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CYTOTAXONOMIC STUDIES IN THE GENUS SYMPHYTUM. VI. SOME NOTES ON SYMPHYTUM IN BRITAIN

T. W. J. GADELLA, E. KLIPHUIS and F. H. PERRING

Instituut voor Systematische Plantkunde, Utrecht and Institute of Terrestrial Ecology, Abbots Ripton, England

SUMMARY

122 British plants of the genus *Symphytum* were investigated cytologically. White-flowered diploid (2n = 24) and white- and purple-flowered tetraploid (2n = 48) plants of *S. officinale* occur in Britain. *S.* × *uplandicum*, the hybrid between *S. officinale* (2n = 40 or 2n = 48) and *S. asperum* (2n = 32) is variable, but two types can be distinguished, the first of which has 2n = 36, purple flower-buds and purple (or blue-purple) corollas, the second 2n = 40, pink flower-buds and pink-corollas, which turn blue when the flowers age. The way in which these hybrids arose is discussed.

1. INTRODUCTION

The genus *Symphytum* has received much attention from cytologists during the past few years (GADELLA 1972; GADELLA & KLIPHUIS 1967, 1969, 1971, 1972, 1973; GRAU 1971; BASLER 1972). Most interest was focused on *Symphytum asperum*, *Symphytum officinale* and *Symphytum* × *uplandicum*. From these studies it became clear that *S. officinale* is a cytologically variable species, which deserves a closer examination in its total distribution area.

In Britain the genus *Symphytum* was studied by TUTIN (1956) and WADE (1958). Tutin is of the opinion that originally most of the hybrids (*S.* × *uplandicum*) were introduced into Britain from Russia as fodder-plants. He suggests that the purple-flowered plants might have arisen as a result of introgression between *S. officinale* and *S. asperum*. WADE (1958) gives as his opinion that *S.* × *uplandicum* is probably the commonest *Symphytum* in Britain, which backcrosses with *S. officinale* resulting in highly variable hybrid swarms. Since neither Tutin nor Wade studied their plants cytologically, the present authors (G. & K.) decided to investigate the plants which they collected with the other author (F.H.P.) in England during their stay in 1969. They extended these studies to the collections which were then cultivated in the University Botanic Garden of Cambridge in connection with the BSBI Network Research Programme. The results of these studies, together with a comparison of continental species and artificially produced or natural hybrids, are given in this paper.

2. MATERIALS AND METHODS

The plants were collected in nature, dug up, and transplanted to the botanical garden of Utrecht. From all plants of the collection of Perring at Cambridge cuttings were made; these were also cultivated at Utrecht. For cytological studies root-tips of potted plants were used. They were fixed in Karpechenko's fixative, embedded in paraffin-wax, sectioned at 15 micron and stained according to Heidenhain's haematoxylin method. Voucher material of all studied plants are preserved in the Herbarium of Utrecht University.

3. RESULTS

The results of the cytological studies are summarized in the table, together with the place of origin of the material and the collection numbers (Cambridge and Utrecht).

Table. The plants studied, with indication of their place of origin, chromosome number, and collection number.

Symphytum asperum Lepech.	
Croome Dabitot (Worcestershire), FHP 68/33; G & K 10.248	2n = 32
Symphytum officinale L.	
Wicken Fen (V.C.29 Cambridgeshire), FHP 68/4; G & K 10.215–10.231	2n = 24
Welches Dam (V.C.29 Cambridgeshire), FHP 68/1; G & K 10.281	2n = 24
Wedmore (V.C.6 N. Somerset), G & K 10.193–10.194; 10.467	2n = 48
Wells (V.C.6 N. Somerset), G & K 10.639	2n = 48
Chippenham (V.C.7 N. Wiltshire), G & K 10.646	2n = 48
Chesil Beach (V.C.9 Dorset), G & K 10.206, 10.643, 10.648, 10.649	2n = 48
Norwich (V.C.27 E. Norfolk), FHP 64/42; G & K 10.286	2n = 48
Winchcombe V.C.33 E. Gloucestershire), G & K 10.208–10.214	2n = 48
Haverholme Priory (V.C.53 S. Lincolnshire), FHP 69/54; G & K 10.195–10.205	2n = 48
Near Morpeth (V.C.67 Northumberland), FHP 68/39; G & K 10.283	2n = 48
Symphytum × *uplandicum* Nym.	
Manaton (V.C.3 S. Devon), G & K 10.232–10.236	2n = 36
Fletching (V.C.14 E. Sussex), FHP 68/41; G & K 10.254	2n = 36
Thetford (V.C.28 W. Norfolk), FHP 68/8; G & K 10.263–10.265	2n = 36
Bourn (V.C.29 Cambridgeshire), FHP 68/4A; G & K 10.172–10.190, 10.282	2n = 36
Pentre (V.C.50 Denbighshire), FHP 68/16; G & K 10.251	2n = 36
Reepham (V.C.54 N. Lincolnshire), FHP 68/21; G & K 10.267–10.268	2n = 36
Garden origin (Mrs. M. Briggs), FHP 68/40; G & K 10.249–10.250	2n = 36
Santon Downham (V.C.26 W. Suffolk), FHP 68/9; G & K 10.271–10.273	2n = 40
Dereham (V.C.28 W. Norfolk), FHP 68/27; G & K 10.260–10.262; 10.279	2n = 40
Stoke Ferry (V.C.28 W. Norfolk) FHP 68/14A; G & K 10.275–10.276	2n = 40
Fordham (V.C.29 Cambridgeshire), FHP 68/7; G & K 10.237–10.246	2n = 40
Little Chishill (V.C.29 Cambridgeshire), FHP 68/11; G & K 10.269–10.270	2n = 40
Buckie (V.C.94 Banffshire), FHP 68/23; G & K 10.274	2n = 40
Symphytum officinale L. (With hypotetraploid chromosome number)	
Claydon (V.C.25 E. Suffolk), FHP 69/43; G & K 10.287–10.288	2n = 44
Twyford Forest (V.C.53 S. Lincolnshire), G & K 10.191–10.192	2n = 44

4. SOME NOTES ON THE CYTOLOGICALLY STUDIED PLANTS

The plants with the chromosome number 2n = 24 (diploid) belong to *S. officinale* L. They are white-flowered not only in England, but also on the continent. This cytotype is reproductively isolated from the other cytotypes (2n = 48 and 2n = 40) of *S. officinale*. On the continent diploids and tetraploids (2n = 48) sometimes occur in mixed populations. In these populations triploids could neither be demonstrated by GADELLA & KLIPHUIS (1972) nor by SKALIŃSKA et al. (1971), but BASLER (1972) found two triploids near IJsselstein (the Netherlands). Crosses between diploids and tetraploids clearly showed that it is very difficult to produce triploid plants artificially.

The plants with the chromosome number 2n = 48 (tetraploid) should also be assigned to *S. officinale*. The purple-flowered form occurs throughout Europe but the white-flowered form seems to be restricted to western Europe. Mixed populations of white- and purple-flowered forms, often including plants of apparently mixed parentage with corolla colour of alternating vertical pink and white stripes, are of regular occurrence in W. Europe.

In Britain mixed populations are frequent in the south and west but pure populations of both purple- and white-flowered tetraploid plants also occur. However, the white-flowered tetraploid plants are indistinguishable from white-flowered diploid plants, at least in nature.

The plants with the chromosome number 2n = 36 belong to *S.* × *uplandicum* Nym.. They probably originated as follows: *S. asperum* (2n = 32) × *S. officinale* (2n = 40) → hybrid (2n = 36).

This has been duplicated experimentally (GADELLA & KLIPHUIS 1971). In the Netherlands the 2n = 40 cytotype of *S. officinale* is very common in fens, but it seems to be absent from Britain. It was described by GADELLA & KLIPHUIS (1967, 1971). It seems likely that the hybrid (*S.* × *uplandicum*, 2n = 36) was introduced into Great Britain, in view of the fact that hybridisation between the 2n = 40 form of *S. officinale* and *S. asperum* (2n = 32) is impossible in Britain, since the parental forms are either absent (*S. officinale*, 2n = 40) or extremely rare (*S. asperum*). This hybrid is rather tall (up to 1.5), rough and prickly. The flower-buds are dark purple, the corolla is purple or blue-purple. The leaves are not or only slightly and very shortly decurrent.

British plants with 2n = 40 are also regarded as belonging to *S.* × *uplandicum* but they differ in a number of respects from the 2n = 36 hybrid. In the first place the probable way in which they originated differs: one of the parents of *S.* × *uplandicum* (2n = 40) is the tetraploid form (2n = 48) of *S. officinale* instead of *S. officinale* with the chromosome number 2n = 40, the other parent is *S. asperum*. This has also been duplicated experimentally. The *S.* × *uplandicum hybrid* (2n = 40) is rather tall (up to 1.3 m) and is less rough and prickly than the *S.* × *uplandicum* (2n = 36) plants, at least in the majority of cases. The buds are usually pink, but sometimes purplish- or red-pink, e.g. in the plants from Stoke Ferry and Downham. The corolla is pink, turning bluish when the flowers age. They flower during a considerably shorter period than the 2n = 36

hybrids, at any rate in the experimental garden in Utrecht. The 2n = 40 hybrid more frequently shows leaves decurrent than does the 2n = 36 hybrid: sometimes the leaves are decurrent up to half the distance to the next lower leaf. Both the 2n = 36 and 2n = 40 hybrids have corollas that are gradually widened towards the top and have the portion above the constriction longer than the portion below, whereas the plants with 2n = 24 and 2n = 48 chromosomes have urceolate flowers in which the portions above and below the constriction are ± equal in length.

Both the 2n = 36 and 2n = 40 hybrids are fertile and interfertile, but the artificially made hybrid (2n = 38) between these hybrids has not yet been found in nature. The two types of *S.* × *uplandicum* are usually clearly distinguishable by the characters mentioned above, but sometimes puzzling intermediate plants are found, perhaps indicating that segregation of characters occurs. The British *S.* × *uplandicum* hybrids completely agree with the artificially made corresponding hybrids cultivated in the botanical garden of Utrecht.

With regard to the origin of the *S.* × *uplandicum* hybrids we agree with Tutin that they were introduced into Britain. In the majority of cases the local populations seem to be naturalized, but the possibility exists that some plants may be regarded as of spontaneous local origin. At any rate, one of the parents, *S. asperum*, is rare in Britain. The plants from Croome Dabitot (Worcestershire) are the only true representatives of *S. asperum* in the collection at Cambridge. They have the same morphological characters and chromosome number (2n = 32) as some plants collected in the Caucasus. On the stem and on the midrib of the leaves true *S. asperum* plants always have prickles curved towards the base of the stem and leaves; they are further characterized by long petioles of the basal leaves and stem leaves, by short calyces (1/5 × length of the corolla), red buds and sky-blue corollas gradually widened towards the apex. The fruits are reticulate-rugose, not smooth and shiny as in *S. officinale*.

The plants from Twyford Forest (Lincolnshire), with the chromosome number 2n = 44, have the same characters as the plants with 2n = 48 of *S. officinale*. They are white-flowered and their leaves are strongly decurrent. The plants are different from the hybrids (2n = 44) between *S.* × *uplandicum* (2n = 40) and *S. officinale* (2n = 48) described by GADELLA & KLIPHUIS (1971). This hybrid is much taller (up to 1.7 m) than the plants from Twyford Forest and has pinkish flowerbuds and pink flowers (which turn pinkish-blue when the flowers age). The origin of the Twyford Forest plants may also be explained by assuming that the cytotypes 2n = 40 and 2n = 48 of *S. officinale* hybridized. The fact, however, that *S. officinale* (2n = 40) has not yet been found in Britain forms a serious objection against this theory. Moreover, the *S. officinale*-plants with 2n = 40 are usually purple-flowered and exceptionally white-flowered. Since the Twyford Forest plants are white-flowered, it seems highly probable that only white-flowered parents are involved in the formation of the plants concerned. Therefore this theory does not seem to offer the most plausible explanation for the origin of the deviating number of the plants from Twyford Forest. BASLER (1972) also mentions the occurrence of hypotetraploid plants from various

localities in N.W. Germany (Schleswig-Holstein). These plants are regarded by him as back-crosses or as aneuploids. In his opinion backcrosses between *S.* × *uplandicum* (widely introduced into Schleswig-Holstein as a fodder-plant at the turn of the century) and *S. officinale* are of regular occurrence. Unfortunately, his opinion is not supported by the results of crossing experiments. For the time being we are unable to give a satisfactory explanation for the origin of the Twyford Forest plants, but we intend to continue our crossing experiments (including these cytologically deviating plants). The same holds true for the plants from Clayton, Ipswich, which also have the chromosome number 2n = 44. These plants, however, have purple flower buds and light-purple corollas.

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