The Strawberry Plant: What You Should Know

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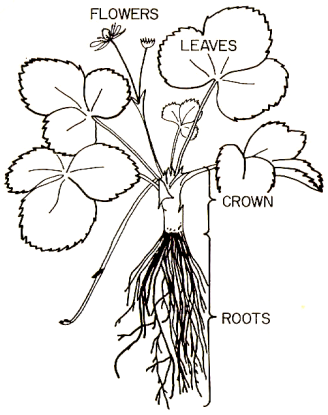
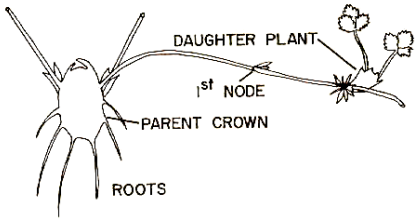
The cultivated strawberry, *Fragaria ananassa* Duch., is a relative newcomer to agriculture. Commercially grown varieties are the result of hybridization by humans, the fruit being quite different from that of the natural ancestors. The unique developmental nature of the fruit has made it the subject of much study. The plant itself also presents features of interest in its vegetative reproductive ability and its response to environmental conditions. In a more practical sense, the strawberry has become the basis of a large commercial industry, and is considered to be the most popular of small fruits in the United States.



The strawberry plant is an herbaceous perennial, living for several to many years, depending upon the environment. The main stem of the plant is a greatly shortened stem called a crown. Buds formed in the crown produce leaves, flowers, stolons (runners), branch crowns and adventitious roots The leaves are arranged spirally, such that every sixth leaf is above the first. Each leaf has three leaflets at the end of a long petiole rising above the crown. Leaflets are round to oblong, with serrated edges and a thick cuticle layer. Older leaves die off in the fall, and are replaced by new leaves in the spring.

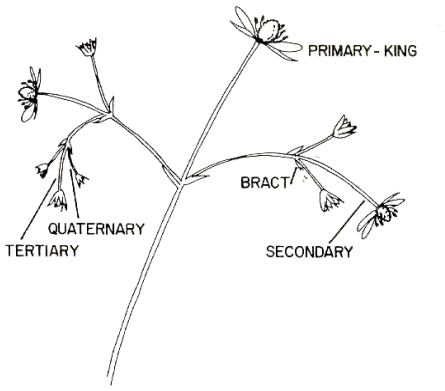
Runners and branch crowns are essentially shoots, which develop from axillary buds that form at the base of each leaf. Environmental conditions strongly influence which type of shoot will develop. Runner development is stimulated by long day lengths and warm temperatures. Therefore, runners emerge mostly during the summer months. Initial growth of runners results from development of a first internode, which extends several inches from the mother plant. Subsequent growth is from a second node at which the runner plant will develop. An axillary bud on the runner plant will typically form a secondary or continuation runner; often before the primary runner plant develops roots. Runner plants are the primary means of propagating strawberries commercially. Runners which have rooted over the summer are dug up late in the fall and stored in coolers at about 0° C (32° F) until spring for planting.



Branch crown development is stimulated by shortened day lengths and cooler temperatures and thus occurs later in the season than runner formation. Branch crowns have much the same anatomy as the main crown, being a very reduced stem with spirally arranged leaves. At one time, strawberry varieties that characteristically produced few runners were propagated by branch crowns. Whole plants would be dug in the fall, and the numerous branch crowns would be divided and stored for spring planting.

Adventitious roots arise from the crown primarily in the late summer and fall. They extend several inches into the soil and form numerous lateral roots, which are the primary means of taking in water and nutrients. Lateral roots usually live one or two years, the primary roots may live two to three years. The largest concentration of roots occurs in the upper three inches of the soil. Length and number of roots formed depends upon soil conditions and plant density. Usually each plant maintains twenty to thirty primary roots, the average length being four to six inches. Only after the development of numerous lateral roots, encouraged by proper soil moisture conditions, can runner plants become independent of the mother plant, i.e., survive without support from the connecting stolon.

The strawberry inflorescence is a modified stem terminated by a primary blossom. Branches arise at nodes from buds in the axils of modified leaves or bracts. Each branch is terminated by a blossom. Following the primary blossom, there are typically two secondary, four tertiary and eight quaternary blossoms. The exact scheme can vary between cultivars and locations. An individual blossom typically has ten green sepals, five white petals and 20 to 35 stamens arranged in a spiral pattern in three whorls. The pistils are arranged spirally on the receptacle, with numbers ranging from 60 to 600. The greatest number of pistils occurs on the primary blossom and decreases successively down the inflorescence.

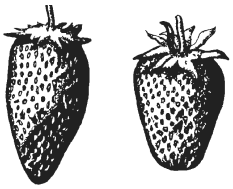


Strawberries are self-fertile. Pollen is mature prior to the opening of the anthers, but is not released for several days, encouraging cross-pollination. Stigmas remain receptive to pollen for eight to ten days. Despite self-fertility, strawberry size and yield have been shown to increase when cross-pollinated by insects. Fertilization occurs 24 to 48 hours after pollination.

Within each pistil is a carpel containing a single ovary. This structure is an achene. Achenes are the true fruits of the strawberry. Together with the receptacle they form an aggregate, which is referred to as a berry, but is not a true berry in the botanical sense.

Following fertilization, the receptacle swells to form the edible part of the "berry." The receptacle is made up of an epidermal layer, a cortex and a pith. The latter two layers are separated by vascular bundles that supply nutrients to the developing achenes. Cells in the cortex and pith are responsible for most of the receptacle growth. Cell division accounts for only a small part of the total growth of the receptacle and occurs primarily prior to bloom. Nearly ninety percent of the growth is a result of cell enlargement. Sugars, aromatic compounds and pigments all increase as the receptacle tissue grows and matures. Ripening, from bloom to harvest stage, lasts approximately 30 days, depending on environmental conditions.

Development of the receptacle is controlled by growth regulators, primarily auxin, which are synthesized in the achenes. Auxin is translocated into the receptacle tissues, stimulating growth through cell enlargement. Removal of achenes after fertilization will result in a proportionate reduction in growth. For



example, leaving only three achenes on a receptacle results in three areas of growth, directly below and surrounding those achenes. A ring of achenes left on a receptacle results in a ring of growth, and so forth. The ultimate size and shape of a strawberry is thus a function of the number of achenes on the receptacle, the area of receptacle tissue surrounding each achene, and the distribution of the achenes on the receptacle. Receptacles with few achenes will be small, as is the case for fruit from the small tertiary and quaternary blossoms. Location of the achenes on the receptacle will affect the distribution of growth, and therefore berry shape.

Lack of fertilization, or damage to the achenes by frost, insects, or disease, will prevent the synthesis of auxin and result in uneven development, or malformation of the receptacle. The degree and character of the deformity will depend upon the number and location of damaged achenes. Injury to the developing receptacle tissue can also cause berry malformation.

While all strawberry plants share common characteristics, they are also extremely variable according to variety and the environment in which they are grown. Different varieties have been developed to grow all over the world, and may be narrowly adapted to a specific region. Thus varieties developed in one part of the world may not be suitable for production in another region. However, understanding the basic anatomy and functions of the strawberry plant can help farmers develop cultural practices that will encourage optimum plant growth and lead to better harvests and higher quality fruit.

[1] Much of this article was adapted from a chapter appearing in the Strawberry Production Guide for the Northeast, Midwest and Eastern Canada (NRAES-88), M. Pritts and D. Handley, eds. 1998. Some of the illustrations were taken from papers written by M. N. Dana.