How Plants Grow—and Let's Hope They Do!

by O. B. Combs

Fruit and vegetable plants are made up of tiny cells. They grow and reproduce by increasing the number, size and nature of these cells. As growth occurs, several important processes take place. Seeds germinate and become young plants that develop roots, stems, leaves and flowers. When flowers are pollinated, seeds and fruits begin to form.

These processes involve intake of carbon dioxide and oxygen, largely from the air and water, and minerals from the soil. Foods manufactured from these raw materials and stored in fruits, seeds, stems, tubers, leaves and flowers provide nourishment, directly or indirectly, for people and animals.

The most important single process carried on by green plants is called photosynthesis. Energy from the sun is trapped by the green plant, simple sugars are formed, and oxygen is released into the atmosphere. Complex carbohydrates, fats, proteins and vitamins are formed by the incorporation of sugars with mineral elements from the soil.

As plants multiply, enlarge their cells and build new tissues and organs, they break down foods with the aid of oxygen to release energy. This process is known as respiration; carbon dioxide, energy and water are released.

Most vegetables are reproduced sexually from seeds. Most fruits and a few vegetables are reproduced asexually or vegetatively from plants or plant parts. Seeds contain the embryo (live plant) and stored foods. For rapid germination, seeds must be alive and strong enough to break the seed coat and emerge from the soil. They need water, oxygen, and a suitable temperature.

The temperature best suited for rapid germination varies with different plants. Seeds of cool season vegetables such as carrots germinate rapidly at soil temperatures between 50° and 60° F, and seeds of warm season vegetables such as beans between 70° and 80°. Sweet corn seeds, which may require ten days to germinate at 50°, may germinate in two to three days at 80°.

Roots anchor and support plants and absorb water and minerals from the soil. These materials are taken in through root hairs and then moved through the stem to the leaves. Roots are the major storage organs of such vegetables as beets, carrots, and sweet potatoes.

Roots have no chlorophyll, thus they depend upon the leaves for their food supply. Roots must be healthy, unrestricted and undamaged by diseases, insects, or deep cultivation if they are to perform their functions. They must have adequate oxygen.

Too much water from a high water table or over-irrigation on heavy soils may result in insufficient oxygen and serious interference with proper root growth and function.

Root systems differ markedly in their form, spread and depth. The tap roots of carrots grow almost directly downward to considerable depths, and give off many lateral branch roots. The fibrous roots of onions grow an extensive, relatively shallow network of small roots. Some plants, such as apple and other tree fruits, have several large roots for anchorage, with many smaller branch roots.

Stems make up the above-ground framework of plants. They provide support for the plant and contain the food storage and transport tissues.

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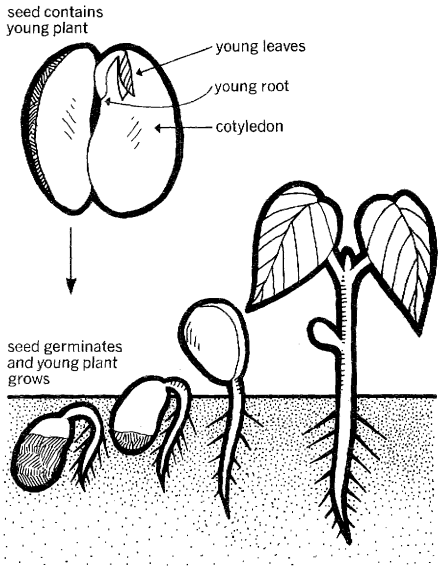

Water and nutrients from the soil move to the leaves, where sunlight and leaf chlorophyll—through the process called photosynthesis—manufacture food for plant growth and production of the edible portions. Water, nutrient, and manufactured food movement within the plant occurs in the conductive tisue, known as the xylem and phloem.

Leaves originate from stems and are the principal food-manufacturing organs of green plants. They take in carbon dioxide from the air and allow oxygen and water vapor to escape through small openings—mainly on their lower surfaces—called stomata. Plants are able to regulate these stomatal openings and thus partially control the loss of water from their leaves.

Flowers are necessary for production of seeds. Beans, peas, and sweet corn are annuals; they produce seeds each year and die when the seeds have matured. Cabbage, beets and carrots are biennials and need some part of two seasons to produce seeds; they die when their seeds have matured. Asparagus and rhubarb are perennials which—once established—may produce and mature seeds each year, but the plants continue to grow in the same location for several years.

Light is the source of energy for photosynthesis, the food manufacturing process carried on only by green plants. It also influences the movement and position of plant organs and the size, form and structure of plants. The amount of food manufactured depends upon the duration, intensity and quality of light. Whether a plant flowers or not is often determined by the relative length of day and night.

Formation of the green coloring matter (chlorophyll) in plants goes on only in light. Pure white cauliflower and creamy white, blanched celery, endive hearts and asparagus spears are produced by excluding light from these plant parts.

Plants arrange their leaves to insure suitable exposure to light. Excess exposure causes stunting; insufficient light causes tall, weak, light green plants.

Plants such as spinach and chinese cabbage go to seed if growing when days are longer than 15 hours.

The above-ground parts of plants generally are positively phototropic, they grow toward light; roots of most plants are negatively phototropic, they grow away from light. Tops of plants are negatively geotropic, they grow upward away from the force of gravity; plant roots are positively geotropic, they grow downward toward the force of gravity.

Temperature markedly influences plant growth. All important functions of plants—respiration, photosynthesis, absorption, digestion and reproduction—are influenced by temperature. Each plant has a temperature range in which it grows best, other factors being equal.

How bean plant develops from a seed.

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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