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X. A REVIEW OF THE FUNGAL FLORA OF THE CANARY ISLANDS

by

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Introduction

The first report on Canarian fungi was published by Montagne (1840) based on specimens collected by P. Barker-Webb, S. Berthelot, and J. M. Despréaux. Among the 53 fungus species recorded, several were described as new. Some of these fungi have subsequently been transferred to other genera or have proved to be imperfect states of other species (e.g. in the *Uredinales*), but some species are still valid.

Subsequent to Montagne's initial paper, there have, to my knowledge, been about 35 papers published which deal solely, or in part, with the Canarian fungal flora. Many of these authors studied fungal material specifically collected by other botanists or phanerogamic collections were examined to ascertain which, if any, fungi were to be found on such material. It is therefore obvious that our knowledge of the Canarian fungi varies very much. Best known are the *Ascomycetes* and *Uredinales*, but even within the *Uredinales*, there is still much work left to be done with respect to the geographical distribution of those rusts now known to be present there and, it is my opinion, additional rust species and host records will be obtained when further collections are made. I have the feeling that the same will be true with respect to other groups of fungi as well.

In the following I have tried to give a short review of the literature concerning Canarian fungi. However, no claim is made with respect to the completeness of the reference list; references to odd finds may well have escaped. I have not treated the different classes of fungi in a uniform fashion herein. In classes where only a few species have been recorded either they are all listed or I have stressed those species whose type localities are in the Canary Islands. In other classes, too many fungi are known to list all species, not even those having their type localities in the islands, but I have noted new genera and attempted to point out total numbers of new species reported by various authors.

For valuable help with providing the literature I want to express my sincere thanks to Dr. Per Sunding and Mrs. Torill Johannessen, Botanical Museum of the University of Oslo, and to Prof. F. Roll-Hansen, Norwegian Forest Research Institute, Ås- NLH, and to Prof. J. Reid, University of Manitoba, Winnipeg, for their valuable suggestions and

corrections of the language of the paper. I also want to thank Mr. Bjørn Eidissen, Botanical Museum, Oslo, for a photograph, and Mr. J. Drew Smith, Saskatoon, Saskatchewan, for help with photography.

Bibliographical review

Myxomycetes

Montagne *(op. cit.)* mentioned one species, viz. *Stemonites fusca* Roth. Later Urries (1957a) reported the presence of three additional species, Marie L. Farr (1959) added two and Wildpret de la Torre *et al.* (1972a) one more species to the class. Three of the species known have been reported from Tenerife, three from La Palma, and one species from Gran Canaria.

Chytridiomycetes

Two species have been reported, viz. *Synchytrium papillatum* Farl. by Magnus (1893) from Tenerife, and *Physoderma ornithogali* Maire by Jørstad (1966) from Gran Canaria.

Oomycetes

Bornmüller (1903) recorded *Albugo candida* (Pers.) Kze. (= *A. cruciferarum* DC. ex S. F. Gray), and Urries *(op. cit.)* reported *Cystopus convolvulacearum* Otth (= *A. ipomoeae-panduratae* (Schw.) Swingle). Later Jørstad (1962, 1966) added records of three additional species of *Albugo*, one of them only identified to genus, *Bremia lactucae* Regel, and six species of *Peronospora*. Oospores were present in the unidentified *Albugo*, in *Bremia*, and in four of the *Peronospora* species.

Zygomycetes

The only published records of fungi belonging to this class were given by Schroeter (1884) and Jørstad (1966), who reported *Mucor stolonifera* Ehrenb. and *Pilobolus* sp., respectively, from Tenerife.

Hemiascomycetes

Only one species of each of the genera *Taphrina* and *Protomyces* have been reported from the Canary Islands. Both Spegazzini (1915) and Jørstad (1962) noted the occurrence of *Taphrina deformans* (Berk.) Tul., which was collected at Gran Canaria and Tenerife. Schroeter *(op. cit.)* and Jørstad *(op. cit.)* also reported *Protomyces macrosporus* Unger from Tenerife.

Plectomycetes

The first mildew recorded from the archipelago was *Erysiphe communis* Schlecht. (= *E. umbelliferarum* de Bary *sensu* Blumer 1933 and *E. heraclei* St.-Am. *sensu* Junell 1967) (Montagne 1840) from Gran Canaria. Bornmüller *(op. cit.)* added two species of *Erysiphe* to the list, and Urries *(op. cit.)* added four additional species of *Erysiphe*, as well as *Leveillula taurica* (Lév.) Arn. and *Podosphaera leucotricha* (Ell. & Ev.) Salm.

The largest contribution to our knowledge of the Canarian *Erysiphaceae* was made by Jørstad (1962). In this publication he placed all of his material of *Erysiphe* in only three aggregate species, viz. *E. cichoracearum* DC. ex Merát, *E. communis* Wallr. ex Fr., and *E. graminis* DC. ex Merát, which, collectively, occurred on 110 host species. In the same publication he noted the occurrence of *Arthrocladiella lycii* (Lasch) Vassilk., and also *Leveillula taurica* on 18 host species, two species of *Microsphaera*, *Podosphaera tridactyla* (Wallr.) de Bary, and four species of *Sphaerotheca*. Later Jørstad (1966) and Gjaerum (1970) added a few new host records and localities for some of the species mentioned by Jørstad (1962).

Pyrenomycetes, discomycetes, and loculoascomycetes

Most authors working with Canarian fungi have recorded fungi from one or more of these classes. Montagne *(op. cit.)* listed three species of *Pyrenomycetes* and nine species of *Discomycetes*, among them a few of which were newly described. Berkeley (1875) listed three species of *Discomycetes*. Other authors who have contributed here are Bornmüller *(op. cit.)*, Spegazzini *(op. cit.)*, Sydow & Werdermann (1924), Cath. Cool (1924, 1925), Jørstad *(op. cit.)*, Gjaerum *(op. cit.)*, and Wildpret de la Torre *et al.* (1972a).

The main contributors to our knowledge of these classes of the *Ascomycetes* in the islands, are Petrak and Urries. All of the fungi noted by Petrak were based on his study of specimens collected by A. Ade. In the first of two papers on these fungi, Petrak (1929) described two new genera, *Amphididymella* and *Adea*, with their respective type species, as well as 20 additional new ascomycetous species. Two additional species were described by Ade in this same publication. In a second publication Petrak (1948) described one more ascomycetous species.

Urries treated material collected by himself, and the *Ascomycetes* were published in three separate papers. In the first of these Urries (1956) described 19 new species, while his second paper (Urries 1957) was a discussion of some other of his specimens collected in the islands. In his third paper (Urries 1957a) he listed all his finds. More than half of all the species listed are saprophytes.

Thanks to the work by these two well known, now late mycologists the *Ascomycetes* are among the best known fungi in the Canary Islands.

Wildpret de la Torre *et al.* (1969) noted the occurrence of some of the larger *Ascomycetes* of the genera *Xylaria*, *Peziza*, and *Urnula*, and Kohlmeyer (1967) reported 17 species of *Ascomycetes* and four species of *Fungi Imperfecti* collected on wood, algae, shells, and in the foam along the shore of Tenerife.

Hyphomycetes and Coelomycetes

Most of the authors mentioned previously have also contributed to our records of fungi in these two classes as well. Montagne (1840) noted the presence of *Sporotrichum flavissimum* Lk. and *Polytrinchium trifolii* Kze., the latter fungus also reported by Schroeter (1884), while Berkeley (1875) recorded *Isaria floccosa* Fr. from insect larvae, and Bornmüller (1903) noted *Macrophoma canariensis* Magn. (in Bornm. Plant exs. canar. nr. 1621 = *M. pinea* (Desm.) Petr. & Syd.) and *Graphiola phoenicis* (Moug.) Poit., *Pycnomma* Syd. and *Thyrodochium* Werd., with their type species, and *Pachybasidiella tilletioides* Werd. were published in Sydow & Werdermann (1924), while Deighton & Gjaerum (1969) contributed a short note on *Cercosporidium punctum* (Lacr.) Deight.

The main publications for these two classes, as for the *Pyreno-*, *Disco-*, and *Loculoasco-mycetes* are those of Petrak (1929, 1948) and Urries (1956, 1957, 1957a), but Jørstad (1962, 1966) has also made a significant contribution. Petrak (1929) reported ten new species of which two were described by Ade, and later he (Petrak 1948) added further four new species to the Canarian flora. Urries (1956) described two new genera, *Moralesia* and *Oramasia*, with their type species and 15 other species of various genera. One more species was described later (Urries 1957), and his large collection of Canarian fungi was discussed in a second paper that year (Urries 1957a). In addition to listing a large number of mainly parasitic fungi, Jørstad (1962) described *Cercospora isoplexidis*, and later he (Jørstad 1966) described four new species.

Altogether a large number of species of the *Hypho-* and *Coelomycetes* are known, but still there is much to do, particularly with respect to the geographical distribution of the various species known in the Archipelago.

Teliomycetes

Of the two orders belonging to this class, the *Uredinales* are the best known. Again our knowledge starts with Montagne (1840) who reported the presence of 13 rust species, many of them described as new. Species described as *Aecidium* and *Uredo* have later been included in other, perfect species, while *Puccinia atropae* described from Gran Canaria and *Puccinia pseudosphaeria* from Tenerife are still valid, the latter, however, has been transferred to *Miyagia* as *M. pseudosphaeria* (Mont.) Jørst. Magnus

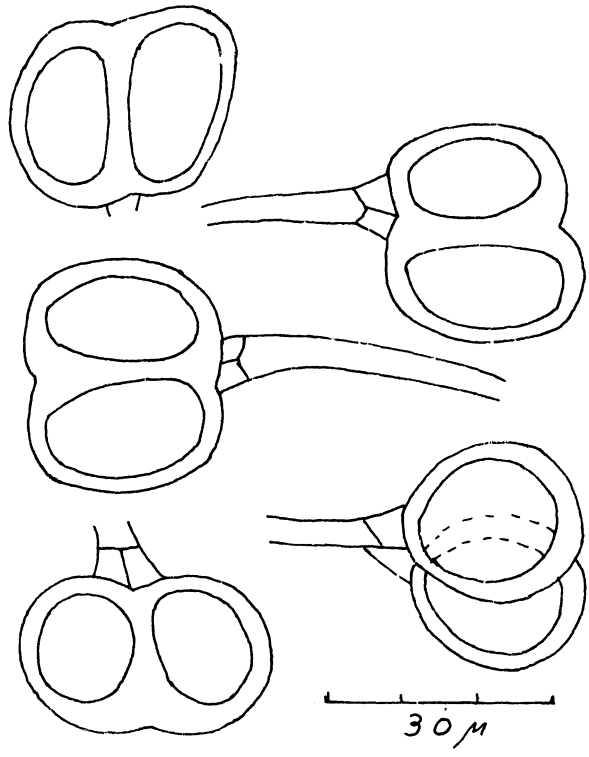

Fig. 1. Teliospores of the endemic rust *Dicheirinia canariensis* Urries.

treated four species collected by Bornmüller who himself (Bornmüller 1903) reported other species which he had collected.

Spegazzini (1915) added a few additional records of species, among them *Uredo marmoxaiae* which he described from Gran Canaria. Sydow in Sydow & Werdermann (1924) described two species from Tenerife, viz. *Puccinia venosa* and *Phragmidium bencomiae*, the latter known only from the type locality.

Other authors who have mentioned rusts species are P. & H. Sydow (1904, 1910, 1924), Walker (1922), Lindinger (1926), Guyot (1957), Guyot & Viennot-Bourgin (1946). Urries (1954) described *Dicheirinia canariensis* from Gran Canaria as the first species of *Dicheirinia* known from outside the Americas, and Cummins (1956) reported *Puccinia hyparrheniicola* Jørst. & Cumm., collected by Jørstad at Tenerife.

The main contribution to our knowledge of the Canarian rust flora was that of Jørstad (1958), wherein he listed 82 species which, with appropriate hosts, resulted in a total of 212 rust/host combinations. One of them, viz. *Puccinia lagunensis*, was described as new from Tenerife. Sixty-five species were recorded on Tenerife while only three on Fuerteventura and

18 on Lanzarote. Though *Uredinales* are probably the best known order of the Canarian fungi, Jørstad stated that this uneven distribution: 'gives an indication of how inadequately investigated the Canaries still are with respect to rusts'.

In subsequent publications Jørstad (1962, 1966) and Gjaerum (1970, 1974) added two species records each, some additional host records, and many new locality records.

The smuts *(Ustilaginales)* seem to be less well known. One of the species reported by Montagne *(op. cit.)* as a rust, *Uredo ranunculacearum* DC., has later proved to be the smut *Urocystis ranunculi* (Lib.) Moesz. Bornmüller (1903) listed the same species (as *Urocystis anemones* Schroet.) and added four additional smuts of the genus *Ustilago*, parasitizing graminicolous hosts. Lindinger (1926) recorded *Urocystis ranunculi* from Tenerife. Viennot-Bourgin (1946) reviewed the smuts on the Atlantic isles without giving exact localities, and Urries (1957a) added records of 7 species, all parasites on *Gramineae*. Jørstad (1962) listed 15 species of which eight were new to the archipelago, and also reported many new Canarian hosts for those smut species previously reported.

Hymenomycetes

In 'Dictionary of Fungi' (Ainsworth 1971) this class has been divided into two subclasses, *Phragmo-* and *Holo-basidiomycetidae*. Very few fungi from the first subclass have been reported from the Canary Islands. The only reports being that of Montagne (1840) for *Exidia auricula-judae* Fr. (= *Hirneola auricula-judae* (L.) Berk.) and *Naematella rubiformis* Fr. (the latter genus is considered doubtful) and Cath. Cool (1924, 1925) for *Tremella mesenterica* Retz. *H. auricula-judae* has also been reported by Wildpret de la Torre *et al.* (1972a, as *Auricularia auricula-judae* (L. ex Fr.) Berk.

Various authors have reported the presence of members of the *Holo-basidiomycetidae*. Geyler (1874) described the fungus *Exobasidium lauri* which causes galls on *Laurus azorica*. Such galls, attributed to *Clavaria lauri* Bory by Montagne *(op. cit.)*, have later been collected by several botanists, but without finding the fungus. But in the parenchyma, both Tubeuf (1913) and Jørstad (1966) have found a mycelium which might belong to this fungus.

Contributions to the *Aphyllophorales* are few. However, Montagne *(op. cit.)* reported *Stereum hirsutum* Fr. (also reported by Berkeley 1875) as with two species of *Polyporus*. Cath. Cool *(op. cit.)* added two more species of *Stereum*, four species of *Polyporus*, and one *Fomes*. These species are, together with those reported by Wildpret de la Torre *et al.* (1969), included in the list by Ryvarden (1972). In this list he includes a total of 19 species of which 14 belong to the *Polyporaceae* and five to the *Stereaceae*. Wildpret de la Torre *et al.* (1972a) reported two species of which one was

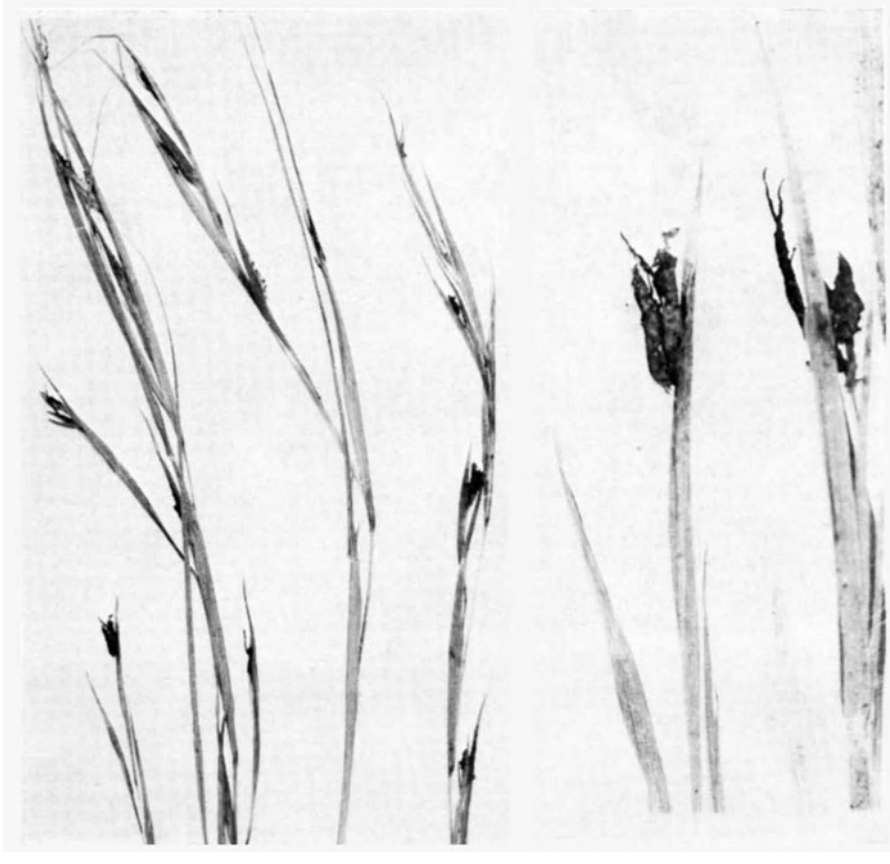

Fig. 2. Ustilago andropogonis Opiz on *Hyparrhenia hirta*, common in the Canaries. Left ×1, right ×4. (Photo J. Drew Smith).

new to La Palma. Recently Beltrán-Tejera (1974) published a catalogue over the *Polyporales* (= *Aphyllophorales*) known in the Archipelago.

More interest has been paid to the *Agaricales*. Montagne *(op. cit.)* listed four species of *Agaricus*, three of *Cortinarius*, one *Lactarius*, and *Schizophyllum commune* Fr. The latter has also been reported by Cooke (1961) and Jørstad (1966). Berkeley (1875) listed five species of *Agaricus*. The main contributors to records of this order are Cath. Cool *(op. cit.)*, Wildpret de la Torre *et al.* (1969), and Wildpret de la Torre *et al.* (1972a).

As most material has been collected at Tenerife and La Palma, further investigations will no doubt yield more interesting knowledge.

Gasteromycetes

As for some other classes of fungi, our knowledge of the Canarian *Gasteromycetes* begins with Montagne (1840) who listed four species. Later

Fig. 3. Galls probably caused by *Exobasidium lauri* Geyler on *Laurus azorica*. ×1. (Photo Bjørn Eidissen).

Spegazzini (1915) added one species, and Cath. Cool (1924, 1925) added four species records. Eckblad (1962) listed eight species of which two were identified only to genera. According to him *Montagnea arenaria* (DC.) Zeller has not been reported since Spegazzini (*op. cit.*, as *Montagnites candollei* (Fr.) Sacc.). Wildpret & Santos (1972) reported one species of *Gasteromycetes*, Wildpret de la Torre *et al.* (1972a) three species, and Wildpret de la Torre *et al.* (1972) added seven additional species to the list of *Gasteromycetes*. Pérez de Paz (1972) has discussed the distribution of *Pisolithus tinctorius* (Mich. ex Pers.) Cok. & Couch more in detail. Finally Wildpret de la Torre et Beltrán-Tejera (1974) reported three more species new to the Canaries.

Plant pathology

In the literature and review journals available to me, very few papers occur which are concerned with fungi parasitizing cultivated plants in the Canary Islands. Walker (1922) reported *Puccinia porri* Wint. (= *P. allii* Rud.) on cultivated onion and Heim (1946) reported *Thielaviopsis paradoxa* (de Seynes) Höhn. and *Gloeosporium musarum* Cke. & Massee (= *Colletotrichum musae* (Berk. & Curt.) v. Arx) as the cause of the main-stalk rot on bananas with *T. paradoxa* as the most important. The so-

called 'Panama disease' caused by *Fusarium oxysporum* Schlecht. ex Fr. var. *cubense* (E. F. Smith) Wollenw. has been reported by Champion and Monnet (1962, as f. sp. *cubense*) causing injury to dwarf bananas under certain ecological conditions. *Colletotrichum musae* and *Piricularia grisea* (Cke.) Sacc., the latter causing blight on bananas, have been discussed by Plata *et al.* (1974).

Potentially dangerous plant parasites are e.g. the cereal rusts which occur in the Archipelago.

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