

FURTHER OBSERVATIONS ON *TRIFOLIUM OCCIDENTALE*

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ABSTRACT

Trifolium occidentale, previously known with certainty only from W. Cornwall and the Channel Islands, is widespread along the exposed rocky and sandy coasts of Brittany and the Cotentin peninsula in N.W. France where it is morphologically, cytologically and ecologically identical with or closely similar to typical British plants. Chromosome counts from French material confirm the number $2n = 16$.

INTRODUCTION

Trifolium occidentale (Coombe 1961) is related to *T. repens* but morphologically, genetically, cytologically and ecologically distinct from it. By 1961 *T. occidentale* was known to occur in W. Cornwall and the Channel Islands and its existence along the coasts of W. and N.W. France seemed likely. A specimen in the Herbarium at Kew suggested that it might also occur in N.E. Spain. Its chromosome number was found to be $2n = 16$ in three clones from W. Cornwall, in two from Guernsey and two from Jersey, whereas $2n = 32$ in wild plants of *T. repens*.

DISTRIBUTION

On 1 May 1962, *T. occidentale* was found by H. des Abbayes (Rennes) on maritime sand dunes at Le Cabellou, Concarneau, on the S. coast of Finistère; the specimen (now in CGE) is identical with the type from W. Cornwall. This is the first localized record for France. H. des Abbayes also noted the plant on the Iles Glénans off Concarneau, but failed to find it around Dinard (Ille-et-Vilaine). Subsequently R. Tüxen (Stolzenau-Weser) found *T. occidentale* in Finistère at Beuzec-Cap-Sizun (14 km W. of Douarnenez) on 7 June 1962, and on maritime sand dunes at Santec (5 km W.S.W. of Roscoff) on 9 June 1962. In the same month J. M. Géhu (Lille and Besançon) found *T. occidentale* on the coast of the northern part of the Cotentin Peninsula (Manche) at the Pointe de Barfleur (26 km E.N.E. of Cherbourg), on the dunes at Vauville (15 km W. of Cherbourg) and at the Cap de Carteret (near Barneville). Later in 1962 and 1963 J. M. Géhu (accompanied on occasion by A. Dizerbo (Brest), P. Jovet (Paris) and R. Franquet (Nancy)) added a large number of localities in Finistère, a lesser number in Manche and Côtes-du-Nord, and one locality in Morbihan.

Géhu (1962) describes the coastal habitats (sand-dunes and cliffs) and communities in which *T. occidentale* was known at that time in N.W. France; Géhu (1963*b*) gives a more detailed distribution map, full lists of localities, and further ecological notes. Neither he nor P. Jovet have been able to find it in the Pays Basque or around Biarritz, or along the W. coast of France south of Lorient (including Belle Ile), or along the Golfe de St. Malo between the Iles Bréhat and Granville; nor has Géhu found it on numerous visits to the coasts of the Pays de Caux and the Pas-de-Calais (Géhu 1962; see also Géhu 1963*a*, 1964 for further observations on associated species*).

In the British Isles *T. occidentale* has still not been found outside W. Cornwall and the Channel Islands; localities which somewhat extend its known range since 1961 are Alderney (Crabby Bay, 19 April 1962, Miss M. McCallum Webster) and Towan Head, Newquay, W. Cornwall (3 June 1964, J. H. Chandler, confirmed in the field by D.E.C.

**T. occidentale* occurs at Marazion Station (W. Cornwall) together with *Cynodon dactylon* (cf. Quadrat 1(a) from Guernsey in Coombe, 1961).

on 9 April 1965). Other new records in W. Cornwall merely close the gaps between published localities: Lamorna Cove, Treen, Gwennap Head, Cape Cornwall, Pendeen Watch (D.E.C., 1961-62); Zennor Head, Portherras Cove (Mrs. J. Paton 1962); St. Levan (D.E.C., 1966); Tresco (abundant near the Blockhouse, both on dune sand and on granite, D.E.C., 1966).

Fig. 1 shows all localities of *T. occidentale* known by 5 May 1966; each dot in the British Isles represents at least one record in a 10 km square of the National Grid (as defined by Perring & Walters 1962); records in France are based on Géhu (1963) and exclude the unconfirmed locality at San Sebastian in N.E. Spain (Coombe 1961).

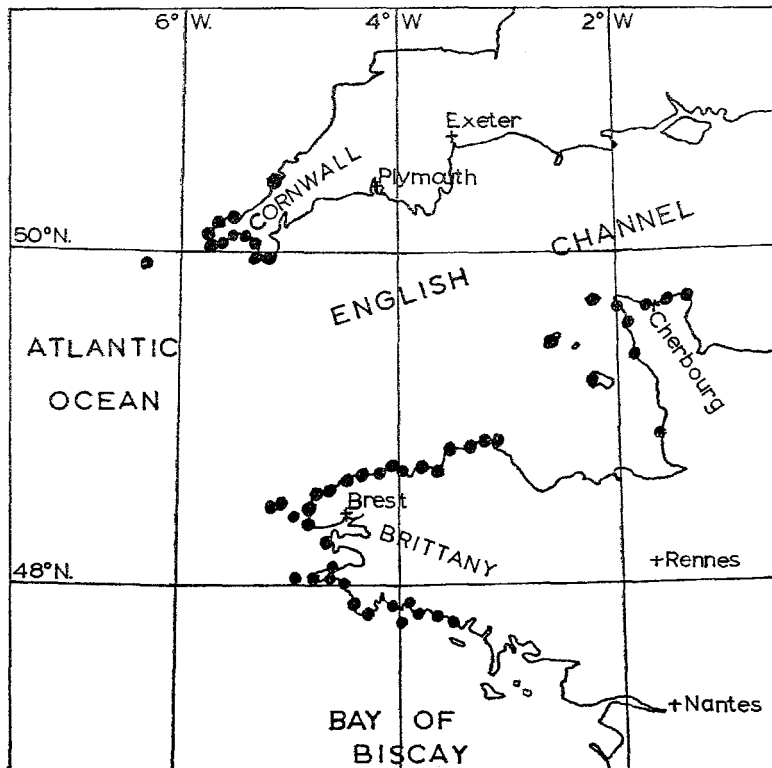


Fig. 1. Distribution of *Trifolium occidentale*.

MORPHOLOGY OF FRENCH PLANTS

In 1965 M. Kerguélen (Laboratoire de Recherches sur les Plantes Fourragères, Rouen, S.M.) distributed wild-collected seed of *T. occidentale* from three localities in Finistère: Lampaul-Ploudalmézeau (24 km N.W. of Brest); Guissény (28 km E.N.E. of Brest); and Pointe de Trévignon near Trégunc (36 km W.N.W. of Lorient). Some of the seed from each of these localities was sown in June 1965 in a cool glass-house at the Cambridge University Botanic Garden where the plants flowered freely from March to June 1966. These plants are identical with typical *T. occidentale* in all characters described by Coombe (1961) with one exception: the calyx-teeth of some of the plants from Trégunc are somewhat recurved at anthesis instead of being straight or even convergent as in all other plants. Otherwise the calyx-teeth are typical in their ovate-lanceolate or broadly triangular shape and in usually having one or two denticulations, particularly on the upper margins of the two uppermost teeth. As these denticulations are not illustrated in Coombe (1961, p. 86), the calyx-teeth of a plant from Trégunc are shown in Fig. 2.



Fig. 2. The calyx-teeth of a plant of *Trifolium occidentale* from Trégunc. Stippled areas: chlorenchyma. Scale: $\times 10$.

CYTOLOGY*

The somatic chromosome number of *T. occidentale* from Brittany was determined using the following method with root-tip meristems from mature plants at the flowering stage, grown at the Cambridge University Botanic Garden: pre-treatment in a saturated aqueous solution of monobromonaphthalene for two hours at room temperature, fixation in acetic-alcohol (1 : 3), clearing of cytoplasm in a mixture (1 : 1) of concentrated HCl and ether for 10 minutes at room temperature, maceration in N HCl for five minutes at 60° C, staining in alcoholic carmine, and squashing in 45 per cent. acetic acid (Snow 1963). Three individuals were studied, one from each of the following localities in Finistère: Lampaul-Ploudalmézeau; Guissény; Pointe de Trévignon (near Trégunc).

Chromosome number

The three individuals of *T. occidentale* studied all have $2n = 16$ (Fig. 3) like those seven plants from W. Cornwall and the Channel Isles previously studied by M. J. E. Coode and M. J. Swift (in Coombe 1961). Wild *T. repens* on the other hand always has $2n = 32$ (references in Löve & Löve 1961). Atwood & Hill (1940) believe that the numbers $n = c. 12$ and $n = 14$ reported for *T. repens* are erroneous. Erith (1924) interpreted figures of meiosis

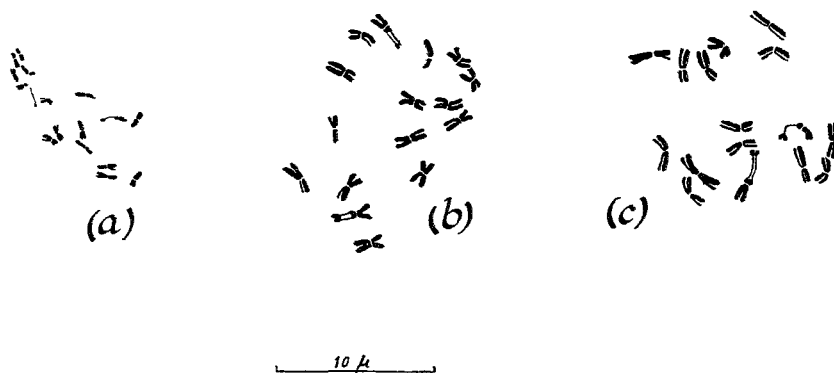


Fig. 3. Root meristem chromosomes of *Trifolium occidentale*; camera lucida drawings, all at the same scale. Plants from Brittany: (a) Trégunc; (b) Lampaul-Ploudalmézeau; (c) Guissény.

in macrosporocytes of *T. repens* as showing $n = 8$ but, as pointed out by Wexelsen (1928), her drawings clearly show that her material had $n = 16$. The only counts of $2n = 16$ in the group of perennial species closely related to *T. repens* are those of *T. thalii* Schreber (Löve & Löve 1961) and *T. occidentale*.

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Chromosome morphology

In *T. occidentale* there are seven pairs of chromosomes with the centromere more or less in the median region (\pm metacentric) and without a secondary constriction. The eighth pair is a pair of satellited chromosomes with an intercalary secondary constriction at about the middle of one arm. The satellites are therefore rather large. The length of the secondary constriction can vary from 0.5 to 5 μ within individuals; sometimes it even differs in the two satellited chromosomes of the same mitotic cell (Fig. 3(a)). Such variation in the length of the secondary constriction has been reported in other genera (e.g. *Polygonatum*; Therman-Suomaleinen 1949); it is probably due partly to differences in the action of the pre-treatment, partly to stretching brought about in squashing the cells.

Another point worth notice is that the individual from Trégunc has chromosomes much smaller (Fig. 3(a)) than those of the other two plants studied. In this plant the length of the chromosomes (excluding the pair of satellited chromosomes) varies from 1 to 1.5 μ ; in the other two from 2 to 3 μ . This is a genuine difference and not an artefact brought about by differing pre-treatment: in the plants from Lampaul-Ploudalmézeau and Guissény with generally larger chromosomes occasional cells have very contracted chromosomes of about the same length as those of the Trégunc plant, but such contracted chromosomes have much thicker arms than those in the Trégunc plant. Genotypically controlled intra-specific differences in chromosome size have been known for some time (Thomas 1936); we are probably dealing with the same phenomenon. Indeed, Wexelsen (1928) observed similar differences in *T. repens* and found in the F₁ plants from a cross between 'var. *giganteum*' (large chromosomes) and 'var. *sylvestre*' (small chromosomes) a chromosome size intermediate between that of the parents. Wexelsen also found a positive correlation between chromosome size and leaf size in his material; no such difference appears to exist in our material of *T. occidentale*, but as mentioned on p. 272 the calyx-teeth of some plants from Trégunc differ (at least in cultivation) from any other so far seen in being recurved and not more or less convergent at anthesis.

DISCUSSION

As expected *T. occidentale* is widespread along the coasts of N.W. France where it occurs in habitats very similar to those already described in Cornwall and the Channel Islands. Géhu (1963b, p. 207) remarks that it is especially characteristic of cliffs exposed to salt spray (*Armerion maritimae*) and of fixed dunes (*Koelerion albescentis*); it occurs more rarely in maritime heaths (*Ulicion gallii*) and related communities (*Sedion anglici*); it is absent from sheltered rocky coasts where vegetation influenced by spray is reduced or absent and where scrub (*Prunetalia*) or woodland (*Quercetalia robori-petraeae* or *Fagetalia*) come right down to the water's edge (as in many rias); and that it is also absent from saltmarshes (*Juncetalia maritimae*).

The record for N.E. Spain remains unconfirmed, and if, as Géhu suggests, *T. occidentale* has the character of a 'eu-atlantic' species, it would be unlikely to occur in the hotter, more extreme climate of the Gulf of Gascony. Nevertheless, it would be interesting to look for *T. occidentale* along the north coast of Spain, particularly in Galicia where plants of *T. repens* have been recorded with villous stems, petioles and peduncles (Merino 1909).

Although *T. occidentale* is superficially similar to *T. repens*, the data presented here confirm that the two species are readily distinguished in the field and are cytologically, ecologically and geographically distinct.

ACKNOWLEDGMENTS

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