

## *ENTORRHIZA* SMUT FUNGUS ROOT GALLS ON *JUNCUS* AND CYPERACEAE

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A series of conspicuous galls caused by five species of the smut genus *Entorrhiza* on the roots of five host species of *Juncus*, *Carex*, *Eleocharis* and *Eleogiton* have been rarely recorded in the past, yet in recent years we have found all of them in Britain, several proving to be common and widespread if only one takes the trouble to inspect the root systems. The galls are one to many on a plant, and those of all five species tend to be rather similar, globose to oblong or butternut-squash-shaped and sometimes branched, and usually 5-12mm long. They are attached to the ends of slender thread-like roots, and are easily detached. Whitish when young, they gradually turn brown from the proximal end as the spores in them ripen. On drying they shrivel and can become hard to see, and thus may easily be overlooked on herbarium specimens of the hosts.

The fungus has no visible effect on the above-ground parts of the hosts, and we have never seen any signs of the galls being eaten. The spores of each species are mostly readily diagnostic. Information on these smuts and their galls is given most extensively in Vanky (1994 and 2012) and in Klenke & Scholler (2015), and also in some of the standard gall literature. An article by the present authors with more information of a mycological nature is in press (Chater & Smith 2018).

Probably the commonest, and certainly the easiest smut to find, is *E. aschersoniana* on the annual and easily uprooted *Juncus bufonius* (Plate 1, Fig. 1), yet a 19th century record from Aberdeen and a 1968 record from Mull were the only ones until PAS found it on Lewis and North Uist in the Outer Hebrides in 2016 and 2017 respectively. In 2017 AOC found it in Cardiganshire, Carmarthenshire, Merioneth and Montgomeryshire, in a total of 35 tetrads, and Ray Woods and Andy Shaw found it in Breconshire in two.

On a visit to Rushmere pond on Wimbledon Common in 2017 AOC found it on the first plant he inspected. The galls seem always to be entire though very variable in shape.

*E. casparyana* var. *casparyana* on *Juncus articulatus* (Plate 1, Fig. 2) is probably as common and widespread, but the host is much more difficult to uproot. Previous records probably of this species were from near Glasgow (Trail 1884), from Kent (Schwartz 1910), and two definite ones from NW Scotland by RWG

Dennis (Fungal Records Database). PAS found it at two sites in North Harris in the Outer Hebrides in 2017, and the same year AOC found it in all the same vice-counties in mid Wales as *E. aschersoniana*, as well as in Radnorshire, in a total of 30 tetrads. The galls are usually larger than those of the other British species, and are mostly lobed.

*E. raunkiaeriana* is on *Eleogiton fluitans* (Plate 1, Fig. 4), and in our experience on plants rooted in the substrate or in *Sphagnum* rather than free-floating ones. The only previous records anywhere were from Denmark over a century ago, but in 2017 AOC and Ray Woods found it in eleven tetrads in Cardiganshire, Carmarthenshire, Breconshire, Radnorshire and Merioneth. Easy to find where it occurs (we have found it in about half the sites for the host that we have searched), it is doubtless elsewhere in Britain. The galls are usually entire and widened towards the apex.

*E. caricicola* on *Carex limosa* (Plate 1, Fig. 3), known previously from Denmark and Sweden, was found new to Britain by AOC in 2017 at three of the four sites for the host that he searched, and is doubtless elsewhere. Among its other hosts abroad is *Juncus filiformis*, which would be worth searching in the few sites where it is found in Britain. The galls are usually entire and widened towards the apex.

*E. scirpicola* on *Eleocharis quinqueflora* had been found in the twentieth century at three sites in Scotland in 1979, as well as one in Norfolk in 1915 (Hooper & Spooner 1981). PAS then found it at one site in Lewis, Outer Hebrides, in 2014; the gall had an unusual form. Although spores were present, they were on a root that was uniformly thicker throughout, rather than with a swelling, narrowly ovoid or cylindrical and sometimes branched, as is reported elsewhere. AOC has failed to find it in Wales, though only five of the host's sites have been searched so far.

The spores of *E. casparyana* (Plate 1, Fig. 5b) are perfectly globose, thick-walled and smooth to strongly warted, while those of *E. aschersoniana* (Plate 1, Fig. 5a) are slightly but quite distinctly subglobose or ovoid, but otherwise similar. *E. caricicola* has ellipsoid, smooth spores (Plate 1, Fig. 5c), while *E. raunkiaeriana* has ellipsoid spores (Plate 1, Fig. 5d) with 10-14 (as seen on the

circumference) longitudinal, usually slightly spiral ridges. *E. scirpicola* spores (Plate 1, Fig. 5e) are very similar, but slightly broader and with 7-11 often interrupted ridges.

On *Juncus bufonius* and *J. articulatus* the most reliable sites are where there is some movement of water, especially gravelly roadside runnels, and the searcher need have few qualms about uprooting the plants. *Carex limosa* and *Eleocharis quinqueflora* can be quite rare, especially in much of England, so care should be taken in their cases, although both can generally easily be replaced in their boggy substrate, as can *Eleogiton fluitans*.

There are about 14 species of *Entorrhiza* worldwide, and several more would be worth looking for in Britain. *E. parvula* on *Eleocharis parvula* is known only from the type collection from France. *E. globoidea* on *Isolepis cernua* is known only from the type collection from Australia, but the host, as well as being native in Britain, is sometimes sold as a decorative pot plant and this source should be investigated. *E. finerani* is known from the same host from New Zealand and Venezuela. *E. casparyana* var. *tenuis* on *Juncus tenuis* is known from Austria, Romania, Costa Rica and Korea; the host is commonly naturalised in Britain, but is notoriously difficult to uproot!

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Fig. 1: *E. aschersoniana* on *Juncus bufonius*, Morfa Mawddach, Merioneth, vc48, SH629143, 7 September 2017.



Fig. 2: *E. casparyana* var. *casparyana* on *Juncus articulatus*, Ffair-rhos, Cardiganshire, vc46, SN782683, 2 November 2017.



Fig. 3: *E. caricicola* on *Carex limosa*, Cors Caron, Cardiganshire, vc46, SN672640, 27 August 2017.



Fig. 4: *E. raunkiaeriana* on *Eleogiton fluitans*, Pen-y-cefn Reservoir, Cardiganshire, vc46, SN659854, 2 October 2017.

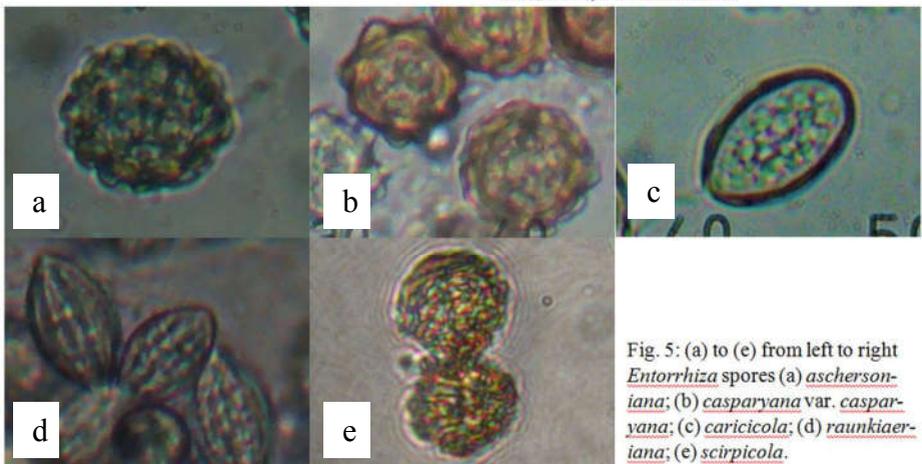


Fig. 5: (a) to (e) from left to right *Entorrhiza* spores (a) *aschersoniana*; (b) *casparyana* var. *casparyana*; (c) *caricicola*; (d) *raunkiaeriana*; (e) *scirpicola*.

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Plate 1 (see page 2-4)