Chaudhary Mahadeo Prasad College

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Root-Stem Transition

It has been stated that the vascular skeleton in a plant is formed due to continuity of root-stem axis and the lateral appendages. The epidermal tissues and ground tissues are directly continuous in the two organs, stem and root.

But the arrangement of primary vascular tissues is distinctly different in the two organs, roots having radial vascular bundles with exarch xylem and stems usually having collateral bundles with endarch xylem.

A region actually exists where changes and adjustments take place, so that the two markedly different types of vascular tissues ultimately become continuous. The change involving inversion or twisting of xylem strands from one type of structure to another is referred to as vascular transition, and the region of the axis where changes occur is called transition region.

This region is usually short, changes may take place gradually or rather abruptly at the top of the radicle and more commonly in hypocotyl—at its base, centre or upper part. The structure of the region often becomes more complex due to origin and departure of cotyledonary traces. The stele may enlarge in diameter in the transition region. The changes occur according to some plans. An account of a few types that have been studied is given here.

I. In this type xylem strands fork by radial division and the two branches formed swing laterally, one to the right and one to the left by 180°, and join the phloem strands. The latter have remained unchanged all through, and run as straight strands from the root to the stem. That is how the radial bundles with exarch xylem become collateral ones with xylem endarch.

The number of primary bundles in the stem here is equal to the phloem groups present in the root. This type of vascular transition has been noted in Mirabilis of family Nyctaginaceae, Fumaria of family Fumariaceae, etc.

II. The second type, what is really more common than the first one, involves forking in both xylem and phloem strands. The phloem branches remain in same position, whereas the branches of xylem strands swing laterally, as in the first type, and ultimately join up with the phloem strands.

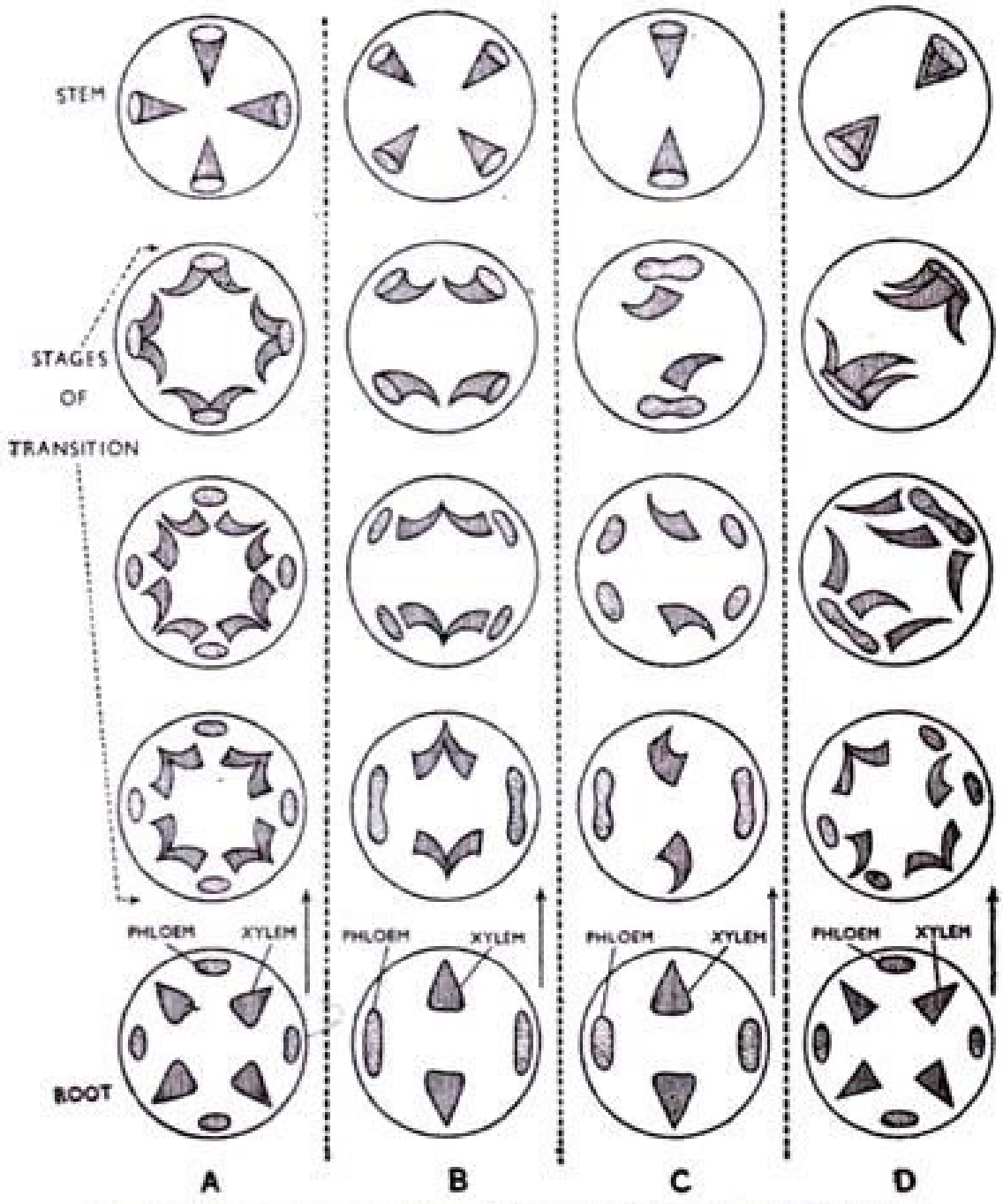

Fig. Root-stem transition. Diagrams of four types A, B, C, and D.

Thus the number of bundles in the stem is twice that of phloem groups present in the root. This type has been noticed in Cucurbita of family Cucurbitaceae, Acer and Phaseolus of family Leguminosae, Tropaeolum of family Geraniaceae, etc.

III. In this type xylem strands do not fork, but while passing upwards they swing laterally by 180°. The phloem strands divide; the branches swing and eventually join up with xylem strands.

So the number of bundles in the stem is equal to that of the phloem groups of the root. This type occurs in Lathyrus, Medicago of family Leguminosae and Phoenix of family Palmae.

IV. Here half of the Xylem strands fork and swing, whereas the other half do not divide, but become inverted. The phloem strands do not undergo any division, but simply fuse. In the meantime the triple xylem strands—the branches of one strand and an unbranched inverted one, join up with the phloem strands which have united in pairs.

Thus, the bundle in the stem is the product of fusion of five strands and the number of bundles is half that of the phloem groups present in the root. This type, though of rare occurrence, has been found in some monocotyledons like Anemarrhena of family Liliaceae.

Some authors are, however, of opinion that this approach towards interpretation of transition region between the stem and the root is not happy. According to them "transition region represents connection not between two axial organs with somewhat different arrangement of tissues but between an organ with an axial vascular cylinder and one whose vascular system develops in relation to leaves".—Esau.

In that case transition region should really explain the relations between the roots and the traces of the first- formed foliar organs of plants. It has been worked out in some cases that inversion of the xylem strands does not occur.

In carrot the cotyledon has three traces—of which the median one consists of exarch xylem flanked by two lateral phloem groups, whereas the two lateral traces are collateral with outer phloem and inner endarch xylem. That shows the continuity between the vascular system of the cotyledon and root without inversion of the xylem strand.