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John E. Sass
Iowa State University

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Development of Axillary Buds of the Tillers of Zea¹

JOHN E. SASS²

Abstract. An inbred line of popcorn and a line that contained teosinte germ plasm were compared with respect to the inflorescences of the numerous tillers produced by plants of these lines. In both lines, all terminal and axillary apices of the tillers initiated inflorescences. No axillary tassels were found on the tillers of either line. On a popcorn tiller, a terminal inflorescence was either a tassel, a tassel that bore a few scattered kernels, an ear, or an ear that had basal tassel branches. Every tiller of the "teosinte-contaminated" corn had a terminal tassel.

The recent revival of interest in the development of axillary buds of *Zea* has been due in part to agronomic considerations, in particular the production of commercially valuable hybrids that produce more than one harvestable ear on a plant. The breeding program has thus called for a search for multiple-eared types of maize as possible sources of the desired germ plasm. Some lines of popcorn are typically multiple-eared and also exhibit considerable tillering, a character that is undesirable in field corn. The introduction of germ plasm of teosinte, *Euchlaena mexicana* into *Zea* has yielded plants that have many ears and many tillers. These characteristics suggested examination of the shoot apices, especially the apices of the axillary buds, as well as all meristematic apices of tillers.

The structure of the pistillate inflorescence of maize had been described in detail in past years, and the extensive literature on the subject has been reviewed by Bonnett (1948), and Kiesselbach (1949). Studies that were related to specific agronomic

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² Professor of Botany, Department of Botany and Plant Pathology, Iowa State University, Ames, Iowa.

problems, such as barrenness, have been reported by Sass and Loeffel (1959) and Sass (1960).

The lines that were used for the present study were a very early popcorn, designated Canadian #3, and a yellow dent corn that contains teosinte germ plasm. Diagnoses were made of the stage of inflorescence development in the more or less elongated axillary shoots of the main stem and of the tillers. The data presented here will be limited to the relative length, and the status of floral development of the inflorescence axes which become the kernel-bearing cob, at successive nodes of the main stem and tillers, at specified dates after planting.³

OBSERVATIONS AND DISCUSSION

The possible occurrence of precocious axillary buds in the embryos of the foregoing types of corn was investigated, and it was found that axillary buds do not occur in the mature, dormant embryos. Furthermore, well defined bud primordia do not become evident until several days after germination. The acropetal formation of axillary buds on the main axis and basipetal transition of these buds to the flowering phase follow the pattern that has been known to occur in many highly diverse types of corn.

Figure 1 shows the growth habit of a typical plant of "Canadian 3" popcorn, 59 days after planting. Plants of this line consistently have three "empty" leaf axils between the tassel and the major ear. The meristematic activity that initiates bud formation is detectable in these upper axils of seedlings, but no bud is evident at anthesis.

The lowermost tiller, #1 in the figure, developed from the lowest surviving axillary bud. The major ear, on which silks had emerged, developed from bud 6, counted acropetally. Thus, this ear is in the axil of the fourth leaf below the tassel. An axillary shoot may be a small, unexpanded bud, a long leafy tiller, or a large harvestable ear on a leafy shank. The terms sucker and stool are also used for elongated leafy axillary branches. The lengths of these axillary structures were measured from the node to the tip of the longest leaf of the tiller. Table 1 gives these lengths on the plant shown in Figure 1.

Tillers were analyzed by dissecting out the bud in the axil of each leaf of the tiller, as well as at the apex. The total length of an axillary bud was found to be of less significance than the length of the inflorescence axis and the extent of floral initiation on the axis. The term "cob" is used herein for a definitely pistil-

³ The plants used in this study were obtained from the breeding plots of the Agronomy Department, by courtesy of Dr. W. A. Russell, Agronomy Department.

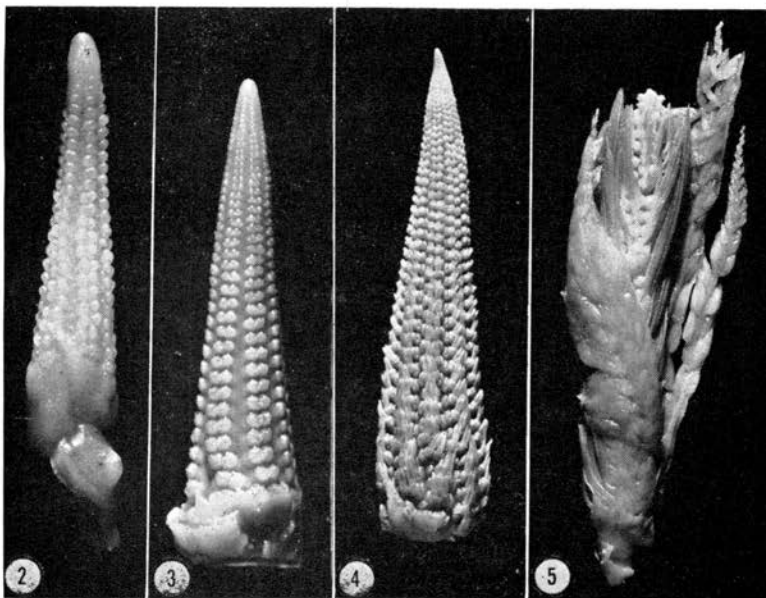


Figure 1. Growth habit of typical plant at anthesis, 59 days after planting.

Table 1. Length of each tiller (axillary branch) of the plant shown in Figure 1. The terminal tassel of the main axis had been shedding pollen, 59 days after planting.

Node 9, 8, 7;	empty
Node 6;	12 cm cob with emerged silks
" 5;	42 cm tiller
" 4;	32 cm "
" 3;	31 cm "
" 2;	78 cm "
" 1;	87 cm " (from lowest surviving bud)

late inflorescence axis, regardless of its length. The pertinent diagnostic characters are illustrated in Figures 2-4. In several lines and hybrids that have been studied previously, and in Canadian 3 popcorn, the axillary buds undergo floral transition when the axis is 1 to 2 mm long, and a 1.5 mm axis may have spikelet primordia on its lower half. The 3.5 mm axis shown in Figure 2 has paired spikelet primordia on the lower 3.4 mm, and only the terminal 1 mm is still meristematic.



Figures 1-5. Inflorescences of "Canadian 3" popcorn.

Figure 2. A 3.5 mm inflorescence with paired spikelet primordia along most of its length.

Figure 3. An 11 mm inflorescence with paired ovaries and a short undifferentiated apex.

Figure 4. A 20 mm "ear," with elongating silks and a very small undifferentiated apical meristem.

Figure 5. A terminal ear with basal tassel branches, on an 87 cm leafy tiller.

Before an inflorescence attains a length of 10 mm, the lower florets become clearly pistillate, style primordia may be evident, and the undifferentiated apical region may be little more than 1/10 of the total length (Fig. 3). A 20 mm cob invariably has long styles (silks) on the lower ovaries, and the residual meristematic apex, which is still elongating, may be a small fraction of the total length.

Table 2 gives the diagnostic data on tiller 1 of Figure 1. All surviving axillary buds had become inflorescences. At the basipetally successive nodes, the inflorescences were shorter and had spikelet primordia along less of the total length. All tillers of this

plant had the same pattern of axillary bud development as tiller 1. By way of comparison with the longest tiller (Table 2), the diagnosis of the shortest tiller, located below the major ear, is shown in Table 3.

Table 2. Length and stage of floral transition of the inflorescence in each axil of an 87 cm tiller of popcorn, 59 days after planting. Terminal has basal tassel branches.

Node 6;	19 mm cob;	silks on basal ovaries
" 5;	22 mm cob;	" " " "
" 4;	16 mm cob;	" " " "
" 3;	12 mm cob;	most of axis in transition.
" 2;	4 mm cob;	¼ of axis in transition.
" 1;	aborted bud.	

Table 3. Length and stage of floral transition of the inflorescence in the axil of each leaf of a 42 cm tiller of popcorn, 59 days after planting. Terminal 82 mm cob, silks on all ovaries.

Node 6;	16 mm cob;	style primordia on basal ovaries
" 5;	8 mm cob;	" " " "
" 4;	16 mm cob;	" " " "
" 3;	18 mm cob;	" " " "
" 2;	25 mm cob;	" " " "
" 1;	basal bud, aborted.	

All tillers of this plant had terminal inflorescences as follows: tiller #6, a 120 mm cob with emerged silks (the major ear in Figure 1); #5, an 82 mm cob; #4, a 45 mm cob; #3, a 28 mm cob; #2, a tassel, bearing a few ovaries with silks; #1, a 55 mm cob with basal tassel branches (Figure 5).

Additional measurements and diagnoses were obtained from tillers of Canadian 3 popcorn, collected 40 to 59 days after planting. The course of floral initiation and development in the axillary apices was so similar to the data in the foregoing tables that detailed tabulation would be repetitious. Only the terminal inflorescences, which may presumably produce harvestable ears, merit special attention here. Of the 28 apices examined, 5 had a tassel, 18 had an ear, 3 had an ear and some tassel branches, and 2 had a tassel bearing a few ovaries. No vegetative apices were found in the 40-day and later collections. Although the apex of a tiller can produce an entirely staminate inflorescence, or one that has both staminate and pistillate florets, the predominant type of terminal inflorescence on the tillers of this popcorn was a purely pistillate ear.

The limited supply of seed of "toesinte-contaminated" maize that was available yielded plants that had 3 to 6 tillers. Preliminary sampling of 3-tillered plants collected 56-60 days after planting showed that the apices of the tillers were either vegetative or in early floral transition. Subsequently, plants that had 4 to 6 tillers were sampled between 60 and 76 days. Only staminate terminal inflorescences were found on the 33 tillers that were available, differing strikingly from popcorn, which

bore predominantly pistillate inflorescences in comparable positions. Further comparison with other types that produce many long, leafy tillers will be needed to determine whether the extent of elongation of an axillary shoot is correlated with the shift of inflorescence primordia to either staminate or pistillate flowering. It is possible that environmental conditions, especially conditions of stress, may influence the type of terminal inflorescence that is produced on tillers.

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The Latex System of Some Native Spurges

ROBERT C. LOMMASSON¹

Abstract. Eight species of *Euphorbia* in the subgenus *Chamaesyce* were investigated anatomically from collections made in Kansas. The latex system is composed of branched nonarticulated laticiferous cells. These laticifers are distributed regularly or apparently at random through the cortex of root and stem depending upon the species. When the outer cortex is destroyed by periderm as in the root or the inner cortex by crushing as in the stem, there are still laticiferous cells apparent in these two organs. The most extensive branching network of laticifers is developed in the leaf. No anastomoses were found. The commonest latex system in the leaf was found to be the subepidermal system.

The latex system of plants was one of the features subjected to investigations of various sorts during the 19th century. By the middle of that century sufficient research on the structure of the latex system had been completed to get a fairly accurate idea of the elements composing those systems in a few of the more common families.

During the latter part of that century investigations as to the function of the latex system had produced some theories which were in disagreement (De Barry, 1884; Groom, 1889). Not much progress in the understanding of the function of latex has been made even until today. Textbooks in plant physiology generally omit any discussion of latex.

¹ Department of Botany, University of Nebraska, Lincoln 8, Nebraska