

NOTES ON CAREX FLAVA AND ITS ALLIES
III—THE TAXONOMY AND MORPHOLOGY OF THE
BRITISH REPRESENTATIVES*

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This group of closely related species included in the section *Extensae* of the sub-genus *Carex* is represented in Great Britain by:— *C. flava* L., *C. lepidocarpa* Tausch, *C. demissa* Hornem., *C. serotina* Mérat, *C. scandinavica* E. W. Davies (E. W. Davies 1953a). These species have for many years caused difficulty and been the subject of much misidentification. And although certain characters have been found useful for distinguishing the species, and their nomenclature has been elucidated (Nelmes 1945, 1947; Wiinstedt 1947; Senay 1950; Tutin 1952; and Davies 1953a and b), no detailed taxonomic or ecological study had been made, and no cytogenetical survey carried out. For this reason an investigation of this kind was begun, and the biometric and morphological aspects of the problem will be briefly discussed here. A key to the European members of this group and *C. viridula* Michx. is given opposite.

A range of forms of each species was collected from as many different localities as was possible. These plants, after their chromosome numbers had been determined, were planted out in an experimental garden, where conditions were as uniform as possible, so that any effects of differences in the environment on the phenotype were to a great extent eliminated; and the genotypes of the individuals and species could be compared directly.

These transplant experiments have shown how much variation within the species is due to environmental conditions. As was to be expected, certain characters, such as absolute size of the plant and its vegetative organs, have proved to be subject to considerable phenotypic modification, while in contrast the floral parts appear to be much more constant. The main morphological study, and detailed measurements given in Table 2, have been made on herbarium specimens gathered from the same plants in the field.

1. HEIGHT

On the whole this has proved an unreliable character, as much variation in height and size is found not only between plants of the same species from the different habitats, but also in the same plant during one year, and in successive seasons growing in the same locality. Thus, *C. serotina*, seen at Wicken Fen, Cambridgeshire, in August 1951, had fertile stems ranging from 2-25 cm. on one plant. This species at Frensham Pond, Surrey, had shoots 25 cm. long in July 1951, while in the same month in 1952 these plants were very dwarf and the fertile stems were only 2 cm. in length.

This variation in absolute size of the plant from season to season, and from different localities, can usually be correlated with a change in ecological conditions, as after they had been grown under uniform conditions for two years they showed very much less range of size.

Although there is considerable variation, it is possible to make some general statements about height. *C. flava* is normally the tallest member of the group, and the

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KEY TO THE EUROPEAN SPECIES INCLUDED IN *C. FLAVA* AGGREGATE

1. Perigynia 4-7 mm. long, arcuate-deflexed with a long attenuate beak.
 2. Female spikes 3-4, upper sessile contiguous, lower sometimes distant and peduncled; perigynia 5.25-7 mm., beak 2-2.25 mm. *flava*
 2. Female spikes 1-3, somewhat distant, rarely contiguous sessile, lower usually long-peduncled; perigynia 4-5 mm., beak 1.5-1.75 mm. *lepidocarpa*
 3. Female spikes short, sub-rotund, with rather few lax spreading perigynia; beak 1.75 mm., attenuate. subsp. *jemtlandica*
 3. Female spikes ovoid, or shortly cylindrical, with rather dense crowded perigynia; beak 1.5 mm.
 4. Stems 20-60 cm., rather slender and often curved in fruit; leaves half the length of the fertile stems, narrow, 1.5-2.5 mm. wide; female glumes pale yellow-brown, hyaline, caducous; perigynia 3.5-4 mm. subsp. *lepidocarpa*
 4. Stems 8-30 cm., stout, rigid, erect in fruit; leaves short, 2.5-4.5 mm. wide; female glumes dark chestnut-brown, usually persistent; perigynia 4-5 mm. subsp. *scotica*
1. Perigynia 1-4 mm. long, usually straight, or only slightly deflexed, with a short beak.
 5. Stems 20-60 cm. erect; leaves blue-green, less than the length of the stems; lower sheaths red-brown becoming fibrous and sometimes coriaceous. *mairii*
 5. Stems 2-30 cm., erect or semi-decumbent; leaves bright yellow-green, more than half the length of the stems; lower sheaths sometimes becoming fibrous, but never coriaceous.
 6. Stems often curved and semi-decumbent; leaves flat, 3.5-5 mm. wide. *demissa*
 6. Stems erect; leaves inrolled, 1.5-2 mm. wide.
 7. Perigynia 3-3.25 mm. long, all but the upper slightly arcuate-deflexed; beak 1 mm. *dyrrachiensis*
 7. Perigynia less than 3 mm. long, straight; beak 0.25-0.5 mm.
 8. Perigynia 1.5-2.25 mm., never inflated; nut completely filling the perigynium; leaves shorter than the stems; female spikes often separated, seldom contiguous to the shortly peduncled male spike. *scandinavica*
 8. Perigynia 1.75-3 mm., more or less inflated; nut filling only three-quarters of the perigynium; leaves usually longer than the stems; female spikes usually contiguous with the sessile male spike.
 9. Plant pale grey-green; stems 5-35 cm., erect; bracts exceeding the inflorescence, upright; male spike sessile, often female in the middle. *viridula*
 9. Plant bright yellow-green; stem 2-25 cm., erect; bracts exceeding the inflorescence upright or often spreading; male spike sessile, sometimes female at the base.
 10. Plant 2-20 cm.; male spike always present; perigynia 1.75-2.5 mm. *serotina*
 10. Plant 15-25 cm.; male spike absent or frequently at the top of the uppermost female spike; perigynia 2.5-3.0 mm. *serotina* var. *cyperoides*

species descend in height in the following order:—*C. lepidocarpa*, *C. demissa*, *C. serotina*, *C. scandinavica* (Plate 7).

2. LEAVES

The dimensions of the leaves, unlike other vegetative parts of the plant, have proved a reliable and a surprisingly constant character, which shows little variation in cultivation.

(a) Length

The leaves of *C. flava* are much longer and broader than those of the other species, and, as in *C. serotina*, they often exceed the fertile shoots. This is likewise a useful

means of distinguishing *C. serotina* and the rather similar *C. scandinavica*, for although in contrast to *C. flava* the leaves of both these species are narrow and canaliculate, those of *C. scandinavica* are always shorter than the stems.

C. demissa has broad leaves, about three-quarters the length of the culms, while the leaves of both subspecies of *C. lepidocarpa* are short and comparatively narrow. Subsp. *lepidocarpa* has leaves that are about half as long as the stems, while those of the subsp. *scotica* E. W. Davies are even shorter.

(b) Width

The leaves of *C. flava* and *C. demissa* in this order are broadest, and usually flat, while both subspecies of *C. lepidocarpa* have narrower leaves. However, those of subsp. *lepidocarpa* are grass-like and herbaceous, while subsp. *scotica* has tough fibrous leaves, which retain this texture in cultivation, a character which is associated with the severe climatic conditions in the north and at high altitudes. The leaves of *C. serotina* and *C. scandinavica* are very narrow, and in contrast to all other members of this group they are inrolled.

3. SPIKES

(a) and (b) Arrangement and number of male and female spikes

The arrangement and number of the spikes are reliable characters, which show little phenotypic variation under normal conditions, and remain constant in cultivation. However, occasionally irregularities have been noticed when culms are produced as a second crop at the end of the season. This is unusual and these late fertile shoots are unreliable for identification.

As can be seen from Table 1, and in Plate 8, *C. flava* and *C. serotina* show a similarity in the number and arrangement of their spikes. Both species have a comparatively short sessile male spike, which is occasionally partly female, while the female spikes (3-4 in *C. flava* and 3-5 in *C. serotina*) are usually contiguous and crowded round the male spike. In contrast the male spikes of *C. lepidocarpa*, *C. demissa* and *C. scandinavica* are considerably longer and the female spikes (1-3 in *C. lepidocarpa*, 2-4 in *C. demissa* and 2-3 in *C. scandinavica*) are often separated from the male spike, and sometimes from each other (Fig. 2). In *C. demissa* there is frequently one remote basal spike with a long peduncle (Fig. 2d).

4. PERIGYNIA OR UTRICLES

(a), (b) and (c) Length and shape of perigynia and length of beak

The dimensions and shape of the perigynia have provided the most reliable biometric character, as they show very little variation and are seldom influenced by environmental conditions (Plate 9). In fact it is possible to identify the members of this group from the length of the perigynia alone. For although a slight overlap can be seen in the accompanying histograms (Fig. 1), in most well-grown specimens there is at least a difference of 1 mm. between any two of the species. Thus the perigynia lengths are as follows :-

<i>C. flava</i>	mode 6.0, range 5.25-7.0 mm.
<i>C. lepidocarpa</i> ssp. <i>lepidocarpa</i>	mode 4.25, range 3.5 -4.5 mm.
<i>C. lepidocarpa</i> ssp. <i>scotica</i>	mode 4.5, range 4.0 -5.0 mm.
<i>C. demissa</i>	mode 3.25, range 3.0 -3.5 mm.
<i>C. serotina</i>	mode 2.25, range 2.0 -2.5 mm.
<i>C. scandinavica</i>	mode 1.75, range 1.0 -2.25 mm.

TABLE 1. Characters for distinguishing British species

Species:	I. <i>Carex flava</i>	IIa. <i>Carex lepidocarpa</i> ssp. <i>lepidocarpa</i>	IIb. <i>Carex lepidocarpa</i> ssp. <i>scotica</i>	III. <i>Carex demissa</i>	IV. <i>Carex serotina</i>	V. <i>Carex scandinavica</i>
1. Height of plant	(15-) 50-70 (-90) cm.	(20-) 30-50 (-60) cm.	(8-) 15-20 (-30) cm.	(5-) 10-20 (-30) cm.	(2-) 5-15 (-25) cm.	(2-) 10-15 (-25) cm.
2. Leaves						
(a) Leaf length	As long or longer than fertile shoots.	About half the length of fertile shoots.	Very short.	About three-quarters the length of fertile shoots and flat.	Canaliculate, often longer than fertile shoots.	Inrolled, usually shorter than the fertile shoots.
(b) Leaf width	3.5-5 mm.	1.5-2.5 (-3.5) mm.	2.5-4 mm.	(2.5-) 3.5-4 (-5) mm.	1.5-2 mm.	0.5-2 mm.
3. Spikes						
(a) Male	Short and sessile, sometimes ♀ in the middle.	Fairly long and peduncled.	Fairly long and peduncled.	Fairly long and peduncled.	Sometimes absent, or occasionally ♀ at the base, sessile.	Always present, peduncled, never female at the base.
(b) Female	3-4, upper sessile and contiguous, lower sometimes distant and shortly peduncled.	1-3, upper sessile, rarely contiguous, occasionally one lower and peduncled.	1-3, usually close together but seldom contiguous to the ♂ spike.	2-4, usually 3, upper two ± distant sometimes contiguous, lowest often remote and peduncled.	3-5, usually 4, contiguous and sessile, frequently crowded round the ♂ spike, occasionally lowest remote and peduncled.	2-3 (-4) often separated, somewhat distant, rarely contiguous, sessile, or lowest shortly peduncled.
4. Perigynia						
(a) Total length	(5.25-) 5.75-6 (-7.0) mm.	(3.5-) 4.25-4.5 mm.	(4-) 4.25-4.5 (-5) mm.	(2.5-) 3-3.5 (-4) mm.	(1.75-) 2-2.5 (-2.75) mm.	(1.0-) 1.5-2.5 mm.
(b) Beak length	2.0-2.5 mm.	1.5 mm.	1.5 mm.	1 mm.	0.25-0.5 mm.	0.25 mm.
(c) Shape	Arcuate, deflexed.	Arcuate, deflexed.	Arcuate, deflexed.	Straight, or very slightly curved.	Straight, inflated. Nut only three-quarters filling the utricule.	Straight, not inflated. Nut completely filling the utricule.
5. Female glumes	Pale brown.	Pale brown-yellow, hyaline, caducous.	Dark brown. Seldom, and only very late in the season, caducous.	Brown.	Pale yellow-brown.	Dark brown, with pale or green midrib.



Fig. 1. Histograms showing the range in perigynia length.

The data used in drawing the histograms were obtained from collections made during the past two years in this country, and augmented by European herbarium material.

The shape of the perigynia is another good character, for *C. flava* and *C. lepidocarpa* have arcuate-deflexed perigynia, which are gradually attenuate into a beak, while those of *C. demissa* are only slightly curved, and the remaining two species have straight perigynia. In contrast to the other species the perigynia of *C. scandinavica* are not inflated, but tightly enclose the nut.

Finally the beak length is a useful character, and, as might be expected, decreases proportionately with the decrease in perigynia length. Thus the beak lengths of the five species are as follows :-

<i>C. flava</i>	2.0-2.5 mm.
<i>C. lepidocarpa ssp. lepidocarpa</i>	1.5 mm.
<i>C. lepidocarpa ssp. scotica</i>	1.5 mm.
<i>C. demissa</i>	1.0 mm.
<i>C. serotina</i>	0.25-0.5 mm.
<i>C. scandinavica</i>	0.25 mm.

5. FEMALE GLUMES

Finally the colour of the female glumes, normally a rather unreliable and variable character, has been found useful in distinguishing certain members of the complex. Thus the female glumes of *C. lepidocarpa ssp. lepidocarpa* are pale brown, hyaline and caducous, while those of the *ssp. scotica* are dark chestnut-brown and usually persistent, so giving the female spikes a characteristic dark appearance,

Likewise the colour of the female glumes is useful in separating *C. serotina* and *C. scandinavica*, for the glumes of *C. serotina* are frequently pale yellow-brown and hyaline, while those of the latter species are dark brown.

This character has always been found to remain constant in cultivation and shows little variation under different ecological conditions.

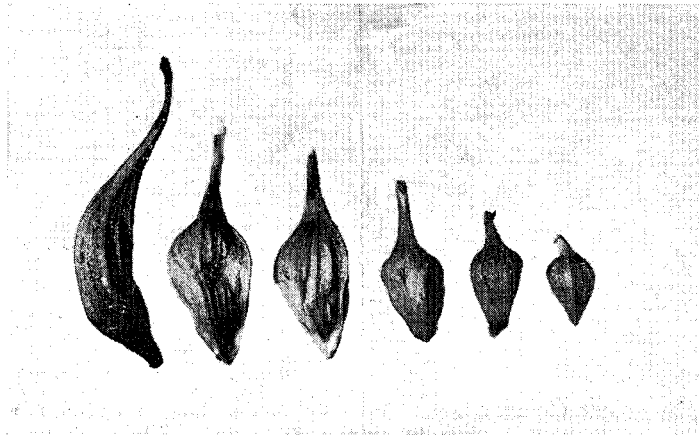
CONCLUSIONS

This morphological and biometric study and the transplant experiments have shown that the phenotype may be modified much more profoundly by environment in the vegetative parts of these sedges than the floral parts; in the latter the appearance of the phenotype is almost entirely the expression of their genotype. For this reason the arrangement and the spikes, and the dimensions and shape of the perigynia have been found the most reliable criteria for identification and classification, while the growth form and size of the plant, and length and breadth of the leaves have proved useful auxiliary characters.

REFERENCES

- DAVIES, E. W., 1953a, Notes on *Carex flava* and its allies : I. A sedge new to the British Isles, *Watsonia*, **3**, 66-68.
- , 1953b, Notes on *Carex flava* and its allies : II. *Carex lepidocarpa* in the British Isles, *Watsonia*, **3**, 69-72.
- NELMES, E., 1939, Notes on British Carices : V. *Carex oederi* Retz., *J. Bot.*, **77**, 301-304.
- , 1947, Two critical groups of British Sedges, *Rep. Bot. Soc. & E.C.*, **13**, 95-99.
- , 1949, *Carex flava* and its allies, in Wilmott, A. J., *British Flowering Plants & Modern Systematic Methods*, 85, London.
- SENAY, P., 1950, Le groupe des *Carex flava* et *C. oederi*, *Bull. Mus. Nat. Hist. Nat.*, Paris, 2me série, **22**, 618-624.
- , 1950, Le groupe des *Carex flava* et *C. oederi*, *Bull. Mus. Nat. Hist. Nat.*, Paris, 2me série, **22**, 790-796.
- , 1951, Le groupe des *Carex flava* et *C. oederi*, *Bull. Mus. Nat. Hist. Nat.*, Paris, 2me série, **23**, 146-152.
- STEBBINS, G. L., 1950, *Variation and Evolution in Plants*, Oxford.
- TUTIN, T. G., 1952, in CLAPHAM, A. R., TUTIN, T. G. and WARBURG, E. F., *Flora of the British Isles*, Cambridge.
- WIINSTEDT, K., 1947, Bidrag til Polymorfien hos den Tidligere som *Carex Oederi* Retz. kendte Art, *Bot. Tidsskr.*, **48**, 192-206.

PLATE 9.



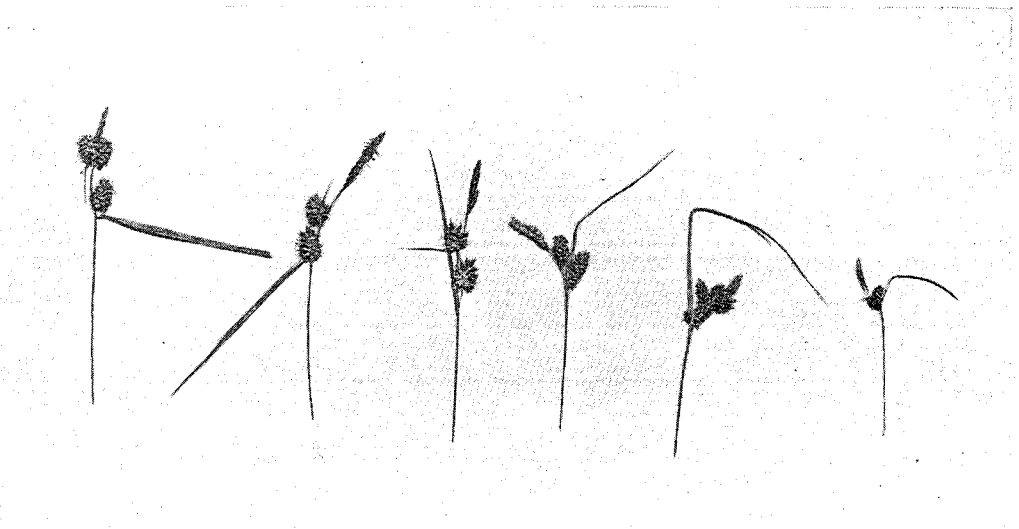
Perigynia of (left to right) : (a) *C. flava*; (b) *C. lepidocarpa* subsp. *lepidocarpa*; (c) *C. lepidocarpa* subsp. *scotica*; (d) *C. demissa*; (e) *C. serotina*; (f) *C. scandinavica*.

PLATE 7.



(Left to right) : (a) *C. flava*; (b) *C. lepidocarpa* subsp. *lepidocarpa*; (c) *C. lepidocarpa* subsp. *scotica*; (d) *C. demissa*; (e) *C. serotina*; (f) *C. scandinavica*.

PLATE 8.



Male and female spikes of (left to right) : (a) *C. flava*; (b) *C. lepidocarpa* subsp. *lepidocarpa*; (c) *C. lepidocarpa* subsp. *scotica*; (d) *C. demissa*; (e) *C. serotina*; (f) *C. scandinavica*.