Four anther smut galls new for or rare in Britain and Ireland

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Introduction

An increasing interest in microfungi has led to many recent records, and the activities of the Welsh Parasitic Microfungi Group in particular have produced red data lists (RDL) for rusts and smuts in Wales (Woods *et al*. 2015, 2018). Many smuts seem to be generally uncommon, and a certain serendipity can be

required to locate specimens, although having a clear picture of what to search for is a substantial aid to locating them. A few species are common, and some are conspicuous, but many are neither, and require concentrated searching or special activity to locate, such as *Entorrhiza* (now split into *Entorrhiza* on Cyperaceae and *Juncorrhiza* on Juncaceae, see Riess *et al*. 2019) on the roots of sedges and rushes, or *Ustilentyloma* embedded in the leaf tissue of grasses (Smith & Lutz 2014).

Some smuts are also gall-causers, affecting a range of different organs of their host plants. A range of species infects the anthers of their hosts, causing them to swell and converting them to spore production. Two species of anther smut galls have recently been added to the British list, and two further rarely reported species have made appearances. They are described below.

Microbotryum pinguiculae (Rostr.) Vánky

Having failed to find this species in western Scotland, PAS alerted the Welsh Parasitic Microfungi Group that this species was apparently unreported for Britain and Ireland, and within 24hrs RGW had located it, at Pentrosfa Mire, Llandrindod Wells, Radnorshire (vc43) SO059597, 30 May 2018 (Smith *et al*. 2021a). There are no previous records or reference specimens for Britain, but the Biological Flora account of *Pinguicula* (Heslop-Harrison 2004) says that "a brownish discoloration of the anthers has sometimes been observed in British plants, perhaps also owing to this infection", so it seems that it has previously been suspected to be present in Britain, if not formally recorded.

M. pinguiculae infects the anthers of *Pinguicula vulgaris* (Butterwort), causing them to swell and produce the brown spores, which have reticulate sculpturing under the microscope. The spores are sometimes visible on the corolla, but do not stand out because they are similar in colour. It is usually necessary to open the corolla to ascertain whether a flower is infected. Fig. 1 shows an opened corolla with infected anthers. Ziegler *et al*. (2018) and Smith *et al*. (2021a) studied smuts

Figure 1: Opened corolla tube of *Pinguicula vulgaris* showing infected anthers producing brown spores. © Ray Woods.

on *Pinguicula* and found that *M. pinguiculae* is restricted to *P. vulgaris* (its type host) and the closely related central European *P. leptoceras*. There are additional segregate species on the non-British *P. alpina* and *P. villosa*.

Some targeted searching in support of the construction of the Welsh smut RDL (Woods *et al*. 2018), found that *M. pinguiculae* is widespread in west Wales, and since the publication of the RDL people have been looking for this fungus which proves to be widespread with records from Scotland (Mull, several records from the Highlands) and England (Lancs, Norfolk). It seems likely that further searching will show that many populations of *P. vulgaris* are infected.

Microbotryum majus (Schröter) Deml & Oberwinker

There are several other species of *Microbotryum* smuts which infect the anthers of members of the Caryophyllaceae, causing them to swell and discharge spores in the same way as *M. pinguiculae*. These have been frequently reported, originally as the aggregate *M. violaceum* s.l., but DNA methods have shown that this species complex contains several host-specific taxa (Lutz *et al*. 2005, 2008). They (almost) all infect only the anthers – among British species only *M. majus* on *Silene otites* deforms other floral parts too. It has been rarely reported – only three records in the wild, in 1888, 1963 and 2012, and one from Cambridge Botanic Gardens in 1961 (Smith *et al*. 2021b).

Regular monitoring of *Silene otites* by the Breckland Flora Group (a partnership of Plantlife, Natural England and Forestry England) turned up deformed plants which proved to be infected with *M. majus*, at RAF Mildenhall base (TL 6791 7717, 16/6/2021, Rob Dyke & Jo Jones) with dark, swollen anthers, and flowers that remain more or less closed. *S. otites* has a restricted distribution in Britain, largely confined to the Brecks with some outlying records, so its smut is never likely to be very widespread. Regular monitoring will now include keeping a look-out, so more information on its distribution and abundance should follow.

Thecaphora melandrii (H. Sydow) K. Vánky & M. Lutz

Knowing that only *M. majus* among British *Microbotryum* spp. infecting hosts in the Caryophyllaceae affects more than the anthers, it was a surprise for PAS to find several plants of *Silene uniflora* on the shingle beach at Stokes Bay, nr Gosport, vc11 (SZ 5984 9823) on 25 May 2019 with deformed, unopened flower buds (Fig. 3). Their form superficially suggested an insect gall, but inside the unopened flowers most of the floral parts were swollen, and there were copious smut spores. A little more detective work showed it to be *Thecaphora melandrii*, which is distinguished by having spores in balls, and the individual spores are verrucose, without the reticulate sculpturing characteristic of *Microbotryum*. The spore balls are very loosely held together, and they disintegrate when mounted in

Figure 2: Contorted (galled) plant of *Silene otites* at RAF Mildenhall with (inset) galled flowers with smut spores in the swollen anthers. Photos: Jo Jones and (inset) Alex Prendergast.

Figure 3: (above left) Plants of *Silene uniflora* infected by *Thecaphora melandrii*, showing the deformed, unopened flowers. (above right) Close-up of infected head. (Note that *S. uniflora* has forms with and without anthocyanins, which is why there is a difference in the colours). Photos: Paul A. Smith.

water for examination under the microscope, so that the spores (Fig. 4) appear separate, which increases their microscopic resemblance to a *Microbotryum*. But the characteristic deformation of the flowers should be enough to give it away in the field.

Further searching showed that *T. melandrii* is also frequent on shingle at Hook with Warsash, vc11 (SU4804, 1 June 2019 and still there May 2020), and it seems likely that it may be in suitable places along the south coast. In continental Europe *T. melandrii* has been recorded additionally on *Silene vulgaris* and *Stellaria graminea*, so should be looked for on these hosts too. Further details of the ecology, host range and distribution of *T. melandrii*, including details of the new British records are given by Smith *et al*. (2020).

Microbotryum lagerheimii Denchev

Microbotryum species gall the anthers of quite a range of host plants, but it is only with the use of DNA sequencing that it has become clear that species on different hosts are distinct and narrowly host-limited (Lutz *et al*. 2008). But the use of DNA sequencing has had another effect, which is to distinguish cryptic species infecting the same host. The usual anther smut of *Silene uniflora* and *S. vulgaris* in Britain is *M. silenes-inflatae* (DC. ex Liro) G.Deml & Oberw., but there is a second species, *M. lagerheimii* which was described only in 2007 (Denchev 2007), that has been found in Britain, in some places in populations of the host plant also infected with *M. silenes-inflatae* (Chung *et al*. 2012).

Figure 4: (left) Spores of *Thecaphora melandrii* showing the verrucose sculpturing in contrast to the reticulate pattern of the spores of *Microbotryum* spp. (on hosts in *Silene*); (right) section through flower of *Silene uniflora* infected by *T. melandrii* showing the swollen inner floral parts.

While investigating potential sites for *Thecaphora melandrii*, the opportunity to collect *Microbotryum* infecting the anthers of *Silene uniflora* was taken, and their DNA sequences obtained. This demonstrated the presence of *M. lagerheimii* at Gilkicker Point, vc11 (SZ60334 97729); more details are given in Smith *et al*. (2020). This is one more piece of evidence about the distribution of anther smut galls, though it will be a while before technology makes this kind of recording straightforward.

Conclusions

Recent advances in the taxonomy of anther smuts have led to the description of many narrowly host-limited species, and our knowledge of these galls is slowly increasing. However, other species which have been known much longer have apparently been overlooked in our area – *Microbotryum pinguiculae* seems to be widespread, but requires specific searching. The origin of *Thecaphora melandrii* is less clear; so far it is known in only two localities. But perhaps it is just the increased attention to smuts and other fungi that is generating new records of galls.

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