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Sue M. Maule
University of Minnesota

Luisa S. Saniel
University of Minnesota

GROWTH CORRELATION IN SHOOTS OF ZEBRINA PENDULA SCHNIZL.

SUE M. MAULE AND LUISA S. SANIEL
University of Minnesota, Minneapolis

The object of this study is to determine the correlation, if any, between the growth of leaf blade, leaf sheath and internode of the *Zebrina* shoot.

MATERIALS AND METHODS

Seven terminal shoots of Zebrina were collected between January 24 and January 28, 1955, from the Greenhouse of the Department of Botany, University of Minnesota. These were chosen from among shoots with about eight visible leaves. Measurements were made of the length and width of the leaf blades, length of leaf sheaths, and length of internodes. All measurements were made on living material. A steel millimeter ruler, an ocular micrometer, and a stereoscopic binocular microscope were used in making the measurements, the combination of these being adapted to the size of the leaves being measured. The widths of the leaves were measured at the widest point of the blade. The leaf sheath was measured from its point of attachment to the stem to the region of transition to the leaf blade. The leaf sheath along with the blade was carefully detached from the stem with the aid of a dissecting needle prior to measurement. Longitudinal hand sections were made of the shoots for the study of possible intercalary meristems.

In numbering the individual leaves of each shoot, the oldest leaf was designated as 1. Plants 1, 3, and 7 had a total of ten leaves including the smallest primordium; plants 2, 4, 5 and 6 had eleven leaves.

It was impossible to follow the growth of any individual leaf from its initiation as a leaf primordium to maturity. Therefore, the assumption was made that the sequence of leaves from the youngest to the oldest along the stem represents the equivalent of the ontogeny of any single leaf. This assumption is valid only if the growth pattern of each leaf is a precise replica of the rest. It is granted that there probably is a deviation to some degree from such a common growth pattern, and that this fact must be kept in mind in reviewing the data.

The blade is considered to be mature when it uncurls and flattens out following its emergence from the sheath of the next lower leaf. Another criterion is the achievement of a uniformly green coloration down to the base of the blade.

OBSERVATIONS

Rate of growth in length and width, with respect to time measured in terms of plastochrons: The average length and width of leaf blade is shown graphically in Fig. 1. These values are plotted against the corresponding plastochrons. When the leaf primordium is initiated, its width is greater than the length (Fig. 1A). But the rate of elongation is greater than the rate of increase in width. Therefore, between the 9th and 10th plastochrons, the length of the leaf blade surpasses the width. The width and length follow similar sigmoid growth patterns until maturity is approached between the 5th and 6th plastochrons. The graphs (Fig. 1), especially that for length of blade, indicate a pronounced tendency for the achievement of maturity at progressively smaller dimensions (*cf.* the shaded symbols). This is not an unfamiliar phenomenon, since such gradients may be observed in many kinds of plants. It may also be true that each successive leaf follows a slightly different sigmoid course of growth. Thus the curves representing the development of the immature leaf blades (unshaded symbols) may well be composites whose components are drawn from corresponding portions of a family of sigmoid growth curves.

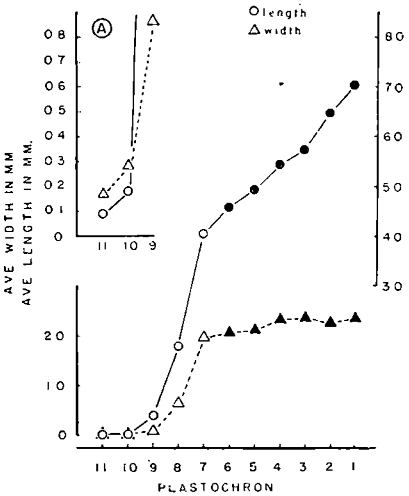

FIG. 1

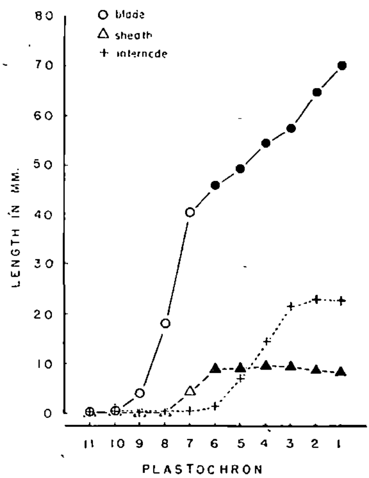

FIG. 2

Correlation in growth of length of leaf blade relative to that of leaf sheath, and of both to length of internode: In Fig. 2 the averages of the length of the leaf blade, leaf sheath and internode are plotted arithmetically against time in terms of plastochrons. A comparison of the three sigmoid curves shows the blade is the first of the three structures to elongate. During the acceleratory phase of elongation of the blade there is virtually no growth in length of the sheath and internode. The acceleratory phase of the elongation of the sheath corresponds approximately to the time at which the blade enters the deceleratory phase of its Grand Period of Growth. So rapid is the increase in length of the sheath, once it begins to elongate, that it achieves mature length during the same plastochron as does its associated blade. Similarly the internode enters into its acceleratory phase of growth at about the time that the sheath enters into its deceleratory phase. In the longitudinal hand sections of the shoots, intercalary meristems were found. These latter may well have been influenced by auxins or enzymes which also influence the growth of leaf blade and sheath.

From the observations described it appears that there is a positive correlation between the time of initiation of acceleratory growth of leaf sheath with the time of initiation of deceleratory growth of the blade. A similar relationship seems to obtain between internode and sheath. The maximum influence of growth stimulating or other substances may be assumed to pass progressively from blade to sheath to internode. The period of decreasing influence of such substances in one structure corresponds roughly to the period of their increasing influence in the next lower structure in the sequence blade-sheath-internode. It has not been demonstrated in this study that the elongation of the structures measured is associated with auxin concentration. Therefore, any implied causal relationship between auxin (or enzyme) production and the observed growth patterns must be viewed simply as a working hypothesis. From a morphological point of view there is a positive correlation between significant portions of the growth process in the sequence of structures concerned.