Cool season vegetables such as carrots and spinach grow best at lower temperatures than those preferred by warm season vegetables such as beans and melons. Likewise, cool season vegetables are less susceptible to injury from frost.

Plants started indoors frequently are "hardened" by gradually exposing them to somewhat lower temperatures before they are set outdoors. Certain vegetables such as asparagus, horseradish, Jerusalem artichoke, parsnip, rhubarb and salsify will withstand very low temperatures and may be left in the soil over winter even in areas with severe climate.

Water is the most frequent factor limiting plant growth. It is the principal constituent of plants, and an essential raw material in the manufacture of food. Mineral salts must be dissolved in water before they can move into plants through the root hairs. Oxygen and carbon dioxide enter and leave plants in water solution. Mineral salts and manufactured foods move throughout the plant in water solution.

Water keeps plant cells turgid so that they can carry on their functions. It also helps to keep plant surfaces cool through evaporation from the leaves and stems.

At least 15 chemical elements are needed for the growth of fruit and vegetable plants. These include carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulphur, calcium, iron, magnesium, boron, manganese, zinc, copper and molybdenum. Some of these—such as boron, zinc, manganese, iron, copper and molybdenum —are referred to as minor or trace elements, since they are needed by plants in very small amounts.

The successful gardener must know something about how plants grow. He must also know the essential needs of plants and strive diligently to fulfill these needs with care and at the proper time.

PLANT REPRODUCTION

by N. Carl Hardin and Bradford C. Bearce

All plants reproduce themselves somehow, either sexually by seed or spores or asexually by splitting off parts such as bulblets, roots, buds and leaves from which new plants are formed.

To produce seed, plants must first produce flowers which come in varied forms among the many plant species. They vary greatly in size and brightness of color. A complete flower has each of the four kinds of parts: sepals, petals, stamens and ovaries. An incomplete flower lacks one or more of these.

The sepals are the outermost parts and together form the calyx, usually green. The calyx is the outer protective cover on a bud with the petals, stamens and ovaries inside. The often brightly hued petals are for attracting pollinating insects.

Next inside are the stamens which furnish pollen, and in the center of the flower are one or more ovaries. The ovaries contain ovules which develop into seeds when fertilized with pollen.

Some species of plants possess individuals with flowers lacking either stamens or ovaries. For such species to form seeds, pollen must be transferred from the stamens of one individual to the ovaries of another. Birds, insects, wind and water are important pollen carriers for these plants.

Once a single pollen grain has been transferred from stamen to the often sticky stigma, top surface of the ovary, it germinates to form a tube which grows through the stigmatic surface and down through an often elongated column of tissue called a

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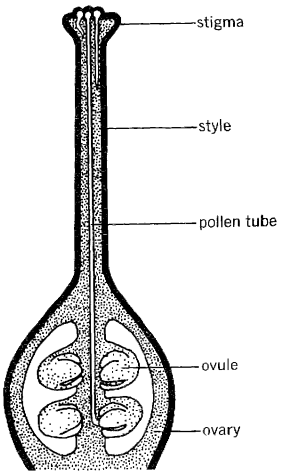

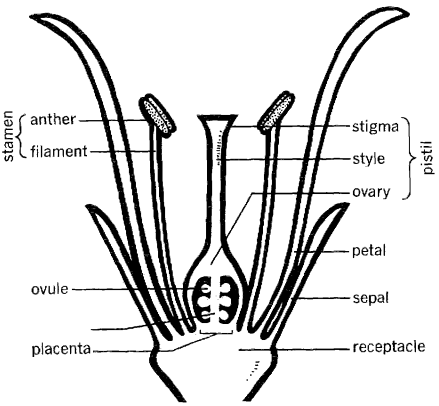

style into the ovary. Here the pollen tube penetrates an ovule.

A sperm nucleus from the pollen tube fuses with the egg nucleus of the ovule to form a zygote, the seed embryo. Another sperm nucleus fuses with other nuclei of the ovule to develop the seed endosperm. The tissue of the ovary surrounding the developing seed becomes the flesh of a fruit or the hardened shell of a nut, depending on the species of plant.

Parts of the Seed

Every seed has at least an embryo and one or more seed coats, while many seeds also possess an endosperm. The embryo in most seeds has a plumule or rudimentary shoot; one or more cotyledons or seed leaves; a radicle or rudimentary root; and a hypocotyl, the part of the embryo between radicle and cotyledons.

The seed coats protect the other parts enclosed within them. Endosperm and cotyledons serve as sources of stored food for the embryo as it develops within the seed and as it germinates. The cotyledons may also act as leaves to carry on photosynthesis, manufacture of food, until the first true leaves of the seedling have expanded.

Many seeds, even though alive, can not germinate right after maturity even under the proper conditions. This delayed germination is called dormancy and serves to prevent the seed from germinating during unfavorable times of the year when adverse climatic conditions might kill the young seedling plant.

Dormancy can be caused by hard seed coats which prevent entrance of water and air to the embryo, by immature embryos, or by presence of natural chemical inhibitory substances. Dormancy can be removed to allow seed germination by acids in the soil dissolving the seed coat, a cold period (winter, for example), or light which can cause breakdown of chemical inhibitors in the seed.

Asexual or vegetative reproduction occurs through cell division which is a normal process of growth and regeneration. In asexual reproduction a cell can split the chromosomes and divide into two daughter cells. As a result, the complete chromosome sys-

Left, germination of pollen grains on stigma, and growth of a pollen tube to ovule. Right, diagram of "perfect" flower with both male (stamen) and female (pistil) parts.

tem of an individual cell is duplicated in each of its daughter cells. The chromosomes produced will be the same as in the cell from which they came.

Asexual reproduction or vegetative reproduction is important in horticulture because the unique characteristics of an individual plant can be maintained. For instance, the millions of Golden Delicious apple trees throughout the world can all trace their ancestry to a chance seedling found in Clay County, West Virginia.

Cuttings and Rootings

The technique of removing a portion of the parent plant and placing it in a favorable condition to produce new roots and shoots is called cutting and rooting. Stems, leaves, and roots may be used.

The advantages of cutting and rooting with those plants that root easily are that many new plants can be made from a few stock plants. The method is simple, inexpensive, rapid, and does not require special skills.

It is important to have nearly ideal conditions to get the cutting to root. Generally, a temperature of 65° to 70° F, 100 percent humidity, and sterile soil produce satisfactory results.

Grafting is the art of joining parts of plants together so that they will unite and continue their growth as one plant. The part of the graft that is to become the lower part is termed the rootstock. All methods of joining plants are properly called grafting, but when the scion part is a small piece of bark containing a single bud the operation is called budding.

The reasons for budding and grafting are (1) to perpetuate a plant that cannot be reproduced by cuttings, layers, division, or other asexual methods; (2) to obtain special forms of plant growth; or (3) to obtain the benefits of certain root stocks. Root stocks may have disease resistance or growth controlling characteristics. Grafting or budding are also done to change the variety of an established plant, to increase production, or to grow a more popular variety.

Tubers (potatoes), bulbs (onions), and tuberous roots (sweet potato) differ botanically but have one thing in common. Each is an enlarged underground portion of the plant. The gardener reproduces these plants by cutting up or pulling apart the thickened structures into pieces from which new plants grow.

Many plants can be reproduced either sexually or asexually and often both methods are used. In other instances a combination of both methods is used.

Apple and other fruit trees are produced in great numbers by planting the seeds to grow into root stocks, then grafting or budding the desired scion wood or variety to the root stock.

PLANT POLLINATION

by S. E. McGregor

Many plants can be propagated vegetatively by cuttings or underground parts. This is not always as practical as growing the plant from seed. But for seed to be produced the plant must flower and the flower needs to be pollinated.

There must be a union of the sperm of the pollen with the ovule, or developing seed, within the flower. This union has to take place at precisely the right time and in a manner carefully prescribed by the flower, as we shall see. First we need to get acquainted with the flower.

Within every flower there is a sexual column, usually surrounded by petals. The female part, the pistil, consists of the ovary, style and stig-

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