# BIOTAXONOMIC NOTES ON THE RUMEX ACETOSELLA COMPLEX IN BELGIUM

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SUMMARY

Cytological studies have demonstrated the occurrence of tetraploids (2n = 28) and hexaploids (2n = 42) of the *Rumex acetosella* complex in Belgium. Diploids have not been encountered. In both the tetraploid and the hexaploid races angiocarpous plants have been recorded next to gymnocarpous ones. There is a correlation between the relative frequencies of the angiocarpous individuals and of the gymnocarpous ones in the hexaploid populations and the type of soil: on the loamy soils of Central and South Belgium almost exclusively angiocarpous plants occur in the populations, whereas in the populations on the sandy soils of the coastal area and of Belgian Brabant the gymnocarpous form predominates. Tetraploids are almost exclusively restricted to the populations found on the sandy soils of northern Belgium.

RÉSUMÉ

Des recherches cytologiques ont révélé la présence des plantes tetraploïdes (2n = 28) et hexaploïdes (2n = 42) de l'agglomérat *Rumex acetosella* en Belgique. Des plantes diploïdes (2n = 14) n'ont pas été trouvées. Les formes angiocarpes et gymnocarpes ont été observées sur les plantes tetraploïdes ainsi que sur les plantes hexaploïdes. Le nombre des individus angiocarpes et gymnocarpes qui se présente dans les populations hexaploïdes et la nature du sol sont en corrélation: les populations de la terre glaise (la Belgique centrale et méridionale) ne contiennent que peu de plantes gymnocarpes, tandis que la forme gymnocarpe prédomine dans les populations trouvées sur les terrains sablonneux de la côte belge et du Brabant. Presque tous les individus tetraploïdes qui ont été trouvés originent des terrains sablonneux de la Belgique du Nord.

## 1. INTRODUCTION

As a sequel to the biotaxonomic inquiry into the *Rumex acetosella* complex in the Netherlands (STERK *et al.* 1969), also in Belgium the geographic distribution of the cytological races of the complex was recorded and the relative frequency of occurrence of angiocarpous and of gymnocarpous specimens was studied in a number of populations.

According to LAWALRÉE (1952a, 1952b) in Belgium the diploid *R. angiocarpus* Murb. (2n = 14) and the tetraploid *R. tenuifolius* (Wallr.) Löve (2n = 28) occur, whereas the hexaploid *R. acetosella* L. *s.s.* (2n = 42) is supposed to be absent. Lawalrée borrowed these data from publications by LÖVE (1941a, 1941b, 1944), see LAWALRÉE (1952b).

STERK *et al.* (1969), on the other hand, after having studied a number of populations of the complex from the southern Netherlands and a few from adjacent Belgian territory, expressed as their opinion that publications reporting

the common occurrence of the diploid *R. angiocarpus* in Belgium might be erroneous and in reality refer to an angiocarpous variant of the hexaploid *R. acetosella*.

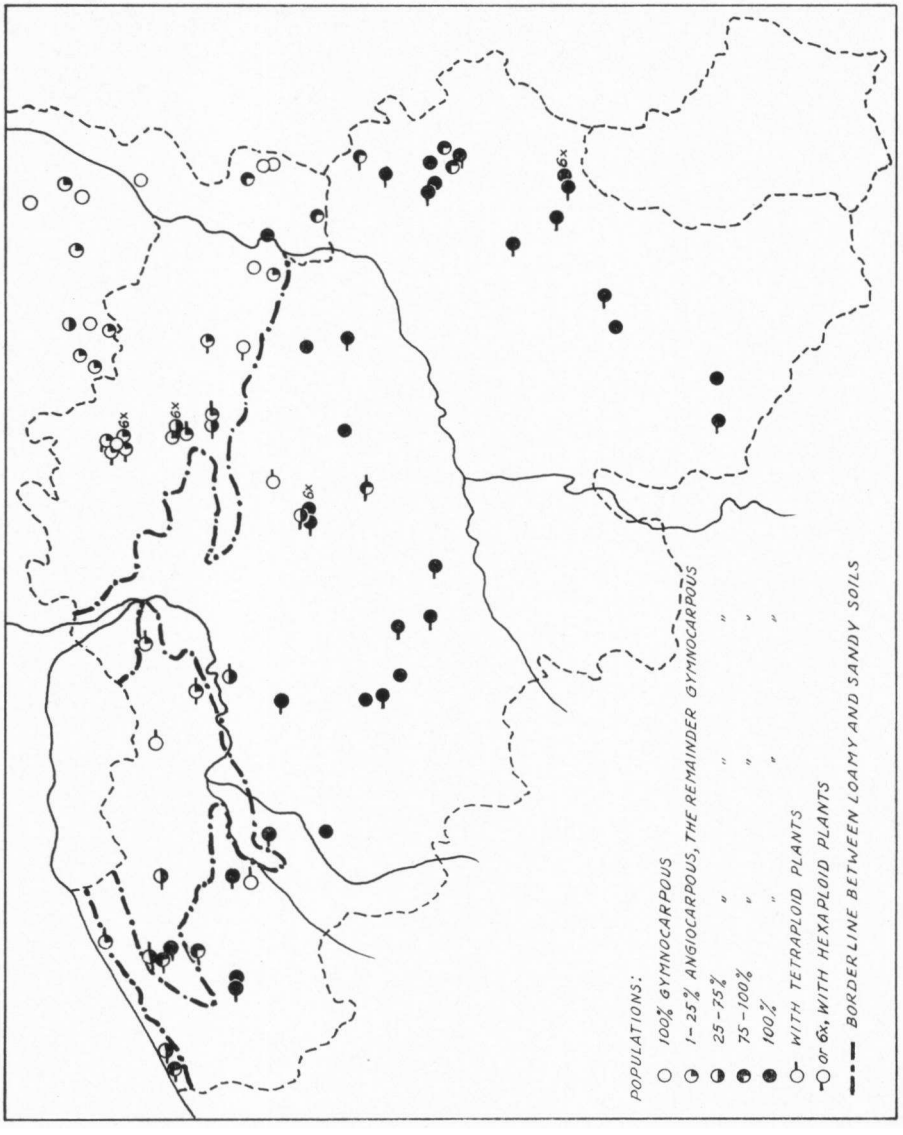
The field studies of Belgian populations, the results of which are partly used for the present paper, were carried out in 1968 and 1969. The populations were studied by means of random samples consisting of 50 to 75 individual plants. For further details concerning the method of inquiry the reader is referred to the above-mentioned paper by Sterk *et al.*

## 2. THE DISTRIBUTION OF ANGIOCARPOUS AND GYMNOCARPOUS FORMS IN BELGIUM

On *map 1* the range of distribution of the populations studied and the composition of the population samples as regards the percentages of angiocarpous and of gymnocarpous specimens are shown. As was done in the publication on Dutch populations, plants producing both angiocarpous and gymnocarpous fruits were included in the group with angiocarpous fruits (for the meaning of these terms in the present context, *cf.* STERK *et al.* 1969).

Of the 63 population samples studied in this way, 31 contained exclusively angiocarpous specimens, 26 both angiocarpous and gymnocarpous plants, and only 6 exclusively gymnocarpous individuals. Apparently populations consisting of gymnocarpous plants are only of rare occurrence in Belgium; they are found in the same area in which the heterogeneous or "mixed" (partly angiocarpous and partly gymnocarpous) populations are encountered. This area includes the coastal region (the dunes), the Flemish sands and the Campine (Kempen). To the South of these regions almost all populations are exclusively angiocarpous.

A projection of this map of geographic distribution on the map of soil types of Belgium published by TAVERNIER & MARECHAL (1959) shows that the exclusively angiocarpous populations are chiefly found on the loamy types of soil, generally speaking South of the dash-dot line on *Map 1* showing in broad outline the boundary between clayey or loamy soils and sandy soils. The completely gymnocarpous populations and the "mixed" ones are mainly encountered to the North of the dash-dot line on the map, *i.e.*, on sandy soil types. There are some exceptions because occasionally gymnocarpous populations occur in the area with loamy soils, *e.g.*, a population from near Louvain (province of Brabant) and one from Oostrozebeke (province of W. Vlaanderen), but in these two cases the sites were local sandy habitats within an otherwise loamy area. From these data the conclusion can be drawn that the angiocarpous plants clearly prefer loamy and clayey types of soil, whereas the gymnocarpous ones seem to feel more at home on sandy soil types. This correlation had previously been found in the Netherlands: in the loess area of S.-Limburg the populations contain a fairly large amount of angiocarpous plants, whereas in central and N. Limburg and Noord-Brabant (the diluvial cover sand area adjoining the equally sandy Belgian Campine) principally gymnocarpous plants occur (STERK




*et al.* 1969). This correlation will be studied in connection with the results of pedological analyses of soil samples and the results of this study will be published elsewhere.

## 3. THE NUMBER OF CHROMOSOMES

The number of chromosomes was counted in one plant or in several specimens

Table 1. Localities, degree of polyploidy and angiocarpy or gymnocarpy, respectively, of the fruits of plants examined. A = angiocarpous fruits; G = gymnocarpous fruits; *: chromosome number counted in root squashes of germinating seeds of "mixed" (partly angiocarpous, partly gymnocarpous) populations.

| Locality | Number of plants | | | |
|---|---|---|---|---|
| | tetrapl. | hexapl. | A. | G. |
| Oostrozebeke – Prov. of West-Vlaanderen | 2 | | | 2 |
| De Haan – Prov. of West-Vlaanderen | 3 | | | 3 |
| Zerkegem – Prov. of West-Vlaanderen | 2 | | 2 | |
| Vijfhuishoek – Prov. of West-Vlaanderen | | 1 | 1 | |
| Oedelem – Prov. of West-Vlaanderen | | 3 | 3 | |
| Houthulst – Prov. of West-Vlaanderen | | 1 | 1 | |
| Coxyde-bad – Prov. of West-Vlaanderen | | 1 | 1 | |
| Deutergem – Prov. of West-Vlaanderen | | 1 | 1 | |
| Potte-Bezem-Hoek – Prov. of West-Vlaanderen | | 1 | 1 | |
| Aartrijke – Prov. of West-Vlaanderen | | 1 | 1 | |
| Nieuwpoort-Bad – Prov. of West-Vlaanderen | | 1 | | 1 |
| Vijfstraten – Prov. of Oost-Vlaanderen | 3 | | 1 | 2 |
| Wieze – Prov. of Oost-Vlaanderen | 1 | | | 1 |
| Wachtebeke – Prov. of Oost-Vlaanderen | 1 | | | 1 |
| Zele – Prov. of Oost-Vlaanderen | 1 A | 1 G | 1 | 1 |
| Kruishoutem – Prov. of Oost-Vlaanderen | | 2 | 2 | |
| Denderhoutem – Prov. of Oost-Vlaanderen | | 1 | 1 | |
| Eindhout, near Geel – Prov. of Antwerpen | 1 | | | 1 |
| Engsberg, near Diest – Prov. of Antwerpen | 1 | | | 1 |
| Engsberg, near Diest – Prov. of Antwerpen | | 1 | 1 | |
| Near Kasterlee – Prov. of Antwerpen | | 1 | | 1 |
| Near Kasterlee – Prov. of Antwerpen | | 1 | | 1 |
| Near Kasterlee – Prov. of Antwerpen | | 1 | | 1 |
| Near Kasterlee – Prov. of Antwerpen | | 1* | | |
| Winkelomheide, near Geel – Prov. of Antwerpen | | 1 | | 1 |
| Near Leuven – Prov. of Brabant | 1 | | | 1 |
| Opprebais – Prov. of Brabant | 2 | 4 | 6 | |
| Near Leuven – Prov. of Brabant | | 1 | 1 | |
| Vaalbeek – Prov. of Brabant | | 1 | 1 | |
| Vaalbeek – Prov. of Brabant | | 1 | 1 | |
| Nivelles – Prov. of Branbant | | 1 | 1 | |
| Opheers – Prov. of Limburg | | 1 | 1 | |
| Hasselt – Prov. of Limburg | | 1 | | 1 |
| Helchteren – Prov. of Limburg | | 3 | | 3 |
| Rèves – Prov. of Hainaut | | 1 | 1 | |
| Labliau – Prov. of Hainaut | | 1 | 1 | |
| Hauset – Prov. of Liège | | 1 | 1 | |
| Welkenraedt – Prov. of Liège | | 3 | 3 | |
| Joubiéval – Prov. of Liège | | 3 | 3 | |
| Bra – Prov. of Liège | | 3 | 3 | |
| Xhoffraix – Prov. of Liège | | 1 | 1 | |
| Tiège – Prov. of Liège | | 5 | 5 | |
| Sombreffe – Prov. of Namur | | 1 | 1 | |
| Beho – Prov. of Luxembourg | | 1 | 1 | |
| Bovigny – Prov. of Luxembourg | | 3 + 1 ♂ | 3 | |
| Beausain – Prov. of Luxembourg | | 3 | 3 | |
| Plainevaux (near Bouillon) – Prov. of Luxembourg | | 3 | 3 | |

reared from seeds obtained from 47 population samples. The results are shown in *table 1* and indicate, among other things, that we did not find any diploids in the Belgian populations of the *R. acetosella* complex. In 9 out of these 47 populations exclusively tetraploids were recorded, in 2 of them both tetraploids and hexaploids, and in the remaining 36 only hexaploids were present. These data show that in Belgium tetraploids are of relatively rarer occurrence than the very common hexaploids. A glance at the distribution of the tetraploids (see *map 1*) shows that they are chiefly found in areas with sandy soil types situated to the N. of the dash-dot line, *i.e.*, in the dune region, northern Flanders and the sandy Campine.

There are two instances of completely tetraploid populations situated within the loam-clay areas, *viz.*, one from near Louvain and one from Oostrozebeke, but in these two cases the sites were local sandy habitats in an otherwise loamy area. These data indicate that there must be a correlation between the occurrence of tetraploids and the presence of a sandy type of soil. Among the tetraploids studied both angiocarpous and gymnocarpous individuals were found (see *table 1*). Owing to the small number of observations no definite conclusions can be drawn for the time being concerning their geographical distribution and ecology.

Hexaploids are very common in Belgium. In the loamy and clayey regions to the South of the dash-dot line shown in *map 1*, all examined plants were angiocarpous, whereas in the sandy areas to the North of that line both angiocarpy and gymnocarpy occur in the populations with a predominance of the gymnocarpous phenotype (see *map 1*). This phenomenon agrees with the results of the study of population samples which clearly point to a preference of gymnocarpous plants for a sandy substratum. For the Belgian region the conclusion can be drawn that in view of the geographic distribution and of the results of pedological and phytosociological studies to be published elsewhere, the angiocarpous hexaploids exhibit a different ecological tolerance and preference from the gymnocarpous hexaploids. Angiocarpous individuals appear to prefer loamy soil types, whereas gymnocarpous ones are almost invariably found on sandy substrata.

## 4. DISCUSSION

In contradistinction to the report of LAWALRÉE (1952a) that the diploid *R. angiocarpus* is of common occurrence throughout Belgium, no diploid specimens of the complex were found during our study. As we have mentioned already, Lawalrée's conclusions are based on publications by Löve who in an earlier phase of his investigations (LÖVE 1941b, 1944) had wrongly concluded that angiocarpy only occurs in the diploid race. Several workers have since demonstrated the incidence of angiocarpous hexaploids: HAIR (in MOORE 1954) for New Zealand, MULLIGAN (1959) for Canada, JOHNSON & BRIGGS (1962) for Australia, HARRIS (1969) for W. Central and S. Europe, the U.S.A., Canada, Ceylon, India, and New Zealand, STERK *et al.* (1969) for the Low Countries.

Löve himself has also recorded the occurrence of angiocarpous hexaploid populations in S. and S.E. parts of C. Europe (see JOHNSON & BRIGGS 1962).

Angiocarpy is not only found in diploids and in hexaploids, but also in the tetraploid race, as recorded by Hylander (in LÖVE 1960), by HARRIS (1969) for S. Europe and by STERK (1970) for South Africa. The supposition made by STERK *et al.* that the angiocarpous plants commonly found in Belgium and said to be *R. angiocarpus* might prove to represent an angiocarpous variant of the hexaploid form has in so far been confirmed that indeed most of these angiocarpous plants are hexaploids. There occur also angiocarpous tetraploids in Belgium, however.

It remains to be seen if the diploid race of the *R. acetosella* complex (*i.e.*, *R. angiocarpus* in the sense of Löve) occurs in Belgium at all, but the results of our investigations do not render this very probable.

In Belgium the tetraploid race is predominantly found on sandy soils. This race appears to be much rarer there, as in the Netherlands (GADELLA & KLIPHUIS 1966; STERK *et al.* 1969), than the hexaploid race, and this may well hold for the whole of western Europe (HARRIS 1969). The ecological amplitudes of the two races appear to be clearly different; that of the hexaploid form is much wider in the area studied than that of the tetraploid one, and this presumably also holds for all of western Europe. This would agree with the often employed rule that the higher components of a euploid series of polyploids possess a greater ecological tolerance than the corresponding lower ones.

The angiocarpous and the gymnocarpous variants of the hexaploid race also differ in their ecology. The populations in the loamy regions of southern Belgium contain almost exclusively angiocarpous individuals, whereas in the sandy areas of the coastal region and the more northerly districts the recorded relative frequencies of such plants are upon the whole markedly lower than those of the gymnocarpous plants.

Northwards, in the sandy areas of the southern provinces of the Netherlands, the relative frequency of occurrence of angiocarpy in hexaploid populations decreases further until (in the Central and N. Netherlands) only gymnocarpous plants are present in hexaploid populations (STERK *et al.* 1969). This can be interpreted as a clinal variation within the hexaploid race as regards the character of angiocarpy *versus* gymnocarpy. This clinal variation must to a large extent be the result of differences in ecological tolerance and preference between the angiocarpous and the gymnocarpous forms. The influence of introgression in this dioecious and anemophilous taxon can not be precluded, since conceivably the pollen grains can be dispersed over relatively large areas. An addition aland presumably very important ecological factor is the dispersal of the mature fruits by human influence.

The correlation within the hexaploid race between the incidence of angiocarpy and a loamy substrate most probably only holds for the area in the Netherlands and Belgium included in our investigation but probably not for other parts of its range of distribution in western Europe. From personal observations the occurrence of angiocarpous hexaploids in the sandy dune area of

Les Landes in S.W. France could be ascertained. HARRIS (1969) reported the occurrence of such plants in S. and Central Europe on a great variety of soils, so that apparently the angiocarpous hexaploid race is there far less fastidious as far as its habitat is concerned than it is in the Low Countries. The angiocarpous populations may be considered to be marginal in the last-mentioned region, and it is known of marginal populations of several other species that they are more particular in their habitat requirements than the central populations.

From the distribution maps of *R. angiocarpus*, *R. tenuifolius* and *R. acetosella* published by LÖVE (1941b) it can be deduced that the clinal variation in the hexaploid race as found in the Low Countries may well be present in other regions of W. and Central Europe. It is not at all improbable that the same holds for the tetraploid race. Studies concerning this question are in progress.

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