MORPHOLOGICAL studies on soybean Glycine max L. are few in number and pertain to segments of structural detail and do not stress the developmental pattern. The knowledge of the normal development would be particularly useful in studies that involve experimental treatment that may affect the normal course of development.

REVIEW OF PERTINENT LITERATURE

Kondo (8) described Glycine as having two plumular leaves, a primary root system, and two cotyledons. Bell (1) reported that prior to germination the epicotyl of the embryo possesses several foliage leaves. More recently, Kato, Sakaguchi, and Naito (7) described the presence of the first trifoliate leaf primordium at dormancy.

The first shoot apex study reported for Glycine was presented in detail by Sun (10). He reported that the shoot apex is delimited into four zones; a two-layered tunica, the central initiation zone, the peripheral and rib meristem zone.

The use of plastochronation as an approach to the study of the soybean stem apex and related leaf histogenesis was first reported by Sun (10). He observed that when a given leaf primordium had developed to a height of about 80 to 90 microns, the next leaf primordium is initiated. Leaf initiation is indicated by anticlinal divisions in the tunical layer and periclinal divisions in the outer corpus.

Compton (4) studied the anatomy of the hypocotyl in certain legumes in relationship to possible phylogeny of the family. Weaver (11) recently substantiated some of Compton's findings by investigating the root-hypocotyl-cotyledon axis of several soybean varieties and concluded that this axis is a single unit.

The first ontogenetic study of the stem of soybean was described by Bell (1). He described the stem as an endarch collateral dictyosteol with annular, spiral, and pitted vessel segments; the primary xylem is present but not abundant throughout the vascular system of the unifoliate leaf. An indentation is present on the abaxial surface of the cotyledons and is prominent in certain varieties and species (Figure 3).

The cotyledons.--The thick fleshy cotyledon has a netted-veined vascular system (Figure 6). The epidermis consists of cuboidal cells that are approximately 16 microns in each dimension. Stomata are present on both surfaces. The mesophyll consists of 2 to 3 adaxial layers of elongated cells, averaging 70 × 30 microns in size, and cells which are loosely arranged and have large intercellular spaces (Figure 1). The cells contain globules of starch of irregular size, shape, and undetermined chemical composition. An indentation is present on the abaxial surface of the cotyledons and is prominent in certain varieties and species (Figure 3).

The plumule.—The dormant plumule has two unifoliate leaves with conduplicate venation. Mature protophloem elements are present but not abundant throughout the vascular system of the unifoliate leaf. Xylem initials are present in some procambium strands (Figure 5). Two stipules occur at the base of the unifoliate leaf. At the level of the stem apex, one procambium strand (Figure 7). The level of the stem apex of the plumular axis has a two-layered tunica, and a massive corpus in which the outer corpus prior to dormancy, indicating that a leaf primordium had been initiated.

The radicle.—The apical meristem of the radicle consists of two zones; the stelar initials and the other details of the root axis as described by Sun (10).

The cotyledonal axillary buds.—The apical meristem of an oblique dome with a uniseriate tunica. Periclinal divisions of the outer corpus cell, adjacent to the tunica, indicate that a leaf primordium had been initiated prior to dormancy.

EXPERIMENTAL RESULTS AND OBSERVATIONS

The Dormant Embryo

The cotyledons.—The thick fleshy cotyledon has a netted-veined vascular system (Figure 6). The epidermis consists of cuboidal cells that are approximately 16 microns in each dimension. Stomata are present on both surfaces. The mesophyll consists of 2 to 3 adaxial layers of elongated cells, averaging 70 × 30 microns in size, and cells which are loosely arranged and have large intercellular spaces (Figure 1). The cells contain globules of starch of irregular size, shape, and undetermined chemical composition. An indentation is present on the abaxial surface of the cotyledons and is prominent in certain varieties and species (Figure 3).

The plumule.—The dormant plumule has two unifoliate leaves with conduplicate venation. Mature protophloem elements are present but not abundant throughout the vascular system of the unifoliate leaf. Xylem initials are present in some procambium strands (Figure 5). Two stipules occur at the base of the unifoliate leaf. At the level of the stem apex, one procambium strand (Figure 7). The level of the stem apex of the plumular axis has a two-layered tunica, and a massive corpus in which the outer corpus prior to dormancy, indicating that a leaf primordium had been initiated.

The radicle.—The apical meristem of the radicle consists of two zones; the stelar initials and the other details of the root axis described by Sun (10).

The cotyledonal axillary buds.—The apical meristem of an oblique dome with a uniseriate tunica. Periclinal divisions of the outer corpus cell, adjacent to the tunica, indicate that a leaf primordium had been initiated prior to dormancy.

MATERIALS AND METHODS

The soybean variety Hawkeye was used in this study. Seed of the 1956 crop was obtained through the courtesy of C. R. Weber of the Iowa State University of Science and Technology Experiment Economics Experiment Station, Ames, Iowa. Project No. 1179. The 1956 crop was obtained through the courtesy of C. R. Weber of the agronomy farm. The planting date was May 28, 1957.

Seeds were also germinated in plastic crispers on a substratum of screened sphagnum moss in the germinators of the University Seed Testing Laboratory. Some seeds were germinated in four-inch pots and germinated in soil in the greenhouse. Collections of the germinating material were made at 4-hour intervals up to 144 hours. The field material was used in the alternate days, at approximately the same time of day, on June 3, up to the time of first visible flowering.

The material was killed in Craf III and was infiltrated with paraffin using the ethyl alcohol-xylene series. Sections were cut at 11 microns. The stains used were carmine, safranin-fast green (9).

Experimental results and observations

The Dormant Embryo

The cotyledons.—The thick fleshy cotyledon has a netted-veined vascular system (Figure 6). The epidermis consists of cuboidal cells that are approximately 16 microns in each dimension. Stomata are present on both surfaces. The mesophyll consists of 2 to 3 adaxial layers of elongated cells, averaging 70 × 30 microns in size, and cells which are loosely arranged and have large intercellular spaces (Figure 1). The cells contain globules of starch of irregular size, shape, and undetermined chemical composition. An indentation is present on the abaxial surface of the cotyledons and is prominent in certain varieties and species (Figure 3).

The plumule.—The dormant plumule has two unifoliate leaves with conduplicate venation. Mature protophloem elements are present but not abundant throughout the vascular system of the unifoliate leaf. Xylem initials are present in some procambium strands (Figure 5). Two stipules occur at the base of the unifoliate leaf. At the level of the stem apex, one procambium strand (Figure 7). The level of the stem apex of the plumular axis has a two-layered tunica, and a massive corpus in which the outer corpus prior to dormancy, indicating that a leaf primordium had been initiated.

The radicle.—The apical meristem of the radicle consists of two zones; the stelar initials and the other details of the root axis described by Sun (10).

The cotyledonal axillary buds.—The apical meristem of an oblique dome with a uniseriate tunica. Periclinal divisions of the outer corpus cell, adjacent to the tunica, indicate that a leaf primordium had been initiated prior to dormancy.