

Strawberry Plant Structure and Growth Habit

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Introduction

The strawberry plant has a short thickened stem (called a “crown”) which has a growing point at the upper end and which forms roots at its base (Fig. 1). New leaves and flower clusters emerge from “fleshy buds” in the crown in the early spring. From a cultural viewpoint, it is desirable in our region to have the formation of 1-2 “side stems” called **branch crowns** form during the late fall (Fig. 2). Each branch crown will add to the yield of the main crown by producing its own “flower cluster” or what is technically called an *inflorescence*. Branch crowns and main crowns are structurally identical, and an inflorescence develops at the terminal growing point of each crown (Fig. 3).

Crown growth and development occur when temperatures are above 50° F (mainly in the month of October). Average daily temperatures in November below this temperature will slow branch crown formation and floral development. Row covers may be a good option in November for Camarosa to help stimulate further reproductive development. A well-balanced Camarosa strawberry plant will form 3-5 branch crowns by the time fruiting season begins in the spring.

There is excellent potential for a 2⁺ lb crop per plant (> 15 tons per acre) when you can see the formation of 1-2 side crowns in addition to the main crown (center) in late fall/early winter (Fig. 7). In Chandler and Camarosa it is critical *not to plant too early in the fall* and run the risk of having too many crowns form (try to avoid the development of more than 6 crowns per plant). There is an important “balance” to keep in mind when growing strawberries on plastic, and this has to do with managing to get enough plant growth for adequate cropping (minimum of 3-4 crowns per plant), but if you go to the other extreme (> 6 crowns) fruit size will potentially *decrease* to the point where small fruit size becomes a marketing problem. Significant fruit size depression occurs on 8-10 crown plants.

When planting in the fall it is important to set the plants so that the **midpoint of the crown is level with the soil surface**. If the plant is set too deep, the plant may die as the “growing point” (at the tip of the crown) may have been covered in soil. If the plant is set too shallow, the root system of a bare-root fresh dug plant will be exposed.

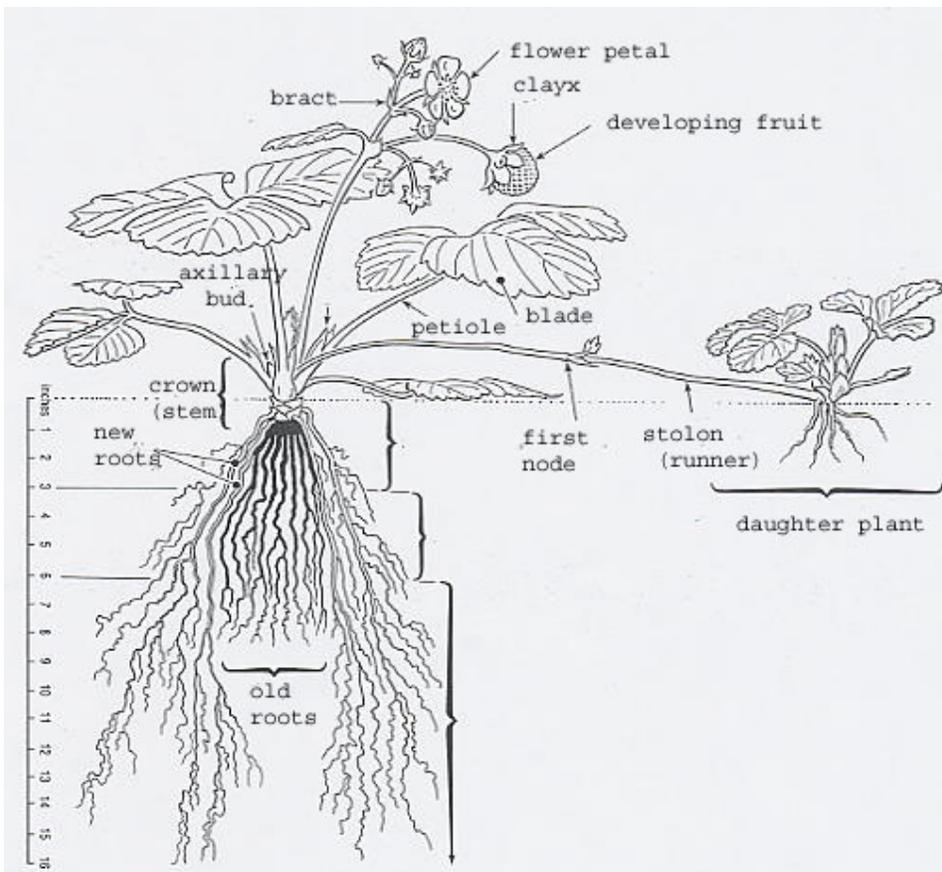


Fig. 1. Strawberry Plant Structure (from Integrated Pest Management for Strawberries, Publication 3351, Univ. Calif., 1994).



Fig. 2. The “growing point” of the strawberry (center). Note the new side stem, or branch crown, that has begun to form in late December (24-Dec-02, Clayton).

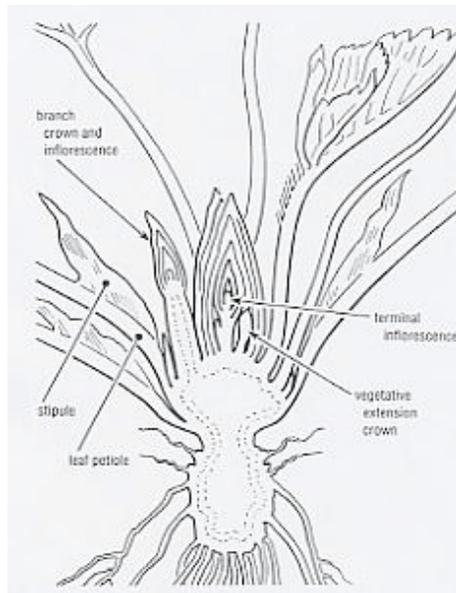


Fig. 3. The crown of the strawberry plant (from Integrated Pest Management for Strawberries, Publication 3351, Univ. Calif., 1994).

Leaves. The leaves are borne along the crown on petioles (leafstalks) arranged in spiral fashion around the crown. Strawberries have compound leaves in which the blade (flattened part of the leaf) is divided into 3 separate leaflets, called a “trifoliolate” (Fig. 4). The strawberry leaf captures light, the source of energy used by plants for food manufacture in photosynthesis. This process requires water and carbon dioxide and involves the movement (translocation) of metabolic products (sugars) from sites of manufacture (in the leaves) to sites of utilization or storage. Sugars are translocated to maturing fruits and other parts of the plant to sustain growth. Late in the fall, sugar is converted to starch in root tissue for winter storage. The number of leaves and total plant leaf area in the late fall/early winter can be correlated with fruit production the following spring.

Individual strawberry leaves live from 1-3 months; however, an untimely early fall freeze, or poor irrigation practices during plant establishment will cause leaves to die sooner. The primary purpose of overhead irrigations following transplanting in the fall is to prevent foliage loss until the root system can develop and absorb sufficient moisture to sustain the plant. Plants should have *three or more fully green leaves* remaining at the end of the initial 3-4 week establishment period, regardless of whether they are fresh dug or plugs. To achieve this outcome, far greater volumes of overhead irrigation are needed for fresh dug bare-root plants than plugs. If the “original” leaves on a fresh dug or plug are lost to drought stress, plant establishment is significantly delayed or “setback” and spring yields will be significantly reduced. The number of leaves and total plant leaf area in the late fall/early winter can be correlated with fruit production the following spring. It is also very important to achieve an adequate plant canopy by late fall as a good leaf canopy acts as an important crown insulator, and is the “cheapest” winter protection you can buy (Figs.5 & 6). An 8-in. plant diameter is about ideal in mid-December.

Most of the water taken up by the plant evaporates through pores called *stomata* in the leaves and stems. The grower must be sure to provide adequate drip irrigations in the spring to replenish water that is taken up by the plant during periods when the stomata are open – strawberry leaves have large numbers of stomata, and water consumption can be very high in warm periods in April and May.

For tissue sampling in late winter and early spring, fully expanded, recently mature trifoliates are selected for tissue sampling starting in early March. The petioles are sampled separately for nitrate nitrogen. Regular tissue sampling in the spring (about every 2-weeks starting after “new leaf” growth in March) and prudent use of N fertilizer and drip irrigation are critical to managing plant size and ultimately fruit quality.

If plant growth is over-stimulated with excess N and watering, the resulting larger plant size and heavy leaf canopy will:

1. Hinder picking – it becomes difficult to “find the fruit” with large “bushes”;
2. There will be an increase disease incidence (mainly botrytis); and,
3. Fruit quality and flavor will be negatively influenced by extra thick plant canopies – if the leaves nearest the berries are well-exposed to light (not shaded by other leaves), you can anticipate higher fruit sugars and more favorable remarks from your customers!

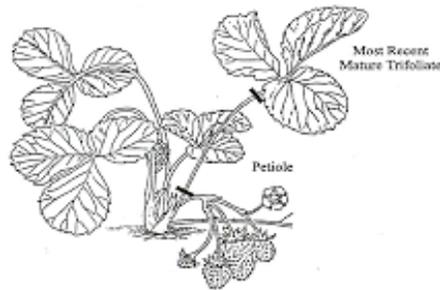


Figure 1. Proper Leaf and Petiole Samples Ensure Reliable Results

Figure 4. Proper leaf and petiole samples ensure reliable results from tissue sampling in the late winter and early spring.



Fig. 5. Chandler with large canopy size on 16-Dec-02 (less was needed).



Fig. 6. Chandler with small canopy size on 16-Dec-02. Floppy is 3 1/2 in.

Roots. The underground parts of the strawberry may be easily ignored – “out of sight out of mind” – but they do: 1) **anchor the plant**, 2) **capture water** and 3) **capture nutrients** from the soil that are necessary for growth and fruit production. In well-

drained, fumigated beds, strawberry roots will penetrate the full depth of the bed. There are usually 20 to 35 primary roots and thousands of small rootlets in a good strawberry root system (Fig. 7). Roots grow most rapidly when the soil is about 55° F. Rooting is active as long as soil temperature is above 45° F. The secondary roots live for a period of days or a few weeks, and are constantly being replaced. They are easily killed by waterlogged soil in winter, or early spring during frost/freeze protections. Also, soil pests like nematodes and root-pathogenic fungi (e.g. *Phytophthora cactorum* – Crown Rot) can severely limit root development.

Water and nutrient uptake. Besides giving structural support, the roots also serve to capture water and nutrients from the soil. The water and nutrients taken up by the roots are distributed throughout the plant in its vascular system. Soil mineral nutrients needed in the largest supply by the strawberry plant include nitrogen (N), phosphorus (P), calcium (Ca), potassium (K), sulfur (S) and magnesium (Mg). Iron (Fe), manganese (Mn), boron (B), zinc (Zn), and copper (Cu) are nutrients required in trace amounts, and are called micronutrients. Natural soil levels of most micronutrients are usually adequate; however, B injection through the drip system in late winter/early spring in very small amounts is routine practice.

Starch reserves in winter. The roots also serve as storage sites for starch reserves during winter. Growers who “push” fall top-growth with extra nitrogen feeding may be doing so at the expense of starch accumulation in the roots. The stored starch is needed for vigorous growth and flowering the following spring and will enhance berry size. When Sweet Charlie strawberries are “forced” in the late fall for fruiting, it is often the case that fruit size and plant vigor will be adversely impacted in spring (Fig. 7).



Fig. 7. Strawberry plugs that have been growing for 5 days (left) and 12 days (right). SC).

You can see the formation of primary roots in the photo (long and stringy appearance) small white secondary roots (rootlets) that make up the bulk of the strawberry root system.



Fig. 8. Sweet Charlie in December! Photo taken on December 8, 2001 (Trenton, SC).

This variety is easily fooled into early blooming and fruiting in the Mid-South in a mild fall. Premature cropping will reduce fruit size and the following spring.

Flowers. The principal parts of the strawberry flower are shown in Fig. 9. Sepals are the small green leaflike structures below the white petals – they enclose the flower at the bud stage, and later on this leaflike tissue is referred to as the berry’s calyx, or “cap.” The strawberry flower has 5 sepals. The stamens are the “male” parts of the flower that

discharge pollen to fertilize the “female” parts of the flower, called the pistils. The numerous pistils are borne on a roundish or conic-shaped flower-supporting stem called the “receptacle.” At maturity, the receptacle becomes the enlarged, juicy “berry.”

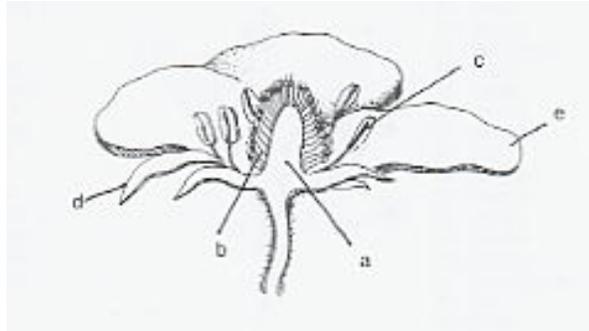


Figure 9. Principal parts of the strawberry flower: (a) receptacle; (b) pistil and fruit wall; (c) anther; (d) sepal; (e) petal.

Botanically, the red fruit we call the “berry” is an enlarged flower stem (receptacle) with many seeds imbedded in the surface. Actually, what looks like seeds really are the “true fruits,” properly referred to as achenes (Fig. 10). Inside the dry ovary wall of each achene is a real seed (ovule) with the potential of becoming a unique strawberry plant (seedling). This offspring is not likely to have any of the desirable horticultural characteristics of the parent strawberry. To preserve strawberry varieties which yield superior fruit, strawberry propagation is generally accomplished by taking runner plants that are identical in genetic makeup to the “mother plant.”

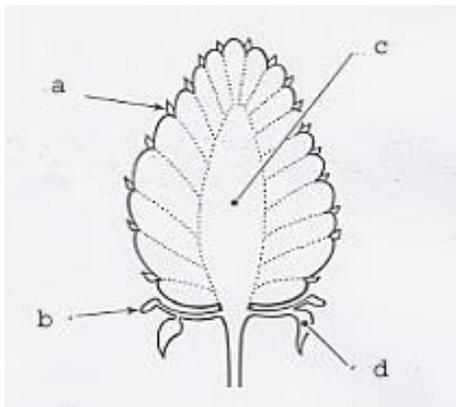


Figure 10. Structural features of the strawberry fruit: (a) achene; (b) stamen; (c) receptacle; (d) sepal (cap).

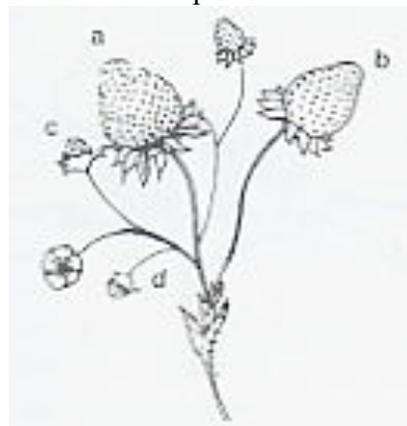


Fig. 11. Fruit cluster: (a) primary fruit; (b) secondary fruit; (c) tertiary fruit; and (d) quaternary berries.

Fruit cluster. Primary berries are not only the largest and first to ripen; they have the most seeds. Secondary berries ripen next and are the next largest in size. Tertiary berries ripen still later and are the third largest. Quaternary berries are the smallest (generally unmarketable) and ripen last (Fig. 11). Development of the fruit from open blossom to ripeness takes 20 to 30 days, depending on weather conditions.