TREE FRUIT PRODUCTION

THIRD EDITION

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TREE FRUIT PRODUCTION
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Preface to the Third Edition

This is a revised and updated edition of the book *Tree Fruit Production*, first published in 1959 and extensively revised in the second edition in 1972. Considerable advances have been made in recent years in the scientific production and handling of deciduous tree fruits in North America. This third edition brings together in up-to-date usable textbook form the essence of pertinent research and practical experience on the subject. Although the principles involved in the different operations of orchard management, such as pruning, soil management, fruit thinning, and harvesting remain constant, practices and techniques have been undergoing considerable change. Economic and social changes have been brought to bear in altering the approach to such aspects of pomology as tree size, plant density, mechanical harvesting, pest control and irrigation.

Greatly increased costs of production have swung the emphasis of attention toward the wider use of organic chemicals in the orchard. Growth regulating substances are finding a place in the orchard, not only for fruit thinning, preharvest drop control and weed suppression, but also for other purposes such as promotion of early flowering, tree training, pruning and the advancement and extension of the harvest season.

The trend toward the smaller, more easily and economically managed apple tree which began slowly some three or more decades ago and increased rapidly in subsequent years is now complete. This same trend, for the same reasons, is now beginning to involve the pear, the peach and the cherry. Thus, the constant search for suitable, size-controlling rootstocks is spreading from the apple to the other tree fruits as well.

To comply with the demands of a changing market and with altering marketing methods, new cultivars of tree fruits are being developed. The modern cultivar may have to fit into a processing, farm market or consumer-pick operation. It must also satisfy the demands of new

manual, semi-mechanical and mechanical harvesting methods. The cultivar must also be compatible with the dwarfing rootstock used and suited to the environmental conditions prevailing in each specific production area.

Irrigation, which in earliest times was often a vital factor in fruit production, is now becoming a standard practice in many orchards outside of the arid and semiarid areas of the continent. As furrow irrigation has given way to the sprinkler system, so now the overhead sprinkler is being replaced by the more precise drip or trickle method.

The large reference list has been updated where necessary and enriched where possible in order to provide even greater substance and scope to principles and practices presented in the text. Many changes have been made to the nearly 100 photographs and drawings with which the text is illustrated so that the illustrations truly reflect the timely character of the treatise.

It is hoped that the material presented and the way in which it is presented will prove useful as a text and reference book and as a guide for orchard practice.

B.J.E. TESKEY
J.S. SHOEMAKER

March 1978

Preface to the First Edition

This is a book on the culture and handling of apples, pears, peaches, cherries, plums, apricots, nectarines, quinces, and citrus fruits. It has been written to answer the need of students, teachers, and others who require the most up-to-date information on the production of tree fruits. Included in the discussion are subjects which confront every grower of these fruits and every student of pomology.

Orchard operations, such as soil management, use of fertilizers, pruning, thinning, harvesting, storage, and marketing, that are commonly referred to as standard practices, are constantly undergoing change. Research developments resulting in better techniques and materials, together with increased mechanization and the pressure of economic competitition, force the adoption of improved procedures such as are presented in this text.

The text is an outgrowth of experimental work, research, classroom, and a practical orchard experiences over a wide range of territory in North America. These firsthand personal experiences were gained over many years and in widely differing areas, from the colder parts, through the more moderate, to the warmer parts of this continent—from the province of Alberta to the state of Florida, including extensive periods of service in Ontario, Iowa, Minnesota, and Ohio.

Also, in this book a great deal of emphasis has been placed on recent research by horticultural scientists throughout this country and abroad, who have contributed to needed improvements in production and handling methods with tree fruits. To this end, information from more than 800 references has been incorporated into the treatise. All of this has resulted in a text that is adapted to widespread regions in the United States and Canada.

Increasing costs of orchard management and the introduction of automatic spraying equipment have, within the last few years, created a

growing interest in smaller fruit trees. A need has thus arisen for the consolidation and presentation of presently available information on this subject. For this reason a separate chapter on dwarf apple and pear trees has been included in the text.

Apricots, nectarines, and quinces have been discussed in one chapter. Each of the other chapters deals with one particular kind of tree fruit and comprises all phases and aspects of its culture, production, and handling. The reasons for certain orchard practices are given, and physiological phenomena involved in tree growth and fruit production are explained.

The headings and subheadings throughout each chapter have been carefully arranged to make specific points stand out clearly for easy reading. The text is illustrated with a total of 103 photographs and drawings. The detailed index given at the end of the book will help the reader find information quickly on any phase of production for any of the specific tree fruit crops discussed.

A chapter is included on citrus fruits even though such fruits are not adapted to regions where the major deciduous fruit trees are at their best. The large citrus industry, however, has many unique features which should be of interest in northern regions. Conversely, many suggestions applying to deciduous fruit trees should be of interest in citrus regions.

Different regions vary in certain practices, such as spraying, and the recommendations are commonly modified from year to year. Therefore, pest control schedules are not presented in this text. Local bulletins, circulars, and other publications can often be used to advantage to supplement the discussion in the text.

It is hoped that the material presented, and the manner in which it is presented, will prove useful as a text and reference work, and as a guide for orchard practice.

J.S. SHOEMAKER
B.J.E. TESKEY

November 1958

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Contents

1

Apples

Many different fruits and vegetables have been known as "apples." The fleshy fruit referred to in this book is the major deciduous tree fruit of North America and of the world. The term "pomology," the science of fruit production, comes from the apple, a pome.

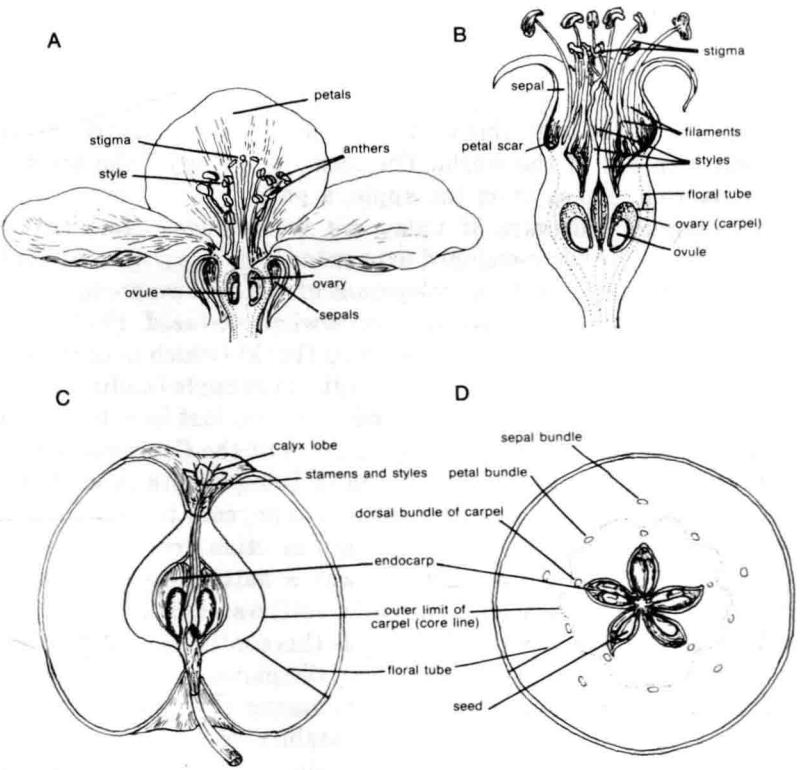
The commercial cultivars of today are far removed from the wild apples from which they developed over many centuries. Several species may have contributed to the development of the modern apple. For this reason the taxonomy of the apple is somewhat confused. Horticultural authorities generally use *Malus domestica* (Bork) (which is preferred in this text) as the scientific name of the cultivated apple (Zielinski 1955).

The early history of the domestic apple becomes lost in antiquity. The apple probably originated in the region south of the Caucasus, where it appears to be indigenous. It has existed in Europe, both in wild and in cultivated forms, from time immemorial and appears to have been well developed there at the beginning of the Christian era. The westward movement of the apple from Europe was a natural sequence of colonization of North America by the early settlers. Indians, traders, and missionaries first took it westward across this continent. An interesting legend is that of Johnny Appleseed (John Chapman) who assisted in the planting and distribution of apple seeds among the westward moving families. By 1868 the apple had become established from coast to coast.

Botanically, the apple is a pome fruit developed from an inferior ovary, and is derived both from the ovary wall and the floral tube, which is composed of the basal parts of the sepals, petals, and stamens. This tube is fused with the ovary wall, becomes fleshy, and ripens with it. The fleshy mesocarp constitutes the main edible portion. The five cavities may each contain two seeds (Fig. 1.1).

PRODUCTION

Apples are grown in nearly every state of the United States and in most of the provinces of southern Canada, but the three main regions of production in North America are (1) the Eastern section comprising the Northeastern States, the Atlantic States, Ontario, Quebec, New Brunswick and Nova Scotia (about 90 million bushels or 1.5 million tonnes annually), (2) Central United States, including Ohio to Arkansas (about 0.5 million tonnes), and (3) Western section from Colorado to British Columbia (about 1.25 million tonnes). The state of Washington leads



Redrawn from Weir et al. (1970) and used with permission of John Wiley & Sons

FIG. 1.1. THE ONTOGENY OF THE FLOWER AND FRUIT (POME) OF APPLE (*MALUS DOMESTICA*)

(A) Median longitudinal section of flower; (B) median longitudinal section of maturing fruit; (C) median section of fruit; (D) cross-section of fruit.

with more than 0.5 million tonnes, New York is second with less than 0.5 million tonnes, and Michigan with about 0.33 million tonnes is third. The total North American production of about 3.33 million tonnes per year is nearly 25% of the world apple production.

PROPAGATION OF NURSERY STOCK

Apples reproduce themselves by means of seeds, but their offspring differ widely; thus, they must be maintained by vegetative propagation. By means of grafting, two distinct parts (namely, the root system and the stem and branch system), which may have very diverse characteristics, are made to grow together as a single plant.

Seedling Rootstocks

Rootstocks are raised either from seed or by vegetative propagation (for the latter see Dwarfed Apples).

French crab seedlings and domestic seedlings have been commonly used by nurserymen. The French crab seedlings were grown in France and then imported to America, or the seed was imported and the stock grown on this continent.

Seed from Delicious, Yellow Newtown, Wealthy, and Rome gives good germination and vigorous seedlings. Seed from triploid cultivars, e.g., Rhode Island Greening, Gravenstein, and the Winesap group, is unsatisfactory for rootstock production.

Producing Nursery Seedlings

Afterripening.—Seeds of apple normally will not germinate directly after harvest. A period of afterripening is essential for certain chemical and other changes to take place in the seed and start the dormant embryo into growth. The length of the afterripening period of seed of domestic cultivars is usually 70–80 days at 4°–10°C (40°–50°F); the optimum is 4°–5°C (40°–41°F) under moist conditions. Temperatures of 0.6°–3°C (33°–38°F) are more favorable than those above 5°C (41°F). Seed may become dry before afterripening begins without reducing germination, but during the following afterripening it must be kept moist until sown.

For afterripening, soak dry seeds in water for several hours and place them in mouse-proof containers with a moisture-holding material such as damp peat moss. Bury the containers over winter in the ground in a sheltered place or store them in a cool place. Keep the medium, in which the seeds are stored, moist. Polyethylene film envelopes, permitting

ready examination of the seed, may be used if they contain some damp peat moss or perlite.

Sowing the Seed.—Seeds sown directly in the nursery row should be evenly distributed in a narrow, shallow trench and covered with soil. Fall sowing of the seed may provide a suitable environment for afterripening, but apple seed is more commonly afterripened under controlled conditions and sown in the spring.

In soil that tends to form a hard crust, cover the seed first with either moist peat or softwood sawdust and then cap the rows with sandy soil. When seed is sown in the fall, mound up additional soil over the rows to protect the seed over winter, but draw this soil away in early spring, leaving only a thin cover through which the sprouting seed can easily emerge.

Lining Out.—Trim the rootstocks and plant them in early spring. In trimming, cut back the lateral roots, remove all side branches, and cut the top to a total plant length of about 38 cm (15 in.). This trimming expedites planting, since the rootstocks are inserted in a narrow vertical trench opened by a special trenching plow. Many nurseries buy lining-out stock from other nurseries.

Budding

Budding is the usual method of propagating fruit trees in the nursery. Normally only one bud is inserted on each rootstock. A fast budder working under favorable conditions on properly cleaned stock, and with someone else doing the tying, may insert 1200 or more buds in a day. Probably 800–1000 buds per day is a good average.

When to Bud.—Budding is done in the summer when buds of the current season are well formed and the bark slips well. It may take place from June till September, depending on the locality and the fruit. Buds may be too immature, but seldom are too mature, for successful budding.

In New York, budding is done on the following stocks in the order given: mid-July to mid-August, Western sandcherry, European plum, pear, apple, mazzard cherry, and quince; late August to early September, myrobalan plum, mahaleb cherry, and peach (Brase 1956).

Budsticks.—Cut shoots of the current season's growth from either bearing or nursery trees. These shoots which carry the buds for budding are called budsticks.

To check loss of moisture by evaporation from the leaves after the budstick has been cut from the parent tree, promptly remove leaves and

keep the budsticks moist. Leaving a short portion of the petiole in place as a "handle," wrap the budsticks in moist cloth, in plastic bags, or place them with the basal end in water in a container. They can thus be stored in a cool place for several days; but it is better to use them soon after cutting. Use the well-developed plump and hard buds from the mid-portion of the shoot, discarding the soft tip buds and basal buds.

Preparing the Seedlings.—Prepare the seedling nursery stock by stripping off the lateral shoots on the lower 15 cm (6 in.) of the stem in early summer. Wipe the stock clean of soil particles near the point of bud insertion.

T-cut.—At budding time make a T-cut in the bark of the stock 5–7.6 cm (2–3 in.) above ground. Make the cut through the bark to cambium depth (not into the wood). Some budders prefer to make the transverse cut first, about 1/3 around the stock. They then make a vertical cut upwards to meet the transverse cut. As it reaches the transverse cut, the knife blade is twisted to raise the edges of the bark just enough, without tearing, so that the bud may be easily inserted. Other budders prefer to make the upward cut first, then the transverse cut.

Cutting the Bud.—Cut the bud with a shield of bark by holding the budstick by the top end, with the lower end away from the body. Place the knife 1.3 cm (1/2 in.) below the first suitable bud and by a shallow slicing movement pass the knife beneath the bud approaching the surface 2.5 cm (1 in.) above it.

Cut the shield bearing the bud fairly thin, but not so thin that the soft growing tissue beneath the bark and wood is injured. Retain the thin strip of wood that was cut with the shield.

Inserting the Bud.—After cutting, hold the bud by the petiole and insert the bud into the T-shaped incision. Fast budders slip the bud on their knife directly to the T-cut. A properly inserted bud is at least 2 cm (3/4 in.) below the transverse cut. Avoid undue manipulation or prying of the bark flaps.

Buds are usually placed on the same side of the stock along the row so that they may be readily inspected and manipulated the following season. The side from which prevailing winds come is the preferable one to prevent subsequent breakage.

Tying.—After inserting the bud wrap it snugly. Be sure to leave the bud exposed. Rubber budding strips have largely replaced raffia or string as binding material. Rubber strips have the merit of expanding with growth of the rootstock and after exposure of a month to the sun rot and fall off. By this time a good union between bud and stock has taken place.

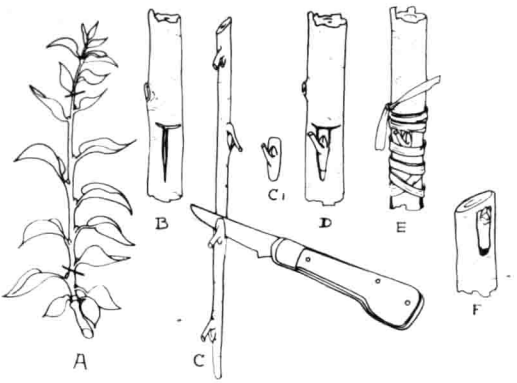


FIG. 1.2. SHIELD BUDDING

(A) Terminal growth of current season, the source of buds; (B) the T-cut in the stock; (C) the prepared budstick showing method of cutting the bud; (C-1) the shield bud; (D) the bud in place; (E) the bud tied tightly against the stock; (F) the branch of the stock cut off close to the bud the following spring.

When active cambial layers are in close contact they establish an intimate contact of the cambial region, usually by producing thin-walled parenchyma cells. This step is followed by interlocking of parenchyma cells (callus tissue). When parenchyma cells of both stock and bud (scion) are locked, a new or "bridge" cambium is produced which begins typical cambium activity and starts formation of new xylem and phloem. Probably the origin of new xylem tissue is from the bud (or scion) rather than from the stock.

Care After Budding

The first indication that the bud has united with the stock is the dropping off of the leaf stem. In successful budding, the bud usually will have grown to the stock in 2–3 weeks. Shriveled adhering leaf stems often indicate failure; if the bark still separates readily from the wood, a new bud may be inserted in a new position on the stock.

Buds inserted in late July or later remain dormant until the following spring. Buds properly united with the stock do not require any winter protection such as plowing up to budded stock in the fall. Besides eliminating two extra time-consuming operations, namely, covering in the fall and uncovering in the spring, buds that have no soil cover over winter start earlier and more uniformly the following spring. Cut off rootstocks immediately above the grafted bud in early spring.