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The Development of Ear Primordia of *Zea* In Relation to Position on the Plant¹

JOHN E. SASS²

Abstract. The development of auxiliary buds of a yellow dent maize hybrid was studied. Seven buds at acropetally successive nodes survived at least to 68 days after planting and became pistillate inflorescences, potential ears. Meiosis occurred in the basal ovaries of the upper two ears after 68 days, when the styles were 2 mm. long, and complete embryo sacs were present by 71 days. The two upper ears attained approximately the same morphological and cytological stage between 68 and 71 days. The top bud invariably became the harvestable ear. The failure of complete development of the second ear is not ascribed to inadequate ovule development by the time of anthesis, nor to failure of pollination of this ear, but to factors associated with competition prior to, and after anthesis.

The structural development of the ear and kernel of *Zea* has been described in a series of classic papers over a period of many years. Those studies have been reviewed and augmented by Bonnett (1948) and Kiesselbach (1949). In the past, attention was centered on the morphology of the ear and kernel as reproductive structures of the plant and on phylogenetic considerations. Interest is now shifting to studies of the developmental rates of the numerous potential ears at various nodal positions on the plant, to the developmental pattern in the many highly diverse types of maize, and to ear development in relation to cultural practices. For instance, a recent study related to the production of barren stalks (Sass and Loeffel, 1959) showed that in several inbreds and hybrids that characteristically produce one major ear, seven axillary buds may survive, and that all such buds differentiate into ear primordia. Diagnoses were made by dissection. The uppermost axillary bud, designated top bud or top ear, was invariably the source of the harvested ear. The second bud, herein named bud 2 or ear 2, frequently did not extrude silks in time to become pollinated, or produced, at best, an inferior ear. The growth of ear primordia below bud 2 was greatly retarded after 55 days. The present report is limited to ear development in a one-eared yellow dent hybrid.³

OBSERVATIONS AND DISCUSSION

The acropetal development of florets was studied in dissections

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³A multiple hybrid derived from eight inbred lines; hybrid plants were made available by courtesy of Dr. W. A. Russell, Agronomy Department.

and microtome sections. Stained sections made possible the detection of the localized sub-surface meristematic activity that gives rise to floral primordia (Figures 3, 4), and provided diagnoses of embryo sac development (Figures 6, 7). Sections confirmed the diagnoses made by dissection that the lower-most and most retarded bud, the seventh bud basipetally, was entering floral transition approximately 55 days after planting (Figures 1, 2). At 68 days the basal portion of the short cob axis of this bud had small floral primordia, which produce floret primordia on surviving buds (Figure 3). At this age, tissue deterioration was evident in the basal bud, which eventually aborted.

The axis of the top ear had developed primordia along most of its length by 55 days (Figure 4), and by the 68th day it had floral primordia at the end (Figure 5). The mean length of second ears at 68 and 72 days was considerably less than that of top ears in the hybrids studied previously (Sass and Loeffel, 1959). This relative mean length was not ascertained in the present hybrid, but acropetal development of floral primordia on ear 2 did not lag measurably behind ear 1 at either 68 or 72 days.

The progress of ovary and ovule development was judged primarily by the extent of closing of the stylar canal, by the initiation of the style, and by the development of the integuments and embryo sac. On the basal, most advanced ovaries of the top two ears, the stylar canal was still wide open at 68 days, and the style had begun to elongate; the integuments were short primordia, and sporocyte had undergone some enlargement (Figure 6). At 71 days, the edges of the ovary wall had closed the stylar canal, but the integuments had not yet closed over the micropylar end of the ovule. The longest styles had attained a length of 2 mm. Meiosis occurred between 68 and 71 days, and complete 8-nucleate embryo sacs were present in the most advanced ovules of the top two ears at 71 days (Figure 7), showing that the upper two ears had attained essentially the same morphological and cytological stage of development. Ovules at the stage shown in Figure 7 are presumed to be ready for fertilization. Material collected after 71 days was not processed for microscopic diagnosis.

It is known that if the upper ear is removed at anthesis, rapid silking of the second ear occurs and it becomes a full-sized ear. The third ear does not commonly respond in a similar manner. These observations are correlated with the morphological and cytological status of the two upper ears at anthesis, but do not account for the poor development of the second ear even when silks emerge and abundant pollen is available. The partial or complete suppression of the second ear, and the drastic suppression of the third ear in

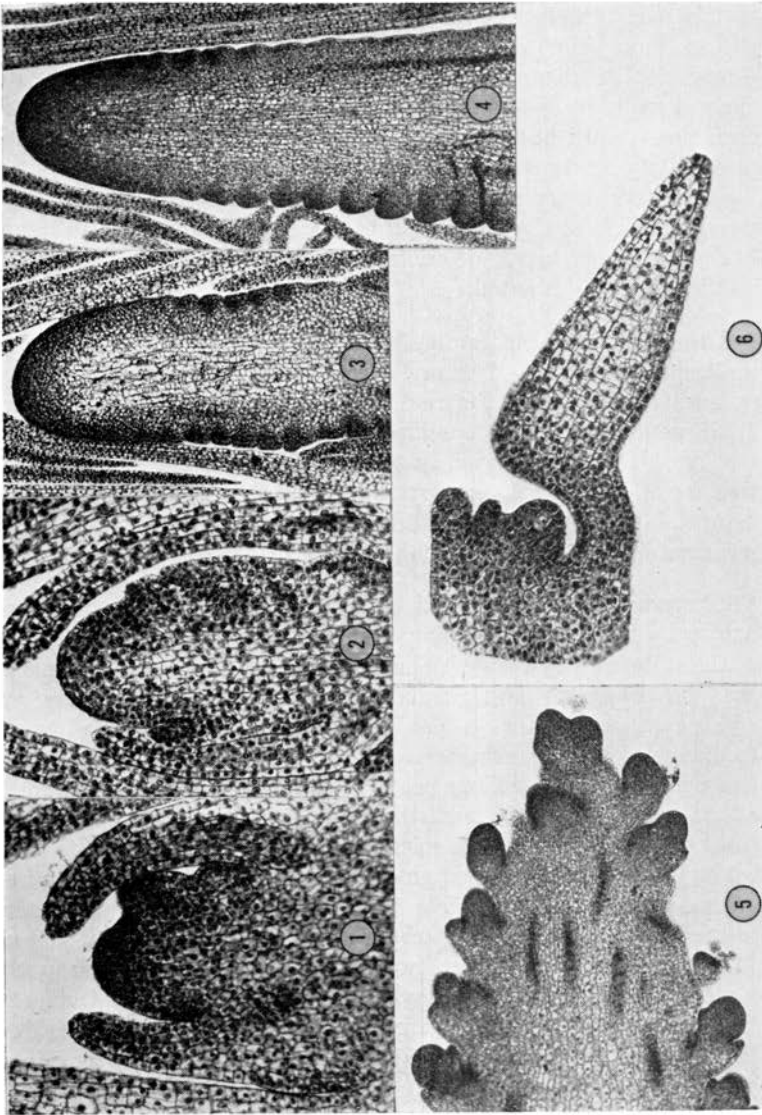


Figure 1. Vegetative apex of sixth bud below major ear of maize, 55 days after planting.
 Figure 2. Early phase of floral transition in sixth bud, 55 days.
 Figure 3. Elongated inflorescence (cob) axis with lateral floral primordia, sixth bud, 68 days.
 Figure 4. Terminal third of uppermost bud (major ear), with floral primordia almost to meristematic apex, 55 days.
 Figure 5. Apical portion of top bud with floral primordia along entire length to apex, 68 days.
 Figure 6. Ovary of fertile floret from base of top bud, 68 days. Terminology of structures is given in the legend of Figure 7.

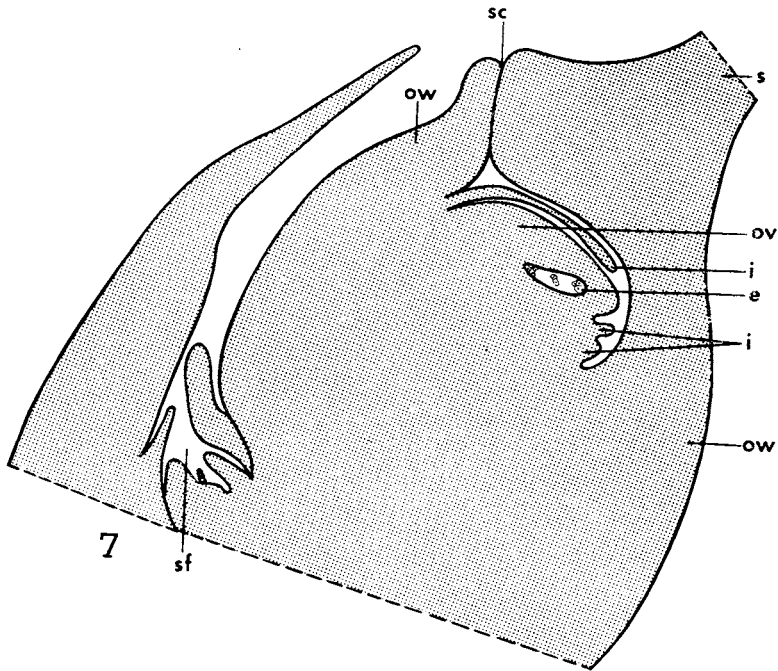


Figure 7. Fertile and sterile floret from base of top ear, which becomes major ear, 71 days. Abbreviations: e, embryo sac; i, integuments; ov, ovule; ow, ovary wall; s, style; sc, stylar canal; sf, sterile floret.

such one-eared maize, may be due to some competitive advantage of the top ear. This study is being extended to "prolific" types of maize that characteristically produce several to many harvestable ears on a plant.

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