Embryology of Mono- and Multigerm Fruits in the Genus Beta L.

HELEN SAVITSKY[1]

Embryology of multigerm seed balls was studied in *B. vulgaris L.* Development of monogerm fruits has been studied in all three sections: *Vulgares Tr., Corollinae Tr.* and *Patellares Tr.*

Beta Vulgaris, Multigerm Sugar Beet

Development of multigerm seed balls in *B. vulgaris* is as follows: The apex of the floral axis is built of meristematic tissue (Figure 1, upper left). The cells of this tissue are small and contain dense protoplasm. They are capable of rapid growth and cell division. Proportionally with the growth of the seedstalk, meristematic tissue of the apex produces new primordia of the bracts on the sides of the growing point. The edges of the apex of the meristematic tissue develop small primordia of flowers and seed balls in the axils of the bracts (Figure 1, upper right). The proturberances grow fast and differentiate the upper extended part, the receptacle, and a lower part, the peduncle (Figure 1, second from top, right). Each receptacle produces a flower.

The primordium of the second flower in the seed ball is formed before the protuberances of the sepals appear on the first receptacle, or at the time of their appearance. The edges of the meristem of the first receptacle come down covering the outside of the peduncle. Meristematic tissue forms a small swelling on the side of the peduncle at some distance from the first receptacle (Figure 1, third from top, right). This small swelling grows and turns into a protuberance and later into a new receptacle on the side of the same peduncle. Two, three and four such protuberances developing from these receptacles can be borne on a common peduncle and they correspond to the number of flowers in the seed ball (Figure 1, lower left). All flowers of the same seed ball develop simultaneously (Figure 1, lower right).

The bases of the ovaries of all flowers are imbedded in the tissue of the same peduncle (Figure 1, middle left). All flowers are joined by the tissue of the peduncle thus forming the seed ball, but the upper part of the buds, beginning from the base of the sepals, grows over the peduncle and gives the impression that each bud is developing separately. The individual flowers in the seed ball are borne together, but they do not grow together as is often assumed.

Figure 1. (See page 161) *Beta vulgaris* multigerm sugar beet: Upper left—apex of the floral axis x 300. Upper right—Primordium of the seed ball x 300. Center left—three matured buds in one seed ball x 20. Second from top, right—the receptacle and peduncle x 300. Third from top, right—beginning of development of second receptacle under first one x 300. Lower left—two receptacles on the common peduncle x 300. Lower right—two young buds developing in one seed ball x 68.

[1] Collaborator, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, in cooperation with the Curly Top Resistance Breeding committee.

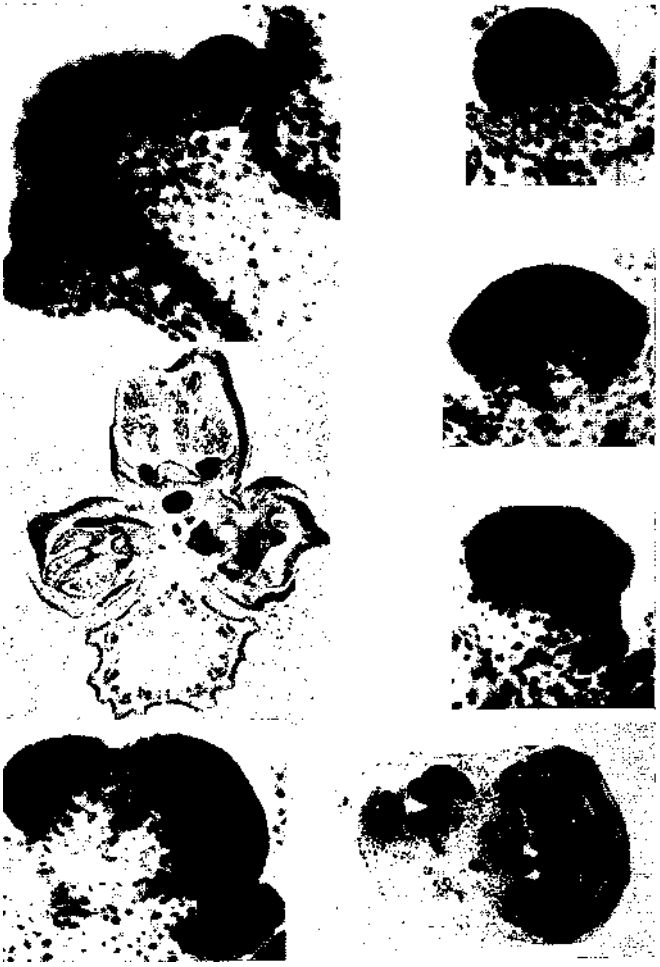

Figure 1.

Beta Vulgaris Monogerm Sugar Beet

In monogerm sugar beet plants the meristematic tissue of the apex of the floral axis produces also primordia of bracts, and small primordia of flowers in their axils. The protuberance of each flower in a short time forms a receptacle and a peduncle (Figure 2, upper left). The meristematic tissue of the receptacle does not come far down in monogerm beets and does not produce new receptacles. Only one receptacle develops on each peduncle; therefore, separate buds are always located in the axil of the bracts (Figure 2, middle top, and upper right). The formation of a flower involves the entire meristem of the receptacle. Monogerm races of *B. vulgaris* do not produce seed balls, they produce simple fruits. Each bud rests on a small peduncle. In monogerm plants the length of the peduncle is about one-third as long as in multigerm plants. Therefore, monogerm fruits shatter less than the seed balls in the majority of sugarbeet races.

Beta Lomatogona

The mode of production and development of the buds in *B. lomatogona* (Fisch and Mey) does not differ from the mode of development in the monogerm sugar beet. The primordia of the flowers are borne in the axils of the bracts. Additional receptacles and buds never develop on the same peduncle. Individual flowers grow in the axils of bracts of the floral axis in *B. lomatogona* (Figure 2, middle left). The length of the peduncle in the matured buds is the same as in monogerm sugar-beet plants, but the width of the peduncle in *B. lomatogona* differs from multi- and monogerm plants of *B. vulgaris.* Narrow peduncles are typical of *B. lomatogona* and cause comparatively easy shattering of the seeds (Figure 2, middle right). Like the monogerm sugar beet, *B. lomatogona* has simple fruits but not seed balls.

Beta patellaris and Beta procumbens

In spite of monogerm fruits in section *Patellares Tr.,* development of fruits in *B. patellaris* Moq. and *B. procumbens* Chr. Sm. follows the type of development of multigerm seed balls in sections Vulgares and Corollinae. Meristematic tissue of a protuberance produces several receptacles on the sides of the same peduncle (Figure 2, lower left). Each receptacle produces a single flower, but every flower develops its own pedicel. Thus, simple fruits but not seed balls are formed. The pedicels of all flowers in one inflorescence are joined at their base and form the umbel (Figure 2, lower right). The long and narrow pedicels in *B. patellaris* and *B. procumbens* cause the extremely easy shattering of fruits in these species.

Figure 2. (See page 163) Top row, *Beta vulgaris* monogerm sugar beet: Left—the receptacle and peduncle x 300. Center—the floral axis x 20. Right—developed bud in the axil of the bract x 68.

Center row, *Beta lomatogona:* Left—the floral axis x 20. Right—developed bud in the axil of the bract x 68.

Bottom row, *Beta patellaris:* Left—development of the second receptacle on the common peduncle x 300. Right—developed buds on the pedicels in one inflorescence x 68.

Figure 2.

Conclusions

The type of inflorescence in beets has been described as a spike, but the individual flowers and seed balls of beets do not grow directly on the floral axis, they are connected to the stem by peduncles or pedicels. Thus the inflorescence in all species of *Beta L.* is a panicle and not a spike.

The panicle bears simple fruits in *B. lomatogona* and monogerm sugar beets. In all sub-species and varieties of *B. vulgaris*, including ordinary sugar beets, the panicle bears multiple fruits or seed balls. As in all other species of section Corollinae *(B. trigyna*, Waldst and Kitt, *B. intermedia*, Bunge, etc.) the panicle bears seed balls. In *B. patellaris* and *B. procumbens* the panicle bears umbels.

Only in *B. lomatogona* and in monogerm races of *B. vulgaris* can it be considered that the fruits are truly monogerm in their origin. Therefore, only these two groups are valuable for the production of monogerm varieties.