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DEVELOPMENT OF THE VASCULAR SYSTEM
OF CORN

A. L. HERSHEY AND J. N. MARTIN

The body of a plant is a cooperative system of cells, tissues, and organs. Yield is a function of the cooperation of these structures. Viewing the plant from this angle a knowledge of the kinds, relationships and time of formation of tissues of *Zea mays* is essential for an understanding of the factors which influence yield.

Due to the fact that the water and minerals that the plant receives from the soil must pass through the vascular tissues of the lower internodes, this portion of the stem is of vital importance to the plant. If the vascular system in the lower internodes is established at an early period in the growth of the plant, this places a limiting factor upon the further development of the plant and its yield. For this reason a study was made to determine the time of appearance and rate of development of the vascular bundles in the two lower internodes.

The data used in determining the time and rate of the development of the bundles were obtained through a study of five varieties of yellow dent corn, commonly grown in Iowa. The procedure of study consisted in taking cross-sections from the middle of the first and second internodes of plants collected at five different periods of growth. By means of these sections, it was possible to trace the development and the increase in number of vascular bundles during the growth of the plant.

Previous to the thirtieth day it is very difficult to recognize the vascular bundles and estimate their number, due to the fact that the majority of the bundles are in the primordial stage.

The first step in the development of the bundles is the formation of small and numerous strands of vascular primordia scattered through the other tissues of the stem, but always more numerous near the periphery. Such primordia appear as aggregates of small cells. These cells have thin walls, relatively large nuclei and small amounts of dense cytoplasm.

This first stage is followed by a second stage of development characterized by enlargement of cells and differentiation of phloem and xylem. By the fifteenth day around thirty per cent of the bundles have reached this second stage of differentiation. The majority of the bundles in this stage of development are located in

the central region of the stem, whereas the undifferentiated bundles are numerous in the peripheral region.

A study of sections taken from plants thirty days of age show similar anatomical features as those observed at fifteen days. However, approximately 62 per cent of the bundles have assumed the structure and form of mature bundles; but many of the peripheral bundles are still undifferentiated.

The rapid formation of bundles continues until the forty-fifth day. By the thirty-seventh day around 89 per cent of the bundles are fully established, and over 92 per cent are developed by the forty-fifth day.

Another count of the bundles was made after the corn had reached maturity. At this time the average number of bundles was 680 in the first internode and 750 in the second internode. The number of bundles per plant ranged from 400 to over 950, depending mostly upon the thickness of the stem.

In order to determine whether these variations in size of stem and number of bundles were a result of environmental factors, a further study was made of plants grown under similar field conditions, but at different rates of planting. Some plants were also shaded. The following tables show that a very marked reduction in the number of bundles may be caused by such factors.

FIRST INTERNODE

PLANTS PER HILL	NO. OF VAS. BUND.	PER CENT REDUCTION
1-3	680	—
3-5	666	2%
5-10	496	27%
10-15	380	44%
15+	345	49%
1-3 (shaded)	348	49%

SECOND INTERNODE

PLANTS PER HILL	NO. OF VAS. BUND.	PER CENT REDUCTION
1-3	750	—
3-5	709	5%
5-10	570	24%
10-15	403	46%
15+	403	46%
1-3 (shaded)	384	49%

SUMMARY

1. More than 90 per cent of the total number of vascular bundles in the lower internodes of yellow dent corn are formed by the forty-fifth day.

2. The number of vascular bundles is influenced more or less by environmental factors. Crowding and shading of plants reduces the number of bundles. More than five plants per hill causes a very marked reduction.