

A CASE OF ABNORMAL FLOWER STRUCTURES
CONNECTED WITH REDUCED FERTILITY IN
SOLIDAGO VIRGAUREA L.

BY

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With plates 27 and 28

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In 1949 the author noticed *S. virgaurea* with the spreading part of the ray flowers, the so called rays, "split" into narrow lobes (Plate 27 B; a normal individual is illustrated in Plate 27 A). The observation was first made on a plant, that had settled with some normal ones into a flower box; it seems probable that the plants have been brought there as "seeds" among the soil rests from a cleaned collecting container. Having thus become acquainted with the modified plant, similar individuals could be collected in nature; (Baarn, province of Utrecht; on the slopes along a railway, September 1949, specimens in herb. pr.).

An examination of the abnormal flower structures provides the distinction of two groups, as a result of the floral organization of *S. virgaurea*, there being two types of flowers in the head: the outer zygomorphic, female ray flowers and the inner actinomorphic, perfect disk flowers.

The flower differences observed may be characterized as follows.

The differing ray flowers show from one to five narrow lobes of varying breadth. Some instances are represented in Fig. 1, B, C, D and E.

The differing disk flowers show deviations in corolla structure. The anthers are free in most cases and no more united; occasionally a few were found to be united. Some instances are illustrated in Fig. 2, B, C, D and E. Pollen production is reduced or wanting.

Drawings are given both of a normal ray and a normal disk flower and of some main forms of abnormal ones. The description hereafter relates to the altered flower parts and to the pollen production only.

NORMAL FLOWERING HABIT

Ray flower (Fig. 3, A). One side of the corolla is extended into a single, broad, flat, spreading lobe, in form and size typical of the species (this part is named in Floras in plural: rays, the term that is used above). Pappus hairs \pm equal in length.

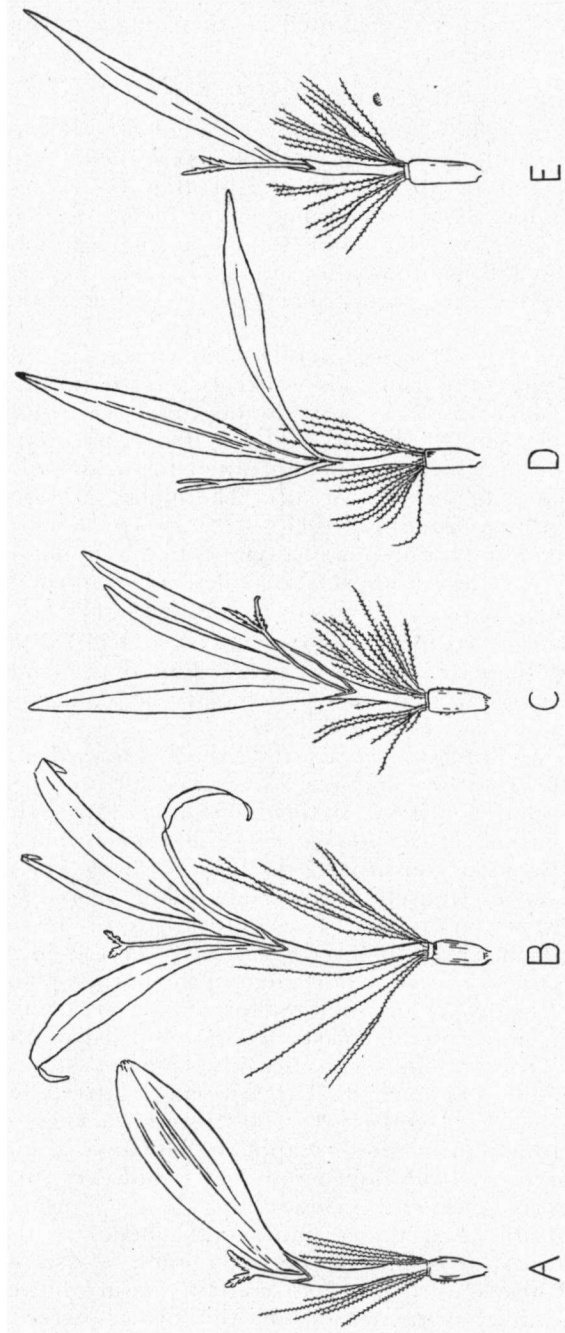


Fig. 1. *Solidago virgaurea* L. A, normal ray flower; B, C, D and E, differing ray flowers; pappus omitted partly to show corolla. $7\times$

Disk flower (Fig. 2, A). The corolla is expanded at the top into 5 equal lobes. The 5 anthers are united by their edges into a tube and produce pollen.

ABNORMAL FLOWER STRUCTURES

Ray flowers (Fig. 1, B, C and D). Development of 4, 3 and 2 narrow lobes of various breadth; the lobes are bent into different directions and in instances Fig. 3, B and C are more or less united. Pappus hairs often unequal in length.

Ray flower (Fig. 1, E). Development of one narrow lobe.

Disk flower (Fig. 2, B). Corolla abnormal by having a reduced number of lobes of deviating forms. There are ± 5 free anthers. Pollen little or wanting.

Disk flower (Fig. 2, C). Formation of a small, irregular, green, calyx-like structure; the tube above bears ± 5 petal-like anthers, which in some instances were found to produce pollen.

Disk flower (Fig. 2, D). There are ± 5 irregularly shaped corolla lobes, some of which were often noted to be united and all of them often coherent at the tip. There are 2-5 free anthers. Pollen is seldom produced.

Disk flower (Fig. 2, E). Formation of a sympetalous, cucullate structure. There are 2-5 free anthers. No pollen ascertained.

Transitional forms may be found.

The normal heads include 8-12 ray flowers and 11-17 disk flowers. Approximately the same numbers were counted in the heads with abnormal flowers, so that there seems to be conformity in the composition of the flower-heads.

ROUY (ROUY, FOUCAUD et CAMUS, 1903, Flore de France, 8: 133-138) mentions of *S. virgaurea* a considerable number of forms and varieties included in these. In the description of these the variation stated of the outline of the foliage leaves is remarkable. The lower leaves of the varieties constituting the form I, *S. vulgaris* Lamk. are indicated from ovate and elliptical to lanceolate. In individuals with abnormal flowers, lanceolate leaves appear to predominate. This shape is conspicuous even in the radical leaves (Plate 28 A). The involucre bracts too are more slender than in the normal plant. It is emphasized that the leaves are not malformed or abnormal in color.

The differing individuals nevertheless develop fruits, although the number of achenes remains considerably below that produced by the ordinary plant. The normal *S. virgaurea* has relatively few abortive fruits in the heads. An average of $\pm 80\%$ sound achenes was found. The plants with differing flowers appeared to have a maximum of $\pm 50\%$ of the ovaries developed into fruits; however, in most cases the percentage is considerably lower.

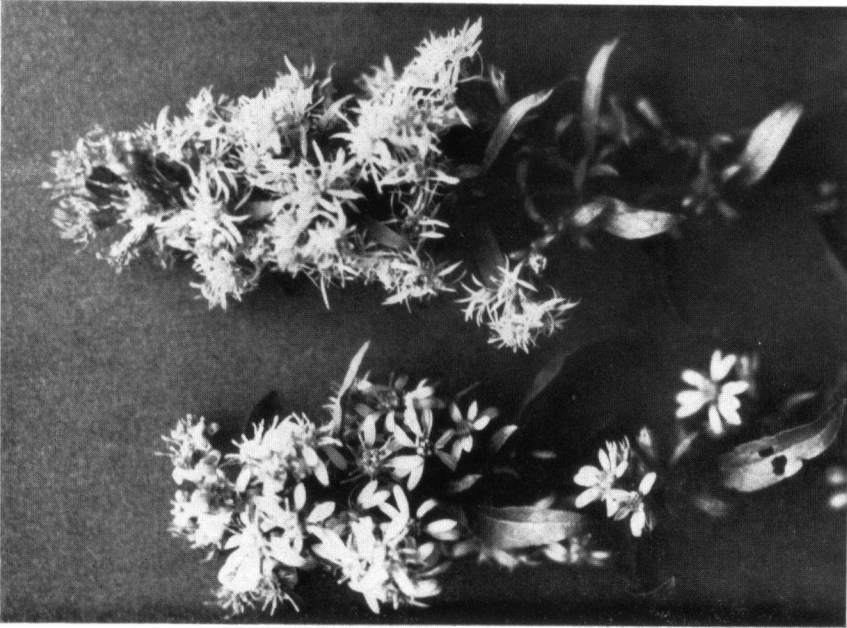
It seems possible that the formation of achenes in the differing flowers is, at least for a part of the latter ones, a case of apomixis, because some heads were noted to contain mainly flowers without pollen grains on the stigmas, while the ovaries were apparently developing.



B *Solidago virgaurea* L. Individual with differing flowers



A *Solidago virgaurea* L. Normal plant



B *Solidago virgaurea* L. Breeding experiment with abnormal plant. Stems with ordinary and differing flowers on the same rhizome



A *Solidago virgaurea* L. Breeding experiment with abnormal plant. Radical leaves

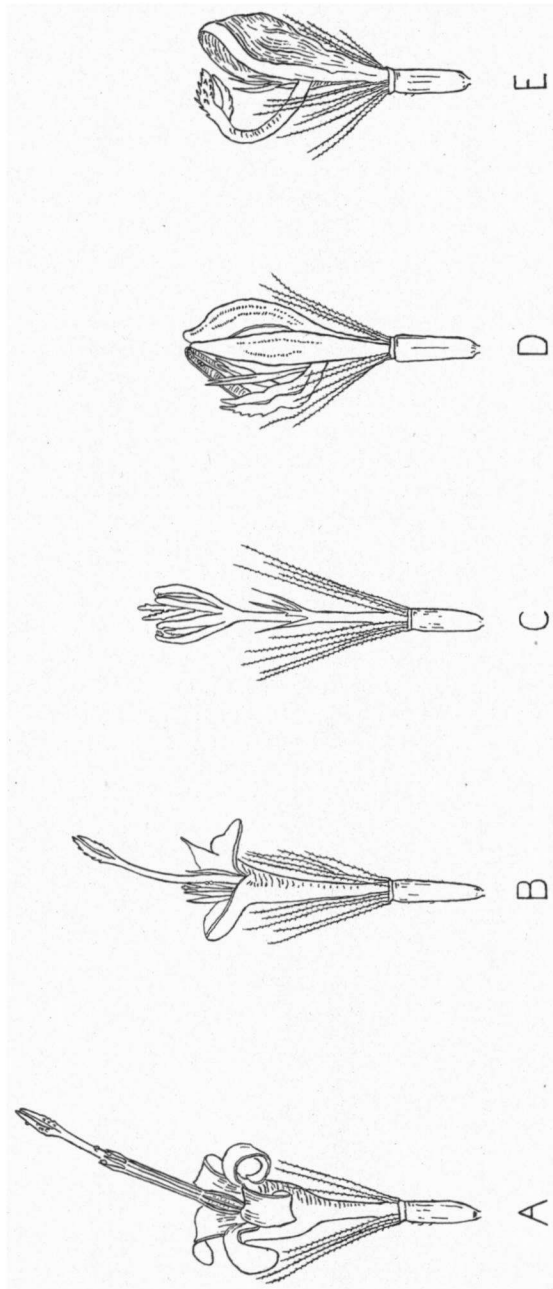


Fig. 2. *Solidago virgaurea* L. A, normal disk flower; B, C, D and E, differing disk flowers; pappus omitted partly to show corolla. 7 ×

In a breeding experiment, started 1951 with the abnormal plant first noticed, $\pm 50\%$ of the achenes germinated. The descendants appeared to be of two kinds, viz.:

- a) the plant develops shoots with abnormal flowers as well as, on the same rhizome, stems having normal flowers (Plate 28 B);
- b) the plant produces shoots which first form normal flowers at the top and continue with abnormal flowers on the lower branches and, in addition, there are on the same rootstock stems having ordinary flowers only.

The flower differences outlined bear certain resemblances to structures of floral cecidia and attempts to find out the cause responsible for the irregular behaviour of these plants of *S. virgaurea*, therefore, seem reasonable. Several external conditions were considered and studied. (To mention some. 1. Consumption of the foliage, sometimes resulting in bareness of the plants, possibly by birds; the occurrence appeared to coincide with the flower deviations. 2. An Aphid was noticed living among the abnormal florets in the heads; the same kind appeared to occur in ordinary heads of Goldenrod too, without affecting the flowers. 3. Individuals with differing flowers were noted to be attacked on the foliage by *Erysiphe cichoracearum* D.C.—identified by Prof. Dr Joh. Westerdijk. The latter hypothesis seemed promising; however, sound plants infected with the Powdery Mildew mentioned did not show flower disturbance). The causation of the flower deviations is not yet understood.

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