FRUIT-BUD FORMATION IN EVERBEARING STRAWBERRIES

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INTRODUCTION

In the northern part of the United States everbearing strawberries fruit in the spring, in the summer, and in the fall until freezing weather occurs. This habit of continuous bearing seems to be the result of certain environmental conditions in some cases and of genetic characteristics in others.

Since Goff found that fruit-bud differentiation took place in the Clyde, a spring-bearing variety, in September, reports of subsequent investigations have been confined entirely to the spring-bearing varieties. This neglect of the everbearing strawberry is attributed to its comparatively recent appearance in this country and to the fact that it is as yet of little importance in the fruit industry. However, with the recent introduction of the Mastodon variety more interest promises to attach to the growing of this type of strawberry.

The studies reported in this paper were undertaken to determine how and when fruit-bud formation takes place in certain varieties of the everbearing strawberries.

MATERIALS AND METHODS

The investigations were conducted at East Lansing, Mich., during the summers of 1924 and 1925 and at the United States Plant Field Station, Glenndale, Md., during the spring months of 1926 and 1927. The work at East Lansing was confined entirely to the Progressive, an everbearing variety originated by Harlow Rockhill of Conrad, Iowa. The plants used at East Lansing were grown on a well-drained sandy soil. The studies at Glenndale included three varieties, all of which were originated by Rockhill. These plants were grown on a rich clay loam.

Crowns containing the buds for study were collected at intervals of 10 to 15 days throughout the experimental period in both localities. The usual methods of killing, fixing, and embedding as outlined by Chamberlain were followed. Allowing the buds to remain in a 10 per cent hydrofluoric acid solution for about three days made sectioning much easier, because the acid dissolved the crystals of calcium oxalate, which greatly interfered with sectioning. The sections were mounted on slides, and photomicrographs and camera-lucida drawings were made of them.

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The results of the investigations reported herein pertain to work performed at East Lansing, Mich., and done in partial fulfillment of the requirements for the degree of master of science at the Michigan State College, East Lansing, Mich.


DEVELOPMENT OF THE CROWN

Vilmorin \(^5\) says that the practical difference between the single and the perpetual-bearing strawberry can be traced back to an anatomical difference which consists in the production of flowering stems instead of runners from the axils of some of the leaves on the main stems. The investigations reported herein show that in the everbearing strawberry the growing point, which is located at the apex of the crown or runner, may differentiate into a fruit bud almost as soon as the elongating runner thickens into a crown, in some cases before roots appear. (Figs. 1, A and B.) However, a few leaves are usually produced in nearly all new-runner plants of everbearing strawberries before the growing point develops into a fruit bud. After a growing point of a crown has differentiated into an inflorescence there appears in the axils of many of the earlier formed leaves, possibly of all of them, meristematic tissue which may differentiate immediately into an inflorescence. However, there are usually a few or several leaves produced first which form a new crown. Sooner or later the growing point of this crown differentiates into an inflorescence, after which no further elongation of the crown can occur. Similarly, other crowns arise on those already developed, and thus in the course of time an old crown becomes very much branched, as is shown in Figures 4, C and D; 2, A, B, and C.

Everbearing strawberries produce a spring crop at about the same time that the spring-bearing kinds are fruiting. Following the spring crop there seems to be a period during which only a few ripe berries are produced. However, during this time, late May to early July, everbearers produce most of their runners. (Fig. 3.) Such everbearing varieties as Progressive, Rockhill, and Americus are not prolific runner producers. Apparently at the time the spring crop is ripe, or just following it, runners rather than branch crowns are developed in the axils of the leaves. Instead of the formation of only a few branch crowns and the production of runners in the axils of all the leaves, as occurs in the spring-bearing plants, many branches are formed and only a few runners are produced.

FRUIT-BUD DIFFERENTIATION

During the summers of 1925 and 1926, studies in Michigan showed that differentiation of fruit buds in the Progressive variety occurs throughout the summer. However, there was found to be a break in the continuous production of fruit; this break occurred immediately following the maturity of the spring crop. Before these observations were made the interrupted production between the spring crop and the summer and fall crop was assumed to be due to a corresponding break in the continuity of fruit-bud differentiation.

In order to determine how early in the spring fruit-bud differentiation takes place, studies were conducted at the United States Plant Field Station during the spring months of 1926 and 1927 with three varieties, Progressive, Rockhill, and Americus. Only a few early stages in fruit-bud formation were found until late in May. Those early stages which were found in April and early May may have been differentiated the previous fall. It seems apparent that a break

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Figure 1.—A, Runner plants of U. S. D. A. No. 447 strawberry, with flowers open but no roots appearing. July, 1927. B, Runner plants of U. S. D. A. No. 400 strawberry beginning to take root and having flower stalks with open blossoms. July, 1927. C, Young plant of the Progressive strawberry, showing buds on the crown developing in the axils of the leaves, which have been removed. Photographed January 11, 1929. D, Runner plant of the Progressive strawberry which had taken root in June, 1928, showing old fruit stalks attached below the region where new branching is taking place. Photographed January 11, 1929.
occurs in the continuity of fruit-bud differentiation in April and early May, a period when the fruit buds differentiated the previous fall are developing into fruit clusters. Figures 4, 5, and 6 show photomicro-

![Figure 2](image)

**Figure 2.**—A, Old plant of the Progressive strawberry, with old fruit stalks still attached. Photographed January 11, 1929. B, An old Progressive strawberry plant, showing old fruit stalks attached lower on the crown and new flower stalks terminating the new branches. Photographed January 11, 1929. C, Two-year-old Progressive strawberry plant from which leaves and roots have been removed in order to show the branched crown.

graphs of the early stages in fruit-bud development, in both spring and fall, in the three varieties studied.

The fruit that ripens in May and early June develops from buds which apparently differentiated the previous fall, and the fruit that ripens in July develops from fruit buds differentiated late in May and
in June. Because of little or no differentiation in April, little or no fruit is produced in June and early July. Runner production is high during this time, but gradually becomes less, with fruit production increasing as the summer advances.

**DISCUSSION AND SUMMARY**

After producing a spring crop of fruit, strawberries of the everbearing type send out a few runners from the axils of their leaves. Instead of continuing runner production over an extended period, like the spring-fruiting type, everbearers may send out a flower stalk from

![Figure 3.—A seedling clon of everbearing strawberry producing fruit buds on many runner plants and on some before they had rooted. July 13, Osage, Iowa](image)

the leaf axil, though more often they produce very short branches, the growing point of each of which soon differentiates a fruit bud. As a result, fruit is produced throughout the summer from a crown which gradually becomes more and more branched, the process continuing until the cold of winter checks growth.

The almost entire absence of developing flower stalks over a period of three or four weeks immediately following the spring crop, together with the existence of favorable temperatures and long days, are suggested as the causes of the unusual activity of everbearing strawberries in producing runners, new branches, and differentiating fruit buds all at this time.
FIGURE 4.—A, Fruit bud of the Progressive strawberry, showing secondary flowers differentiating on May 23, 1926, at Glenndale, Md. B, Fruit bud of the Progressive strawberry in the process of differentiation on June 27, 1926, at Glenndale, Md. × 90
FIGURE 5.—A, Fruit bud of the Rockhill strawberry in process of differentiation on June 8, 1926, at Glenndale, Md.  B, Fruit-bud differentiation just beginning in the Rockhill strawberry on October 7, 1926, at Glenndale, Md.  X 90
Figure 6.—Fruit bud of the American strawberry, showing secondary as well as primary flowers in process of differentiation on June 8, 1928. X 90