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# STUDIES ON THE ETIOLOGY AND PATHOLOGY OF THE BLACK-CURRANT REVERSION. I. ON THE CHARACTER OF THE CHANGES IN FLOWER MORPHOLOGY

*A. TIITS.* UURIMISI MUSTASÕSTRAREVERSIOONI ETIOLOOGIA JA PATOLOOGIA ALALT. I. MUUTUSTE ISELOOMUST ÕITE MORFOLOOGIAS

*А. ТИЙТС.* ИЗУЧЕНИЕ ЭТИОЛОГИИ И ПАТОЛОГИИ РЕВЕРСИИ ЧЕРНОЙ СМОРОДИНЫ. I. О ХАРАКТЕРЕ ИЗМЕНЕНИЙ В МОРФОЛОГИИ ЦВЕТКОВ

Black-currant reversion, a serious disease in the species *Ribes nigrum* L., has been notorious in Europe for 60 years. The name "reversion" refers to the changed character of the leaves and the "wild" type of bush. The name "reversion" has been rarely used in reference to flower symptoms. The changes of the flowers are regarded as belonging to the double flower type, but there are also "normal" double flowers (especially among the hybrids of the European black-currant with Asian species, e. g. *Ribes dikuscha* Fisch.). For obtaining some clarity on the problem, some investigations on the morphology of the changed flowers of the diseased black-currant plants and of the normal flowers of the healthy plants were carried out at the Institute of Experimental Biology of the Academy of Sciences of the Estonian SSR in 1968.

## Material and method

The buds and flowers were taken for investigations from healthy and seriously affected (reverted) black-currant bushes ('Goliath', 'Boskoop Giant'). The natural material (in some cases also fixed in Carnoy's solution and in acid fuchsin or Delafield's hematoxylin stained material) was studied and photographed under the microscope with incident lights.

## Observations

The receptacle of the healthy black-currant flower is not stem-like, but broad-campanulate (Fig. 1, *1*). In the changed flower of the reverted bush it is more stem-like, showing, to some extent, the spiral arrangement of the changed petals and sepals (Figs 1, *4* and 2). The atavistic stem-like form of receptacle and the spiral arrangement of the flower parts are especially well visible in the primordial stage in the winter period (Fig. 3).

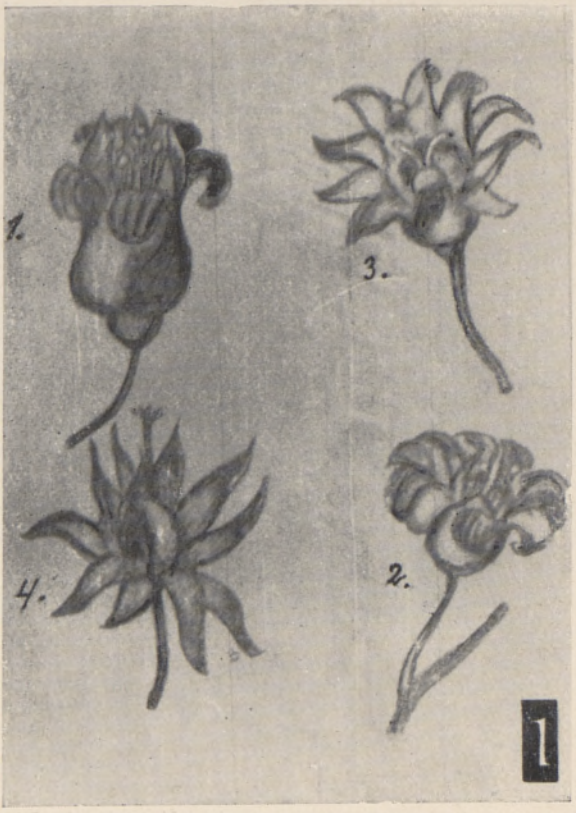


Fig. 1. The reversion character can clearly be seen in the first published drawings of the changed black-currant flowers (Ritzema Bos, 1904) already; *1* — normal flower with broad-campanulate receptacle and clearly inferior ovary; *2* — a slightly changed flower where one can still see stamens; *3*, *4* — the typical reverted ("female") flowers with a superior ovary (especially on *4*).


Fig. 2. Reverted flower with leafy pistil; stamens are missing.

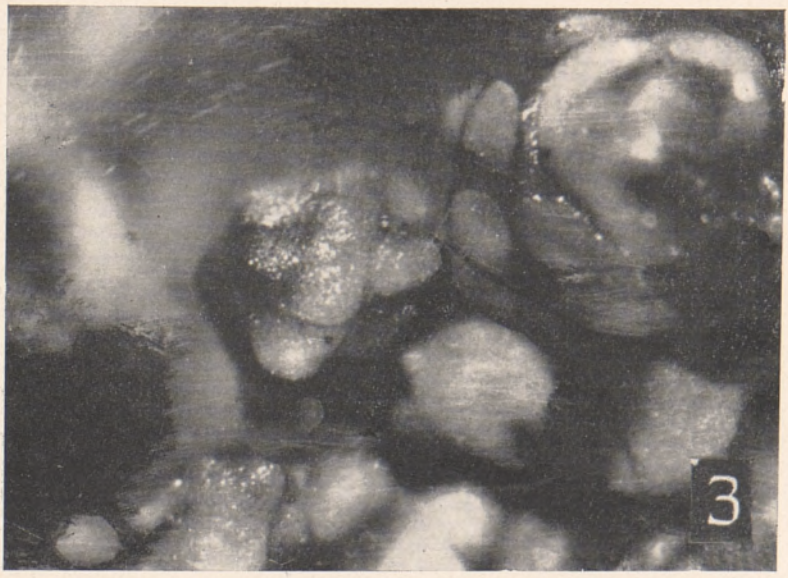


Fig. 3. Changed flower primordia in various developmental stages. (Note the spiral development and arrangement of the changed flower parts.) (Enlargement 205×.)

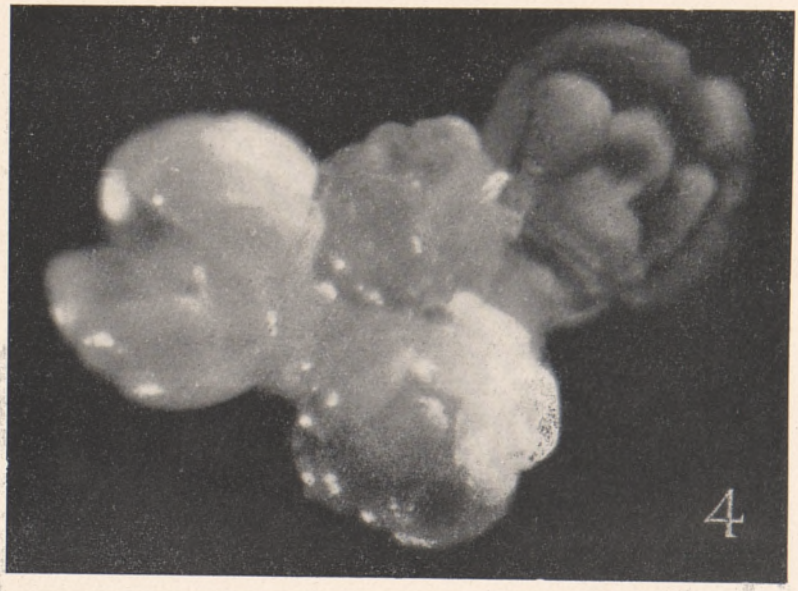


Fig. 4. The normal flower primordia with well-developed stamen primordia and primordium of stigma-style in every flower primordium. The petal and sepal primordia are less developed. (Enlargement 215×.)

The petals and sepals are oblong and have a similar higher colouring. Because of the similarity of the petals and sepals, the flower seems to be double; actually there are, as usual, 5 petals and 5 sepals, only they are changed. If there are more than 10 petaloid formations, the other parts of the flower are petaloid as well. For example, in most cases the style is only shortened and thickened, but there are also flowers in which the upper parts of the carpels (2) do not form a style, but 2 laminar appendages (Fig. 2).

The healthy black-currant plant has bisexual proterandrous flowers, whereas the diseased plant has "female" flowers. The lack of the stamens is closely correlated with the changes in the receptacle-calyx-crone complex. In the changed flowers the stamens are missing (Figs 1, *3*, *4* and 2), but if the receptacle, petals and sepals are developed more normally (as sometimes on a few branches of the bush or in 1—2 basal flowers of some racemes)*, we may see the stamens (Fig. 1, *2*).

The lacking of stamens is not a feature of the growth suppression type, as it could be supposed, but it is of an organogenetic nature. As a rule, there are no stamen primordia in entirely abnormal flower-primordia at any developmental age (compare Fig. 3 with Fig. 4). If there are more than 12 appendages in primordial flower-bud (the number of petal primordia is 5; the number of sepal primordia — 5; the number of changed carpel primordia — 2), the additional appendages are of the same type as the primordia of petals-sepals-carpels and similarly regulated in the spiral arrangement.

The spiral arrangement can be seen very clearly in some flower-primordia in winter, which resemble "stem-primordia" and have, accordingly, "leaf-primordia" and axillarily "bud-primordia" (the latter cannot be seen in further development).

As regards the higher colour of the diseased plant flower, there are chlorophyll pigments in addition to usually occurring pigments. Carnoy's solution (fixator) acquires a green colouring due to the changed flowers, which is not at all (or to a slight extent) observed in the case of normal flowers.

## Discussion

The comparative observations of flowers and flower primordia of deeply diseased black-currant plants and normal ones render it possible to make some conclusions concerning the character of the changes of the flowers of infected black-currant plants.

1. There are no common double flowers in diseased black-currant bushes. The changes in flowers are deeper, due to the reversion type. The following atavistic characters are in favour of this assumption: (1) the arrangement of flower parts in spiral; (2) alteration of receptacle to a more stem-like form; (3) ovary changing from an inferior type to a superior one; (4) occurrence of pistil in leaf form; (5) the unisexuality of flowers; (6) occurrence of chlorophyll pigments in petals.

2. The character of changes of diseased black-currant flowers is evidently due to local changes in metabolism. The following findings are in favour of this position: (1) the variability of flower changes in one raceme; (2) the greater variability of changes (more numerous occurrence of intermediate and normal forms among reverted flowers) in promoting external environments (see Помазков, 1964).

* The ratio of abnormal and nearly normal flowers is dependent on the external environment. After some summers there have been considerably more abnormal flowers than after other ones (Tiits, 1966).

3. The changes of diseased black-currant flowers may be due to deviations in hormonal balance. This can be inferred from the decrease of changes in changed flower buds when transferred on a medium containing a certain balanced concentration of hormones (Tiits, 1969b).

4. The studies of both pathogenetic phyllodies of some plants (see, e. g., Tiits, 1969a) and black-currant reversion show that there are many traits in common to both diseases. Possibly they are induced by similar pathogens. Both types of diseases are of the kind that they may be induced by deviation in hormonal balance.

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Proceeding from the characters of the changes in diseased black-currant flowers and from the occurrence of "normal" double flowers of black-currant which are of a different type, it should be more correct to name the changes of the flowers of the diseased black-currant the "reversion" as well, and it is desirable to name the disease, in all languages, the "black-currant reversion" (in Russian: «реверсия черной смородины» and in Estonian: «mustasõstrareversioon»).

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