spreading tree with unbreakable crotches. In pears such flattened trees bear earlier. In parts of Europe and California the branches of young pear trees are often tied down in a nearly horizontal position in order to flatten the tree and make it bear earlier. A "Clapp's Favorite" pear on the Bussey grounds has been treated in this manner with very satisfactory results.

Another process is based upon the transfer of plant hormones. The plant hormones produced by the leaves and growing points pass down the phloem of the bark and stimulate root growth. The passage of the hormone in the phloem is in only one direction. If a complete ring of bark is removed from the trunk of the young tree and turned upside down, the plant hormone is checked and a swelling occurs at the point of bark reversal. As a result the hormone does not get to the roots in normal amounts and growth of the tree is retarded. The tree shown in Figure 4 had a section of bark inverted three years ago.

Bradley, in 1726, described a method of grafting which we have repeated with some modification. The tops of two seedling pears growing about 18 inches apart in the nursery row were brought together. A graft was made so that the stems formed an arch. According to Bradley, if the roots of one of the two seedlings are dug up and the seedling staked upright so that it stands inverted on the stem of the other seedling, the roots in the air will form leaves and flowers. We do

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not expect such results, but we have inserted a "Clapp's Favorite" bud upside down a few inches beyond the graft. Next spring the seedlings will be cut off just below the inserted bud. As a result we shall have a normal pear seedling with an upside down section of the second seedling, and on top of this the bud which is to form the new tree. The inverted stem section should exert a dwarfing effect. In the upside down bark and stem grafts it is possible that the new cells may eventually become reoriented to provide normal polarity. In such case the dwarfing effect would be temporary.

Many species of apples, pears, hawthorns, and other Pomoideae have been intergrafted to find dwarfing stocks. A promising dwarfing stock for pears is *Cotoneaster multiflora*, although not all cultivated pears grow well on Cotoneaster.

Quince rootstocks of specific clonal lines are commonly used for dwarfing pears, but since all pear varieties will not grow on quince, double working is often necessary, as is the case with Cotoneaster. The Cotoneaster root system makes it difficult to transplant the grafted pear, so we now bud Cotoneaster on either wild pear or on hawthorn and double work with cultivated pear. Thus we have a seedling pear or hawthorn root, an intermediate stem of Cotoneaster, and a pear top. The intermediate stem piece acts as a dwarfing stock.

One of the most interesting combinations is *Aronia arbutifolia* budded on hawthorn rootstock. There is considerable overgrowth of the *Crataegus pedicellata* rootstock, but the Aronia top is healthy and fruited abundantly in its third year. The tree form is much more attractive than the usual bush type (Figure 8).

Graft combinations of various Prunus species have shown some interesting results. Peaches and plums budded on *Prunus tomentosa* seedling rootstocks produce dwarfed trees which bear early. All varieties of peaches and plums do not make compatible unions with the Nanking Cherry rootstock. Most peaches budded on *P. tomentosa* produce trees about two to nearly three feet tall the first year. The second year most of them flower and occasionally fruits are produced. A two-year old tree of "Jerseyland" peach bore eleven full-sized peaches the second year after budding, and the peaches were ripe before August 1 in 1949 (Figure 5). This summer a four-year old "Valencia" peach on *P. tomentosa* stock bore 84 peaches on a tree about six feet tall.

Prunus tomentosa is also a good rootstock for plums and a three-year old "Stanley" plum tree flowered heavily and bore a few fruits this summer, although the tree was little more than three feet tall (Figure 6). *Prunus triloba multiplex* budded on *P. tomentosa* produced a tree growth habit, although both stock and scion species commonly grow as a spreading bush. The tree form is most attractive and the plant bloomed profusely the second year. A picture of this graft at the age of three years is shown in Figure 7.

Beach plums have also been grown on *P. tomentosa*. Seedlings or cuttings of beach plums are often difficult to transplant and it is hoped that by budding on the Nanking Cherry, with its more fibrous root system, the peach plum can be

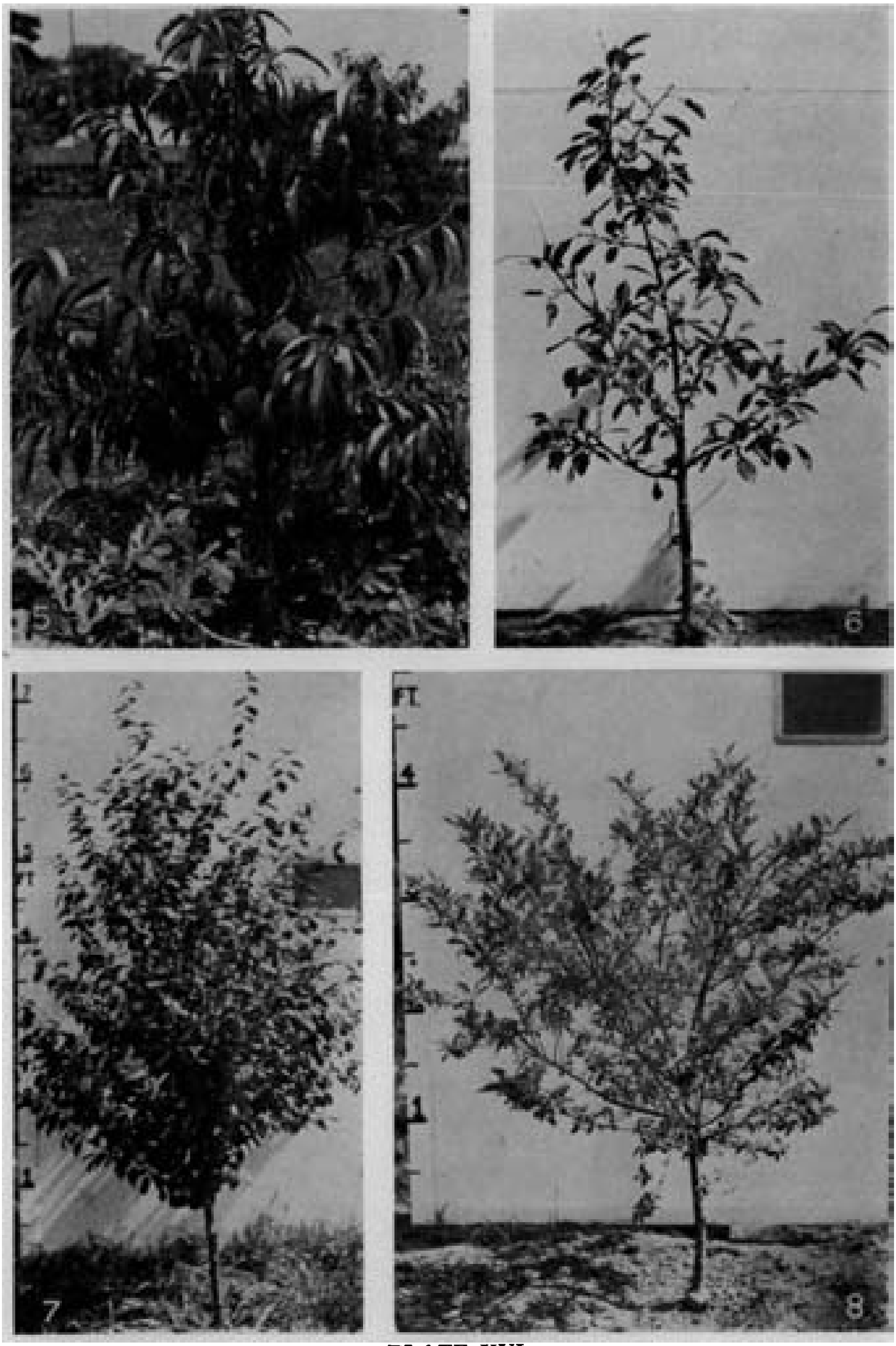

PLATE XVI

transplanted more readily. There is some dwarfing effect of the *P. tomentosa* rootstock, but the beach plums are still too young to be sure of ultimate success.

Peaches and plums are dwarfed even more when budded on *Prunus glandulosa*, but this rootstock suckers badly from the root and the suckers have to be pruned back for several years. In spite of this difficulty, *P. glandulosa* may prove to be a better rootstock than *P. tomentosa* because of better compatibility with more varieties of peach and plum, and a somewhat greater dwarfing effect.

It is hoped that eventually we shall be able to produce dwarf apples, pears, peaches and plums, as well as dwarf ornamental trees and shrubs, on seedling rootstocks which will induce the desired degree of dwarfing. Most people prefer trees which are small and can be cared for by the home gardener. Although our work with seedling dwarfing stocks is still in the early stages of development, many horticulturists may be interested in the project, and all are invited to visit our test plots at the Bussey Institution adjacent to the Arnold Arboretum.

KARL SAX

1. Graves, George. Double working, the art of setting graft upon graft. Nat. Hort. Mag. 29: 118–127. 1950.

2. Bradley, R. A general treatise of husbandry and gardening. London 1726.