

# Keys to smut fungi of selected host plant families and genera

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**Abstract.** Identification keys to smut fungi (*Ustilaginomycotina* p.p. and *Microbotryales*) of 14 selected host plant families and 51 keys to 92 selected host plant genera are presented to facilitate world-wide identification of these plant parasitic microfungi.

**Key words:** identification keys, *Microbotryales*, smut fungi, *Ustilaginomycotina*

## Introduction

In *Smut Fungi of the World* (Vánky in press), 1650 species in 93 genera are treated. A key to the genera and keys to the species within each genus are placed immediately before the detailed species descriptions and illustrations. In practice, the determination of a smut fungus starts with the identification of the host plant. Hence it is most useful to have keys to smut

fungi on host plant groups, e.g. families or related genera. Such keys are presented below.

Often mentioned smut fungus genera are shortened as follows: *E.* = *Entyloma*, *Mac.* = *Macalpinomyces*, *Mel.* = *Melanotaenium*, *Microb.* = *Microbotryum*, *Spor.* = *Sporisorium*, *Thec.* = *Thecaphora*, *T.* = *Tilletia*, *U.* = *Ustilago*, *Ur.* = *Urocystis*, *Ustanc.* = *Ustanciosporium*.

## I. Smut fungi on selected host plant families

### Key to the smut fungi of *Acanthaceae*

- |    |                                                                                                                                    |                                      |
|----|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| 1  | Cortex of spore balls composed of one kind of sterile cells . . . . .                                                              | 2                                    |
| 1* | Cortex of spore balls composed of two kinds of sterile cells . . . . .                                                             | 3                                    |
| 2  | Cortical layer 4–8 µm thick. On <i>Hygrophila</i> . . . . .                                                                        | <i>Doassansia kamatii</i>            |
| 2* | Cortical layer 14–21 µm thick. On <i>Hemigraphis</i> . . . . .                                                                     | <i>Doassansia hemigraphidis</i>      |
| 3  | Spore balls 110–200 µm long; spores 9–16 µm long; sterile cells finely, low verrucose-echinulate. On <i>Hemiadelphis</i> . . . . . | <i>Heterodoassansia khandalensis</i> |
| 3* | Spore balls 110–160 µm long; spores 9–13 µm long; sterile cells with 0.5–1 µm high spines. On <i>Hygrophila</i> . . . . .          | <i>Heterodoassansia hygrophilae</i>  |

### Key to the smut fungi of *Apiaceae*

- |    |                                                                                  |                              |
|----|----------------------------------------------------------------------------------|------------------------------|
| 1  | Spores single, embedded in the host tissue (leaf spots) . . . . .                | <i>Entyloma</i> (17 species) |
| 1* | Spores forming spore balls; spore mass powdery . . . . .                         | 2                            |
| 2  | Spore balls surrounded by sterile cells (pustules on <i>Azorella</i> ) . . . . . | <i>Ur. antarctica</i>        |
| 2* | Spore balls formed by spores only (in seeds of <i>Pimpinella</i> ) . . . . .     | <i>Thec. pimpinellae</i>     |

Key to the smut fungi of *Asphodelaceae* (*Liliaceae* s. lat.)

- 1 Spores single, embedded in the leaf tissue; sori as leaf spots. On *Eremurus* . . . . . *Gjaerumia eremuri*  
 1\* Spores in balls surrounded by sterile cells, powdery . . . . . 2  
 2 Sori in all flowers. On *Bulbinella* . . . . . *Ur. bulbinellae*  
 2\* Sori as leaf pustules. On *Asphodelus* . . . . . *Ur. asphodeli*

Key to the smut fungi of *Campanulaceae*

- 1 Spores in balls, pale coloured, embedded in the host tissue of aquatic plants; on leaves and stems of *Downingia*. . . . .  
 . . . . . *Heterodoassansia downingiae*  
 1\* Spores single, pigmented, not on aquatic plants . . . . . 2  
 2 Spores powdery, with two light-coloured polar caps; in capsules of *Triodanis* (*Specularia*). . . . . *Yelsmia speculariae*  
 2\* Spores embedded in the host tissue, not powdery, without polar caps; on stems of *Peracarpa* . . . . . *Mel. tochinaianum*

Key to the smut fungi of *Chenopodiaceae*

- 1 Spores solitary, poorly pigmented, embedded in the leaf tissue. On *Spinacea* . . . . . *E. ellisii*  
 1\* Spores in balls, pigmented, powdery, in the seeds . . . . . 2  
 2 Spore balls 60–150 (–190)  $\mu\text{m}$  long. On *Maireana* . . . . . *Thec. maireanae*  
 2\* Spore balls 40–60 (–90)  $\mu\text{m}$  long. On *Chenopodium* . . . . . *Thec. leptideum*

Key to the smut fungi of *Convolvulaceae*

- 1 Sori in the seeds; spores in balls, powdery . . . . . *Thec. seminis-convolvuli*  
 1\* Sori in the leaves or stems; spores embedded in the host tissue, not powdery . . . . . 2  
 2 Spores firmly agglutinated in indefinite masses; spore wall thick, multilayered . . . . . 3  
 2\* Spores single; spore wall relatively thin; not multilayered . . . . . 6  
 3 Sori as witches' brooms of the axillary shoots . . . . . *Georgefischeria riveae*  
 3\* Sori in the leaves as yellow spots with black veins . . . . . 4  
 4 Spores 7–14  $\mu\text{m}$  long; inner, pigmented layer of the spore wall *ca* 0.5  $\mu\text{m}$  thick . . . . . *Georgefischeria thirumalacharii*  
 4\* Spores larger; inner, pigmented layer of the spore wall thicker . . . . . 5  
 5 Spores 8–17  $\mu\text{m}$  long; pigmented layer of the spore wall 1–2  $\mu\text{m}$  thick; contents granular . . . . . *Georgefischeria narasimhanii*  
 5\* Spores 13–17.5  $\mu\text{m}$  long; pigmented layer of the spore wall 2–3  $\mu\text{m}$  thick; contents homogeneous . . . . .  
 . . . . . *Georgefischeria mundkurii*  
 6 Sori as leaf spots; spore wall thin. On *Calystegia* . . . . . *E. convolvuli*  
 6\* Sori in hypertrophied flowers and stems; spore wall thick. On *Cuscuta* . . . . . *E. martindalei*

Key to the smut fungi of *Eriocaulaceae*

- 1 Sori in the leaves and stems forming lead coloured, compact striae . . . . . *Tolyposporella eriocaulonis*  
 1\* Sori in the seeds . . . . . 2  
 2 Spores single. . . . . 3  
 2\* Spores in balls. . . . . 4  
 3 Spore wall *ca* 0.5  $\mu\text{m}$  thick, in SEM finely foveolate . . . . . *Eriocaulago eriocauli*  
 3\* Spore wall 0.5–1 (–2)  $\mu\text{m}$  thick, in SEM irregularly low verrucose . . . . . *Eriocaulago jagdishwari*  
 4 Spore balls mixed with sterile cells and covered by a cortex . . . . . *Eriomoeszia eriocauli*  
 4\* Spore balls without sterile cells and cortex . . . . . 5  
 5 Spores 10.5–16  $\mu\text{m}$  long; wall 2–3 (–4)  $\mu\text{m}$  thick, verrucose . . . . . *Eriospodium hessii*  
 5\* Spores 6.5–9.5 (–10)  $\mu\text{m}$  long; wall 0.5  $\mu\text{m}$  thick, apparently smooth . . . . . *Eriospodium mesanthemi*

**Key to the smut fungi of *Euphorbiaceae* (*Euphorbia*)**

- 1 Spores in the seeds, powdery ..... *Ahmadiago euphorbiae*  
 1\* Spores embedded in the host tissue, not powdery ..... *Mel. euphorbiae*

**Key to the smut fungi of *Lamiaceae***

- 1 Spore mass dark pigmented, embedded in the host tissue ..... *Mel. jaapii*  
 1\* Spore mass violet tinted, powdery, in the anthers ..... 2  
 2 Spores 13–16.5 µm long. On *Salvia* ..... *Microb. salviae*  
 2\* Spores 10.5–15 (–16) µm long. On *Stachys* ..... *Microb. betonicae*

**Key to the smut fungi of *Oxalidaceae* (*Oxalis*)**

- 1 Spores in balls surrounded by sterile cells ..... *Ur. oxalidis*  
 1\* Spores single, sterile cells absent ..... 2  
 2 Spores powdery (as an exception not forming balls) ..... 3  
 2\* Spores embedded in the host tissue, not powdery ..... 4  
 3 Sori in the seeds; spores 13.5–21 (–24) µm long; wall often unevenly thick ..... *Thec. oxalidis*  
 3\* Sori in the anthers; spores 14.5–24 (–28) µm long; wall evenly thick ..... *Thec. capensis*  
 4 Spores pale coloured; sori on leaves as spots ..... *E. peullensis*  
 4\* Spores dark coloured; sori on petioles and leaf midribs, dark, swollen. .... 5  
 5 Spores 14–26.5 (–28) µm long; wall 2–5 (–7) µm thick. .... *Melanoxa oxalidis*  
 5\* Spores 13.5–20 (–25) µm long; wall 1.5–4 (–5) µm thick ..... *Melanoxa oxalidiellae*

**Key to the smut fungi of *Polemoniaceae***

- 1 Spores single, embedded in the host tissue, not powdery; on leaves, petioles and stems of *Polemonium*. . . *E. lapponicum*  
 1\* Spores in balls surrounded by sterile cells, powdery; on roots and stems of *Gilia* ..... *Ur. giliae*

**Key to the smut fungi of *Polygonaceae***

- 1 Spores of two types, hyaline ..... *Zundeliomyces polygoni*  
 1\* Spores of the same type, pigmented ..... 2  
 2 Spores forming permanent spore balls (sori on the leaves). .... *Thec. schwarzmaniana*  
 2\* Spores single, not forming balls ..... 3  
 3 Sori as hard, multilocular galls; spores embedded in a gelatinous mass ..... 4  
 3\* Sori not so; spores dusty ..... 5  
 4 Spores smooth to finely punctate-verruculose. .... *Melanopsichium austroamericanum*  
 4\* Spores verruculose-echinulate. .... *Melanopsichium pennsylvanicum*  
 5 Sori with sterile, ramified filaments; spores produced in cavities ..... *Liroa emodensis*  
 5\* Sori without filaments; spores not produced in cavities. .... 6  
 6 Young spores catenulate, mature spores with disjunctors. .... 7  
 6\* Young spores not catenulate, mature spores without disjunctors. .... 11  
 7 On *Fagopyrum* ..... *Sphacelotheca fagopyri*  
 7\* On *Polygonum* ..... 8  
 8 In SEM warts isolated or 2 or 3 connected. .... *Sphacelotheca hydropiperis*  
 8\* In SEM warts usually arranged in rows, finely cerebriform, or spores finely reticulate. .... 9  
 9 In SEM warts often arranged in rows forming finely cerebriform pattern or even incomplete meshes. ....  
 ..... *Sphacelotheca koordersiana*

9*	In SEM spores finely, irregularly, completely reticulate . . . . .	10
10	Spores 10–14 (–15) $\mu\text{m}$ long . . . . .	<i>Sphacelotheca polygoni-serrulati</i>
10*	Spores 12–18 (–19) $\mu\text{m}$ long . . . . .	<i>Sphacelotheca serrulati-magna</i>
11(6)	On <i>Bilderdykia</i> . . . . .	12
11*	Not on <i>Bilderdykia</i> . . . . .	13
12	Spores 8.5–14 $\mu\text{m}$ long; meshes per spore diam. 4–6; muri 1 $\mu\text{m}$ high . . . . .	<i>Microb. anomalum</i>
12*	Spores 10–17 $\mu\text{m}$ long; meshes per spore diam. 5–8; muri 1–1.5 $\mu\text{m}$ high . . . . .	<i>Microb. cilinode</i>
13	On <i>Koenigia</i> . . . . .	14
13*	Not on <i>Koenigia</i> . . . . .	15
14	Sori on stems or leaves; spores (5.5–) 6.5–10 (–13) $\mu\text{m}$ long, finely striate . . . . .	<i>Microb. koenigiae</i>
14*	Sori in ovaries; spores 11–18.5 $\mu\text{m}$ long, finely, densely verruculose . . . . .	<i>Microb. picaceum</i>
15	On <i>Oxyria</i> (sori in the flowers) . . . . .	<i>Microb. vinosum</i>
15*	Not on <i>Oxyria</i> . . . . .	16
16	On <i>Polygonum</i> . . . . .	17
16*	Not on <i>Polygonum</i> . . . . .	41
17	On sect. <i>Aconogonon</i> . . . . .	18
17*	Not on sect. <i>Aconogonon</i> . . . . .	21
18	Sori completely destroying shoots and leaves, club-shaped, ramified or fasciate; spores coarsely, spirally striate to cerebriform . . . . .	<i>Microb. ocrearum</i>
18*	Sori and spores otherwise . . . . .	19
19	Sori in flowers; spores reticulate; meshes per spore diam. 6–9 . . . . .	<i>Microb. ahmadianum</i>
19*	Sori and spores otherwise . . . . .	20
20	Sori in abaxial side of the leaves as confluent pustules; spore surface finely cerebriform, like fingerprints	<i>Microb. piperi</i>
20*	Sori in swollen floral branches and pedicels; spores verruculose to verruculose-reticulate . . . . .	<i>Microb. bosniacum</i>
21(17)	On sect. <i>Bistorta</i> . . . . .	22
21*	Not on sect. <i>Bistorta</i> . . . . .	26
22	Sori in leaves . . . . .	23
22*	Sori in flowers or nuts . . . . .	24
23	Sori linear along the margin of the leaves . . . . .	<i>Microb. marginale</i>
23*	Sori as round pustules . . . . .	<i>Microb. pustulatum</i>
24	Sori in flowers; spores 9–17 $\mu\text{m}$ long . . . . .	<i>Microb. bistortarum</i>
24*	Sori in nuts; spores 8–14 $\mu\text{m}$ long . . . . .	25
25	Spores finely, densely verruculose . . . . .	<i>Microb. dehiscens</i>
25*	Spores with sparsely situated, acute, blunt, bifurcate or nail-headed spines . . . . .	<i>Microb. himalense</i>
26(21)	On sect. <i>Cephalophilon</i> . . . . .	27
26*	Not on sect. <i>Cephalophilon</i> . . . . .	30
27	Sori in leaf blades as slightly rised spots . . . . .	<i>Microb. tuberculiforme</i>
27*	Sori otherwise . . . . .	28
28	Sori in stems as fusiform swellings; spores reticulate to incompletely reticulate-verruculose; meshes per spore diam. 10–15 . . . . .	<i>Microb. nepalense</i>
28*	Sori in various organs as globoid swellings . . . . .	29
29	Spores in LM densely verruculose, in SEM incompletely verruculose-reticulate; muri 0.2–0.3 $\mu\text{m}$ high . . . . .	<i>Microb. polygoni-alati</i>
29*	Spores reticulate; meshes per spore diam. 4–7; muri 1.5–2.5 $\mu\text{m}$ high . . . . .	<i>Microb. tumeforme</i>
30(26)	On sect. <i>Persicaria</i> . . . . .	31
30*	Not on sect. <i>Persicaria</i> . . . . .	39

31	Spores relatively large, 13–18 $\mu\text{m}$ long (muri 1.5–2.5 $\mu\text{m}$ high) . . . . .	<i>Microb. radians</i>
31*	Spores smaller . . . . .	32
32	Spores verrucose . . . . .	<i>Microb. moelleri</i>
32*	Spores reticulate . . . . .	33
33	Spore wall (incl. reticulum) 3.5–5 $\mu\text{m}$ thick (muri 1–1.5 $\mu\text{m}$ high) . . . . .	<i>Microb. longisetum</i>
33*	Spore wall less than 3.5 $\mu\text{m}$ thick . . . . .	34
34	Spore wall 1–1.5 $\mu\text{m}$ thick (muri 0.5–1 $\mu\text{m}$ high) . . . . .	<i>Microb. prostratum</i>
34*	Spore wall 1.5–3 $\mu\text{m}$ thick . . . . .	35
35	Spores 7–12 (–13) $\mu\text{m}$ long; wall 1.5 $\mu\text{m}$ thick (muri 0.8–1.2 $\mu\text{m}$ high) . . . . .	<i>Microb. tenuisporum</i>
35*	Spores larger; wall thicker . . . . .	36
36	Meshes per spore diam. 4–6; wall 2–2.5 $\mu\text{m}$ thick; spores 8–14.5 $\mu\text{m}$ long . . . . .	<i>Microb. cordae</i>
36*	Meshes per spore diam. 2–4 or 3–4 . . . . .	37
37	Wall 1.5–2 $\mu\text{m}$ thick; muri 1 $\mu\text{m}$ high; spores 11–14.5 (–16) $\mu\text{m}$ long . . . . .	<i>Microb. paucireticulatum</i>
37*	Wall 2–3 $\mu\text{m}$ thick; muri higher; spores smaller . . . . .	38
38	Muri 1–1.5 $\mu\text{m}$ high; interspaces coarsely verrucose; sori in flowers . . . . .	<i>Microb. reticulatum</i>
38*	Muri 1.2–2 $\mu\text{m}$ high; interspaces with a tuberculum; sori in filaments . . . . .	<i>Microb. filamenticola</i>
39(30)	On sect. <i>Tovara</i> (sori in flowers; spores reticulate; meshes per spore diam. 5–7) . . . . .	<i>Microb. tovarae</i>
39*	On sect. <i>Polygonum</i> (sori in flowers; spores reticulate; meshes per spore diam. 6–10) . . . . .	40
40	Spores 11–16 (–18) $\mu\text{m}$ long . . . . .	<i>Microb. aviculare</i>
40*	Spores (7–) 8–10.5 $\mu\text{m}$ long . . . . .	<i>Microb. shastense</i>
41(16)	On <i>Rheum</i> . . . . .	42
41*	On <i>Rumex</i> . . . . .	43
42	Spores 8–11 $\mu\text{m}$ long, finely reticulate; meshes per spore diam. 5–10 . . . . .	<i>Microb. stewartii</i>
42*	Spores 15–24 $\mu\text{m}$ long, variously ornamented: verruculose, verruculose-reticulate or very finely reticulate; meshes per spore diam. 9–18 . . . . .	<i>Microb. rhei</i>
43	Spores 6–10.5 $\mu\text{m}$ long. On subgen. <i>Rumex</i> . . . . .	<i>Microb. warmingii</i>
43*	Spores more than 11 $\mu\text{m}$ long . . . . .	44
44	Meshes per spore diam. 8–14. On subgen. <i>Acetosa</i> . . . . .	45
44*	Meshes per spore diam. 5–10 . . . . .	46
45	Spore mass pale, flesh-coloured; spores in median view with spine-like projections . . . . .	<i>Microb. goeppertianum</i>
45*	Spore mass dark, blackish purple; spores in median view with blunt projections . . . . .	<i>Microb. stygium</i>
46	Spores in median view with spine-like projections; meshes per spore diam. 5–8 . . . . .	47
46*	Spores in median view with blunt projections; meshes per spore diam. 6–10. On subgen. <i>Rumex</i> . . . . .	48
47	Muri 1–1.5 $\mu\text{m}$ high; spores 11–15 (–16) $\mu\text{m}$ long. On subgen. <i>Rumex</i> . . . . .	<i>Microb. parlatorei</i>
47*	Muri 1.5–3 $\mu\text{m}$ high; spores 13–18 (–20) $\mu\text{m}$ long. On subgen. <i>Acetosella</i> . . . . .	<i>Microb. kuehneanum</i>
48	Muri 1.5–2.5 $\mu\text{m}$ high; spores 13–18 (–20) $\mu\text{m}$ long . . . . .	<i>Microb. coronatum</i>
48*	Muri 0.5–0.8 $\mu\text{m}$ high; spores 11–15 $\mu\text{m}$ long . . . . .	<i>Microb. dumosum</i>

#### Key to the smut fungi of *Primulaceae*

1	Spores single . . . . .	2
1*	Spores forming spore balls . . . . .	5
2	Spores in the anthers, powdery, pigmented, with a violet tint . . . . .	<i>Microb. primulae</i>
2*	Spores embedded in the host tissue, not powdery, pale coloured . . . . .	3
3	Spores 11–16 $\mu\text{m}$ long; wall 1.5–3 $\mu\text{m}$ thick. On <i>Primula</i> . . . . .	<i>E. primulae</i>
3*	Spores smaller; wall 1–2 $\mu\text{m}$ thick . . . . .	4

4	Spores globose to broadly ellipsoidal, 8–14 µm long. On <i>Anagallis</i> . . . . .	<i>E. uliginis</i>
4*	Spores globose to subpolyhedral, 10–14 µm long. On <i>Samolus</i> . . . . .	<i>E. henningsianum</i>
5	Spore balls embedded in the host tissue; spores pale yellow. On <i>Hottonia</i> . . . . .	<i>Heterodoassansia hottoniae</i>
5*	Spore balls not embedded in the host tissue, powdery; spores pigmented . . . . .	6
6	Spore balls composed of spores surrounded by sterile cells . . . . .	7
6*	Spore balls composed of spores only . . . . .	11
7	On <i>Cortusa</i> . . . . .	<i>Ur. cortusae</i>
7*	Not on <i>Cortusa</i> . . . . .	8
8	On <i>Trientalis</i> . . . . .	<i>Ur. trientalis</i>
8*	On <i>Primula</i> . . . . .	9
9	Spore balls composed of (1–) 2–7 (–10) spores. . . . .	<i>Ur. tranzscheliana</i>
9*	Spore balls composed of (1–) 3–15 (or ? more) spores . . . . .	10
10	Spore balls 40–88 µm long; spores 12–21 µm long. On subgen. <i>Primula</i> . . . . .	<i>Ur. primulae</i>
10*	Spore balls 26–64 µm long; spores 11–18.5 µm long. On subgen. <i>Aleurita</i> . . . . .	<i>Ur. primulicola</i>
11	Spore balls 28–77 µm long, composed of (10–) 20–?100 spores. . . . .	<i>Thec. oberwinkleri</i>
11*	Spore balls smaller, composed of less spores . . . . .	12
12	Spore balls 20–45 (–52) µm long, composed of 2–15 (–25) spores that separate easily. . . . .	<i>Thec. androsacina</i>
12*	Spore balls 18–40 µm long, composed of 2–12 firmly united spores . . . . .	<i>Thec. pakistanica</i>

#### Key to the smut fungi of *Scrophulariaceae*

1	Spores forming spore balls . . . . .	2
1*	Spores single, embedded in the host tissue . . . . .	4
2	Spore balls embedded in the host tissue; spores pale coloured. . . . .	<i>Doassansia limosellae</i>
2*	Spore balls not embedded in the host tissue, powdery; spores pigmented . . . . .	3
3	Spore balls invested by sterile cells. On <i>Odontites</i> . . . . .	<i>Ur. schizocaulon</i>
3*	Spore balls lacking sterile cells. On <i>Pedicularis</i> . . . . .	<i>Ur. pedicularis</i>
4	Spores pale coloured. On <i>Calceolaria</i> , <i>Chaenorrhinum</i> , <i>Collinsia</i> , <i>Gratiola</i> , <i>Linaria</i> , <i>Mimulus</i> , <i>Tozzia</i> , <i>Veronica</i> . . . . .	<i>Entyloma</i> (8 species)
4*	Spores dark coloured . . . . .	5
5	Sori as large galls on the hypocotyls. On <i>Kickxia</i> . . . . .	<i>Mel. hypogaeum</i>
5*	Sori as pustules on the stems and leaves . . . . .	6
6	Spores usually irregular, often angular, 16–24 µm long; wall uneven, 1–4 µm wide, light-refractive spots often present. On <i>Linaria</i> . . . . .	<i>Mel. cingens</i>
6*	Spores more or less regular, 14–20 µm long; wall even, 1.5–2.5 µm wide, light-refractive spots absent. On <i>Antirrhinum</i> . . . . .	<i>Mel. antirrhini</i>

## II. Smut fungi on selected host plant genera

#### Key to the smut fungi of *Aegopogon*, *Bouteloua*, *Buchloë*, *Cathestecum*, *Hilaria* and *Opizia* (= *Boutelouinae*)

1	Sori restricted to the ovaries . . . . .	2
1*	Sori not restricted to the ovaries . . . . .	9
2	Sori in all ovaries of an inflorescence. . . . .	3
2*	Sori in some ovaries of an inflorescence . . . . .	4
3	Spores evidently reticulate . . . . .	<i>T. aegopogonis</i>
3*	Spores with inconspicuous, subpyramidal tubercles . . . . .	<i>Salmacisia</i> / <i>T. buchloëana</i>

4	Spores obscurely reticulate . . . . .	<i>T. obscurareticulata</i>
4*	Spores otherwise ornamented . . . . .	5
5	Spores over 17 $\mu\text{m}$ long, provided with blunt, pyramidal or cylindrical warts . . . . .	6
5*	Spores 8–13 $\mu\text{m}$ long, verrucose-echinulate or small tuberculate . . . . .	7
6	Spores 17–24 $\mu\text{m}$ long; warts 1.5–3 $\mu\text{m}$ high; sterile cells 15–28 $\mu\text{m}$ long . . . . .	<i>T. boutelouae</i>
6*	Spores 22.5–32 $\mu\text{m}$ long; warts 2.5–5 $\mu\text{m}$ high; sterile cells (25–) 28–51 $\mu\text{m}$ long . . . . .	<i>T. gigacellularis</i>
7	Sterile cells present between the spores . . . . .	8
7*	Sterile cells absent . . . . .	<i>U. opiziicola</i>
8	Spore wall <i>ca</i> 0.5 $\mu\text{m}$ thick, finely verrucose-echinulate . . . . .	<i>Mac. spermophorus</i>
8*	Spore wall <i>ca</i> 1 $\mu\text{m}$ thick, with small tubercles . . . . .	<i>Mac. tuberculatus</i>
9	Sori destroying the whole inflorescence . . . . .	10
9*	Sori in the spikelets, on leaves or leaf sheaths . . . . .	12
10	Spores 14.5–18.5 $\mu\text{m}$ long, finely verruculose-echinulate . . . . .	<i>U. boutelouae-humilis</i>
10*	Spores smaller . . . . .	11
11	Spores 12.5–16 $\mu\text{m}$ long, evidently echinulate . . . . .	<i>U. vilfae</i>
11*	Spores 5–7 (–8) $\mu\text{m}$ long, finely punctate-verruculose . . . . .	<i>U. hilaricola</i>
12	The fungus produces witches' brooms; sori as not pustular striae on congested leaf sheaths . . . . .	<i>U. calcarea</i>
12*	The fungus does not produce witches' brooms; sori otherwise . . . . .	13
13	Sori bullate, sausage-shaped on leaves, leaf sheaths or in spikelets . . . . .	14
13*	Sori otherwise . . . . .	16
14	Spores 11–16 $\mu\text{m}$ long . . . . .	<i>U. buchloës</i>
14*	Spores shorter . . . . .	15
15	Spores 8–11 $\mu\text{m}$ long . . . . .	<i>U. minor</i>
15*	Spores 6.5–9 $\mu\text{m}$ long . . . . .	<i>U. subminor</i>
16	Sori destroying the inflorescence and the distal leaf sheath, fusiform, 2–10 (–15) mm long; spores 10.5–15 $\mu\text{m}$ long . . . . .	<i>U. aegopogonis</i>
16*	Sori in the spikelets, isolated or merged; spores 5–7 (–8) $\mu\text{m}$ long . . . . .	<i>U. hilaricola</i>

#### Key to the smut fungi of *Andropogon* and *Schizachyrium*

1	Sori on the leaves or leaf sheaths as striae; spore wall thick, multilayered . . . . .	2
1*	Sori and spore wall not so . . . . .	4
2	Spores in balls . . . . .	<i>Tolyposporella irregularis</i>
2*	Spores single or in groups, not in balls . . . . .	3
3	Spores 10–20 (–24) $\mu\text{m}$ long; wall 3–8 $\mu\text{m}$ thick . . . . .	<i>Jamesdicksonia brunkii</i>
3*	Spores 8–16 (–18) $\mu\text{m}$ long; wall 1.5–6.5 $\mu\text{m}$ thick . . . . .	<i>Jamesdicksonia caribensis</i>
4	Sori on the top of the shoots as whip-like structures (in <i>Spor. provinciale</i> cylindrical) . . . . .	5
4*	Sori not so . . . . .	9
5	Columella one, stout, with longitudinal furrows; spore wall 0.4–0.8 $\mu\text{m}$ thick, thinner on one side . . . . .	<i>Spor. andropogonis-tectorum</i>
5*	Columellae several, filiform; spore wall thicker, not thinner on one side . . . . .	6
6	Spores 13–19 $\mu\text{m}$ long; wall 3–4 $\mu\text{m}$ thick, minutely verruculose . . . . .	<i>Spor. provinciale</i>
6*	Spores smaller; wall thinner . . . . .	7
7	Spores 11–15 (–16) $\mu\text{m}$ long; wall 1–2.5 $\mu\text{m}$ thick . . . . .	<i>Spor. duranii</i>
7*	Spores smaller; wall thinner or thicker . . . . .	8
8	Spores 8–11 $\mu\text{m}$ long; wall 2–2.5 $\mu\text{m}$ thick, including the 1.5–2 $\mu\text{m}$ high, anastomosing warts . . . . .	<i>Spor. mexicanum</i>

8*	Spores 6.5–9 µm long; wall 1–1.5 µm thick, including the high, single, labyrinthiform or cerebriform warts . . . . .	<i>Spor. sanctae-catharinae</i>
9(4)	Sori destroying the whole inflorescence or the racemes . . . . .	10
9*	Sori restricted to the spikelets or ovaries . . . . .	21
10	Spores dimorphic; columella filiform, one or numerous . . . . .	11
10*	Spores not dimorphic; columella stout, one, sometimes branching . . . . .	16
11	Columella one . . . . .	12
11*	Columellae numerous . . . . .	15
12	Spore balls persistent . . . . .	13
12*	Spore balls more or less easily separating by pressure. . . . .	14
13	Spores 10.5–13.5 µm long . . . . .	<i>Spor. absconditum</i>
13*	Spores 15–20 (–21.5) µm long. . . . .	<i>Spor. blakeanum</i>
14	Spores 10.5–17 µm long, free surface coarsely echinulate . . . . .	<i>Spor. zambianum</i>
14*	Spores 13–20 µm long, free surface finely verrucose . . . . .	<i>Spor. guaraniticum</i>
15	Spores 13.5–18.5 (–20) µm long; sterile cells absent. . . . .	<i>Spor. andropogonis-eucomi</i>
15*	Spores 9–14.5 µm long; sterile cells present . . . . .	<i>Spor. pseudomaranguense</i>
16(10)	Spores very varying in size, 6–13 (–16) µm long. . . . .	<i>Spor. zilligii</i>
16*	Spores less varying in size . . . . .	17
17	Spores up to 20 µm long . . . . .	18
17*	Spores smaller. . . . .	19
18	Spores regular, with a rounded paler area (germ pore). . . . .	<i>Spor. culmiperdum</i>
18*	Spores mostly slightly irregular, with irregular, paler and darker areas . . . . .	<i>Spor. ellisii</i>
19	Spores 7.5–11 µm long. . . . .	<i>Spor. andropogonis</i>
19*	Spores larger. . . . .	20
20	Spores 9–13.5 µm long; wall even, 0.5 µm thick . . . . .	<i>Spor. stuhlmannii</i>
20*	Spores 12–16 µm long; wall uneven, 0.5–1.5 µm thick . . . . .	<i>Spor. leucostachys</i>
21(9)	Sori in the ovaries, compact, hard, black. . . . .	<i>U. andropogonis-tuberculati</i>
21*	Sori in the spikelets, not hard and black . . . . .	22
22	Sori in some spikelets of an inflorescence . . . . .	23
22*	Sori in all spikelets of an inflorescence, both sessile and pedicelled, or only sessile ones (in <i>Spor. everhartii</i> sometimes not in all spikelets) . . . . .	29
23	Sori producing groups of witches' brooms in the inflorescence . . . . .	24
23*	Sori not producing witches' brooms . . . . .	25
24	Spores 10–16 (–18) µm long . . . . .	<i>Spor. holwayi</i>
24*	Spores 6.5–11 (–12) µm long. . . . .	<i>Spor. bicornis</i>
25	Spores not in permanent balls, not dimorphic . . . . .	26
25*	Spores in permanent balls, dimorphic. . . . .	27
26	Spores prominently echinulate, single. . . . .	<i>Mac. ovariicolopsis</i>
26*	Spores finely punctate-verruculose, in loose balls . . . . .	<i>Spor. berndtii</i>
27	Columella one, simple; warts 1–2.5 µm long, filiform . . . . .	<i>Spor. andropogonis-pumili</i>
27*	Columellae several, or one, fused, band-like; warts shorter, not filiform . . . . .	28
28	Columellae several; outer spores finely punctate-verruculose. . . . .	<i>Spor. scholzii</i>
28*	Columella often band-like; outer spores with 0.5 (–1) µm high warts or spines . . . . .	<i>Spor. livingstoneanum</i>
29(22)	Columellae several, filiform (or one, filiform in <i>Spor. schizachyrii</i> ) . . . . .	30
29*	Columella one, flagelliform or stout, simple or with branches . . . . .	32



30	Spores not dimorphic, 7–10 $\mu\text{m}$ long . . . . .	<i>Spor. andropogonis-gabonensis</i>
30*	Spores dimorphic, slightly larger . . . . .	31
31	Spores 8–10.5 $\mu\text{m}$ long; sterile cells absent . . . . .	<i>Spor. schizachyrii</i>
31*	Spores 10.5–14.5 $\mu\text{m}$ long; sterile cells present . . . . .	<i>Spor. gayanum</i>
32	Spores dimorphic . . . . .	33
32*	Spores not dimorphic; spore balls ephemeral or very loose . . . . .	35
33	Spore balls loose, 25–40 (–50) $\mu\text{m}$ long . . . . .	<i>Spor. andropogonis-chinensis</i>
33*	Spore balls permanent, longer . . . . .	34
34	Spore balls 50–130 $\mu\text{m}$ long; outer spores 8–15 $\mu\text{m}$ long . . . . .	<i>Spor. everhartii</i>
34*	Spore balls 50–180 (–210) $\mu\text{m}$ long; outer spores 6.5–10 $\mu\text{m}$ long . . . . .	<i>Spor. sp.</i>
35	Spores 13.5–18 $\mu\text{m}$ long . . . . .	<i>Spor. occidentale</i>
35*	Spores smaller . . . . .	36
36	Sterile cells absent . . . . .	37
36*	Sterile cells present . . . . .	38
37	Spore wall 0.5–1.2 $\mu\text{m}$ thick, thinner on one side . . . . .	<i>Spor. braziliense</i>
37*	Spore wall 1–2 $\mu\text{m}$ thick, uneven, thickest at the angles . . . . .	<i>Spor. polliniae</i>
38	Spores 7–10.5 (–11) $\mu\text{m}$ long . . . . .	<i>Spor. andropogonis-schirensis</i>
38*	Spores larger, up to 13.5 $\mu\text{m}$ long . . . . .	39
39	Spore wall 0.5–1 (–1.5) $\mu\text{m}$ thick, with a paler, thinner germ pore, finely, densely verrucose-echinulate . . . . .	<i>Spor. distachyum</i>
39*	Spore wall thinner, germ pore lacking, more finely ornamented . . . . .	40
40	Sori 2–4 mm long; columella stout; spore wall 0.5–0.8 $\mu\text{m}$ thick; sterile cells in compact, rounded or elongate groups; wall 0.5–1 $\mu\text{m}$ thick . . . . .	<i>Spor. fastigiatum</i>
40*	Sori 3–7 mm long; columella narrowing; spore wall <i>ca</i> 0.5 $\mu\text{m}$ thick; sterile cells in loose groups; wall <i>ca</i> 0.5 $\mu\text{m}$ thick . . . . .	<i>Spor. seymourianum</i>

#### Key to the smut fungi of *Apluda*

1	Sori in the leaves . . . . .	“ <i>Mel.</i> ” <i>apludae</i>
1*	Sori elsewhere . . . . .	2
2	Sori in the ovaries; spores 18–40 $\mu\text{m}$ long . . . . .	<i>T. apludae</i>
2*	Sori elsewhere; spores smaller . . . . .	3
3	Sori in the whole racemes . . . . .	4
3*	Sori in the spikelets . . . . .	5
4	Outer spores 7–12 $\mu\text{m}$ long, finely verrucose-echinulate, profile finely serrulate; inner spores 5–10.5 $\mu\text{m}$ long . . . . .	<i>Spor. apludae-muticae</i>
4*	Outer spores 11–16 $\mu\text{m}$ long, finely punctate-verruculose, profile smooth; inner spores 8.5–14.5 $\mu\text{m}$ long . . . . .	<i>Spor. muticae</i>
5	Sori in all spikelets of an inflorescence; spores 5–7 $\mu\text{m}$ long . . . . .	<i>Spor. apludae</i>
5*	Sori in some spikelets of an inflorescence; spores 8–13 $\mu\text{m}$ long . . . . .	6
6	The fungus produces witches’ brooms; outer spores verruculose . . . . .	<i>Spor. mishrae</i>
6*	The fungus does not produce witches’ brooms; outer spores prominently echinulate . . . . .	<i>Spor. apludae-aristatae</i>

#### Key to the smut fungi of *Aristida* and *Stipagrostis*

1	Spores more than 15 $\mu\text{m}$ long; sori in the ovaries . . . . .	2
1*	Spores less than 15 $\mu\text{m}$ long; sori on the stems, inflorescence, spikelets or ovaries . . . . .	3
2	Sori 2–4 mm long; spores 17.5–23 $\mu\text{m}$ long; warts 2.5–4 $\mu\text{m}$ high . . . . .	<i>T. oklahomae</i>

- 2\* Sori 10–20 mm or longer; spores 15–20 (–21)  $\mu\text{m}$  long; warts 1–2.5  $\mu\text{m}$  high. . . . . *T. palpera*
- 3 Sori in the ovaries. . . . . 7
- 3\* Sori elsewhere. . . . . 4
- 4 Sori destroying the whole inflorescence . . . . . *Spor. aristidae-lanuginosae*
- 4\* Sori in the culms and/or spikelets . . . . . 5
- 5 Spores single. . . . . *U. bornmuelleri*
- 5\* Spores in balls. . . . . 6
- 6 Spore balls 50–120 (–140)  $\mu\text{m}$  long; sterile cells absent . . . . . *Spor. aristidae*
- 6\* Spore balls 30–100  $\mu\text{m}$  long; sterile cells present . . . . . *Spor. dacryoideum*
- 7 Sori bullate, evident, covered by a thick, persistent peridium; spore balls rather permanent; sterile cells present between the spore balls. . . . . *Spor. aristidicola*
- 7\* Sori fusiform, more or less hidden by floral envelopes, covered by a thin peridium; spore balls loose or ephemeral (semi-permanent in *Spor. inopinatum*); sterile cells lacking (but present in *Spor. inopinatum* and *Spor. clandestinum*) . . . . . 8
- 8 Sori 5–25 mm long . . . . . 9
- 8\* Sori less than 6 mm long . . . . . 10
- 9 Spores 5–8 (–9.5)  $\mu\text{m}$  long, in irregular groups; wall densely verruculose . . . . . *Mac. aristidae-cyananthae*
- 9\* Spores 12–15  $\mu\text{m}$  long, single; wall with 0.5  $\mu\text{m}$  high, blunt warts . . . . . *T. aristidae*
- 10 Spores globose, laterally slightly compressed, single . . . . . *U. aristidarius*
- 10\* Spores more or less angular, in ephemeral, loose or permanent spore balls . . . . . 11
- 11 Sori bullate, evident, covered by a thick, persistent peridium; spore balls rather permanent; groups of sterile cells present between the spore balls. . . . . *Spor. aristidicola*
- 11\* Sori fusiform, more or less hidden by floral envelopes, covered by a thin peridium; spore balls loose or ephemeral; sterile cells lacking . . . . . 12
- 12 Spores 11–16  $\mu\text{m}$  long; spore wall uneven, 0.5–2.5  $\mu\text{m}$  thick, verrucose-echinulate . . . . . *Spor. goniosporum*
- 12\* Spores smaller; spore wall even or slightly uneven, thinner . . . . . 13
- 13 Spores 10–15  $\mu\text{m}$  long; spore wall 0.5–1 (–1.5)  $\mu\text{m}$  thick . . . . . *Spor. confusum*
- 13\* Spores smaller; spore wall ca 0.5  $\mu\text{m}$  thick . . . . . 14
- 14 Spore balls ephemeral; spores mostly 5.5–8  $\mu\text{m}$  long . . . . . 15
- 14\* Spore balls loose or semi-permanent; spores larger . . . . . 16
- 15 Spore wall ca 0.5  $\mu\text{m}$  thick, finely, densely punctate-verruculose; warts usually more pronounced on one side; sterile cells absent. . . . . *Spor. fraserianum*
- 15\* Spore wall 0.5–0.8  $\mu\text{m}$  thick, thinner on one side where the spores are slightly paler, surface finely low verrucose; sterile cells present . . . . . *Spor. clandestinum*
- 16 Spore balls loose; spores 6.5–10.5  $\mu\text{m}$  long, finely verrucose. . . . . *Spor. consanguineum*
- 16\* Spore balls semi-permanent; spores 8–12 (–13)  $\mu\text{m}$  long, outer spores verrucose-echinulate. . . . . *Spor. inopinatum*

#### Key to the smut fungi of *Arthraxon*

- 1 Sori in the leaves as black spots; spores embedded in the host tissue, not powdery . . . . . “*Mel.*” *arthraxonis*
- 1\* Sori not in the leaves; spores powdery. . . . . 2
- 2 Sori in the whole inflorescence, 1–2 cm long . . . . . *Spor. tranzschelianum*
- 2\* Sori in the spikelets or ovaries, 1–4 mm long . . . . . 3
- 3 Sori in the ovaries; spores 21–28  $\mu\text{m}$  long . . . . . *T. arthraxonis*
- 3\* Sori in the spikelets; spores up to 15  $\mu\text{m}$  long. . . . . 4
- 4 Spore wall 1–1.5  $\mu\text{m}$  thick, finely, densely echinulate . . . . . *Spor. arthraxonis*
- 4\* Spore wall 0.5–0.8  $\mu\text{m}$  thick, finely punctate-verruculose or verruculose-echinulate. . . . . *Spor. arthraxonis-lanceolati*

Key to the smut fungi of *Arundinella*

1	Sori in the leaves as lead-coloured spots or stripes . . . . .	2
1*	Sori elsewhere. . . . .	4
2	Sori as wide spots; spores 9–16 $\mu\text{m}$ long, wall 1–5 $\mu\text{m}$ thick. . . . .	“ <i>Mel.</i> ” <i>tuberculatae</i>
2*	Sori short or long linear; spores 7–11 $\mu\text{m}$ long, wall 0.8–1.5 $\mu\text{m}$ thick. . . . .	3
3	Sori up to 2.5 mm long. On <i>A. metzii</i> . . . . .	“ <i>Mel.</i> ” <i>metzii</i>
3*	Sori up to 15 mm long. On <i>A. setosa</i> . . . . .	“ <i>Mel.</i> ” <i>arundinellae</i>
4	Spores over 20 $\mu\text{m}$ long . . . . .	5
4*	Spores less than 15 $\mu\text{m}$ long . . . . .	8
5	Sori 10–30 mm long, hispid; spores with 1–1.5 (–2) $\mu\text{m}$ high warts . . . . .	<i>T. chiangmaiensis</i>
5*	Sori up to 5 mm long, smooth; spores with higher warts . . . . .	6
6	Sori obovoid, with two longitudinal stripes; spores 20–27 (–30) $\mu\text{m}$ long; warts 1.5–2.5 $\mu\text{m}$ high . . . . .	<i>T. lineata</i>
6*	Sori ovoid, without longitudinal stripes; spores larger; warts higher . . . . .	7
7	Spores 22–33 (–37) $\mu\text{m}$ long; warts 1.5–3 $\mu\text{m}$ high . . . . .	<i>T. arundinellae</i>
7*	Spores 30–40 $\mu\text{m}$ long; warts 3.5–6.5 $\mu\text{m}$ high . . . . .	<i>T. shivasii</i>
8	Sori on the stems . . . . .	9
8*	Sori in the ovaries . . . . .	10
9	Spores external around a long, flagelliform columella . . . . .	(?) <i>Spor. kusanoi</i>
9*	Spores hidden within a tubular sorus . . . . .	<i>Mac. effusus</i>
10	Sori 0.6–1.2 mm long; spores 9.5–14.5 $\mu\text{m}$ long . . . . .	<i>Spor. arundinellae-pumilae</i>
10*	Sori longer; spores smaller, <i>ca</i> 6.5–10.5 $\mu\text{m}$ long . . . . .	11
11	Sori 5–13 mm long, in some spikelets of an inflorescence; sterile cells present . . . . .	<i>Mac. arundinellae-setosae</i>
11*	Sori 2–3 mm long, in all spikelets of a panicle; sterile cells absent. . . . .	12
12	Spore balls permanent; spores dimorphic . . . . .	<i>Spor. arundinellae-nepalensis</i>
12*	Spore balls ephemeral or absent; spores not dimorphic. . . . .	<i>Spor. arundinellae</i>

Key to the smut fungi of *Beckeropsis*, see *Pennisetum*Key to the smut fungi of *Bothriochloa*, *Capillipedium* and *Dichanthium*

1	Sori as long tubes on the top of the stems . . . . .	<i>Mac. chrysopogonicola</i>
1*	Sori not so . . . . .	2
2	Sori on the leaves or leaf sheaths . . . . .	3
2*	Sori in the flowers, spikelets, racemes or inflorescence . . . . .	4
3	Sori on adaxial surface of leaf sheaths; spores 10–20 (–24) $\mu\text{m}$ long . . . . .	<i>Jamesdicksonia brunkei</i>
3*	Sori on the leaves; spores 9–13 (–15) $\mu\text{m}$ long . . . . .	<i>Jamesdicksonia obesa</i>
4	Sori in the flowers. . . . .	5
4*	Sori in the spikelets, racemes or whole inflorescence . . . . .	13
5	Sori in some flowers of an inflorescence . . . . .	6
5*	Sori in all flowers of an inflorescence . . . . .	7
6	Sori 5–13 mm long; spore balls and columella present; spores 10–14.5 $\mu\text{m}$ long, finely, densely verrucose-echinulate . . . . .	<i>Spor. bothriochloae</i>
6*	Sori 2–3 mm long; spore balls and columella absent; spores 11.5–17 $\mu\text{m}$ long, coarsely, densely echinulate . . . . .	<i>Mac. bothriochloae</i>
7	Spores smooth, lighter on one half . . . . .	<i>Spor. taianum</i>
7*	Spores ornamented, sometimes very finely, not lighter on one half . . . . .	8

8	Spores 5.5–8 (–9) $\mu\text{m}$ long . . . . .	<i>Spor. dichanthicola</i>
8*	Spores larger, more than 9 $\mu\text{m}$ long . . . . .	9
9	Spores dimorphic, i.e. outer and inner spores in a ball different; sterile cells absent. . . . .	10
9*	Spores not dimorphic; sterile cells present. . . . .	11
10	Outer spores 9–13 $\mu\text{m}$ long, wall 0.5–1 (–1.5) $\mu\text{m}$ thick . . . . .	<i>Spor. rubyanum</i>
10*	Outer spores 13–18 (–20) $\mu\text{m}$ long, wall 1.5–2.5 (–3) $\mu\text{m}$ thick . . . . .	<i>Spor. dichanthii</i>
11	Spores dark yellowish-brown, wall 1–2 $\mu\text{m}$ thick, prominently echinulate, spore profile serrulate. . . . .	<i>Spor. sahayai</i>
11*	Spores yellowish-brown, wall ca 0.5 $\mu\text{m}$ thick, finely verrucose-echinulate, spore profile smooth to wavy. . . . .	12
12	Spores with 4–6 thin-walled, light areas . . . . .	<i>Spor. mysorensis</i>
12*	Spores without light areas . . . . .	<i>Spor. andropogonis-annulati</i>
13(4)	Sori destroying some spikelets of a few racemes or all of an inflorescence, usually with remnants of spikelets . . . . .	<i>Spor. doidgeae</i>
13*	Sori destroying the whole inflorescence . . . . .	14
14	Columellae numerous, filiform; spores (?) reticulate . . . . .	<i>Spor. reticulatum</i>
14*	Columella one, simple or ramified; spores not reticulate. . . . .	15
15	Sterile cells between the spores in persistent chains . . . . .	<i>Spor. spinulosum</i>
15*	Sterile cells in irregular groups . . . . .	16
16	Spores 13–16 $\mu\text{m}$ long . . . . .	<i>Spor. superfluum</i>
16*	Spores smaller. . . . .	17
17	Spores between 9–14 $\mu\text{m}$ long . . . . .	18
17*	Spores smaller. . . . .	19
18	Sterile cells 13–22 $\mu\text{m}$ long, pale yellowish-brown; wall 1.5–3 $\mu\text{m}$ thick . . . . .	<i>Spor. foveolati</i>
18*	Sterile cells 7–13 $\mu\text{m}$ long, subhyaline; wall 0.5–0.8 $\mu\text{m}$ thick . . . . .	<i>Spor. dinteri</i>
19	Spores 6.5–9.5 $\mu\text{m}$ long . . . . .	<i>Spor. tenue</i>
19*	Spores 7.5–11 $\mu\text{m}$ long. . . . .	<i>Spor. andropogonis</i>

Key to the smut fungi of *Bouteloua*, see *Aegopogon*

Key to the smut fungi of *Brachiaria*, *Eriochloa*, *Urochloa* and *Yakirra*

1	Sori in the leaves and stems . . . . .	<i>Eballistra brachiariae</i>
1*	Sori in the ovaries, flowers or spikelets . . . . .	2
2	Spores larger than 13 $\mu\text{m}$ long; sori in the ovaries . . . . .	3
2*	Spores less than 15 $\mu\text{m}$ long; sori in the ovaries, flowers or spikelets . . . . .	6
3	Sori in all ovaries of an inflorescence; spores 13.5–18.5 $\mu\text{m}$ long . . . . .	<i>T. mauritiana</i>
3*	Sori in some ovaries of an inflorescence; spores up to 25–27 $\mu\text{m}$ long . . . . .	4
4	Spores provided with 1–2 $\mu\text{m}$ high warts, 13–20 per spore diam., 35–60 on the spore circumference . . . . .	<i>T. majuscula</i>
4*	Warts higher, less per spore diam. and on the spore circumference . . . . .	5
5	Warts 2–3.5 $\mu\text{m}$ high, 10–14 per spore diam., 34–44 on the spore circumf . . . . .	<i>T. brachiariae</i>
5*	Warts 1.5–2.5 (–3) $\mu\text{m}$ high, 5–11 per spore diam., 23–41 on the spore circumf. . . . .	<i>T. yakirrae</i>
6	Sori in some ovaries or flowers of an inflorescence; sterile cells abundant between the spores . . . . .	7
6*	Sori in all ovaries or flowers of an inflorescence; sterile cells few or absent. . . . .	10
7	Spores 8–13 $\mu\text{m}$ long . . . . .	8
7*	Spores 7–11 $\mu\text{m}$ long . . . . .	9
8	Sori inconspicuous, up to 2 mm long; spores densely, evidently echinulate; spore profile serrate. . . . .	<i>Mac. tanakae</i>
8*	Sori hypertrophied, up to 40 mm long; spores prominently, moderately densely echinulate; spore profile serrulate . . . . .	<i>Mac. pretoriensis</i>

- 9 Sori inconspicuous, up to 1 mm long; spores densely, low verrucose-echinulate; spore profile smooth to finely wavy ..... *Mac. brachiariae*
- 9\* Sori hypertrophied, up to 5 mm long; spores sparsely, evidently echinulate; spore profile finely, sparsely serrulate ..... *Mac. ordensis*
- 10 Columella and spore balls absent; sori destroying the inner floral organs and often also the basal part of the floral envelopes ..... *U. operta*
- 10\* Columella and spore balls present, at least in young sori; sori otherwise ..... 11
- 11 Sori 5–10 mm long; spores expressly dimorphic, outer spores in a ball mamillate ..... *Spor. eriochloae*
- 11\* Sori shorter; spores not or only slightly dimorphic, not mamillate ..... 12
- 12 Spores 6.5–9 µm long; wall uneven, 0.5–1.5 µm thick, smooth to punctate-verruculose ..... *Spor. africanum*
- 12\* Spores larger; wall evenly thick ..... 13
- 13 Spores 8–10.5 µm long, finely punctate to verruculose; spore profile smooth ..... *Spor. cryptum*
- 13\* Spores larger, densely verrucose-echinulate; spore profile wavy to finely serrulate ..... 14
- 14 Spores 8.5–11 (–12) µm long ..... *Spor. ovarium*
- 14\* Spores 9.5–15 µm long ..... *Spor. mixtum*

**Key to the smut fungi of *Buchloë*, see *Aegopogon***

**Key to the smut fungi of *Calamagrostis* (incl. *Deyeuxia*)**

- 1 Sori as leaf spots; spores subhyaline, embedded in the leaf tissue, not powdery ..... *Ustilentyloma brefeldii*
- 1\* Sori not so; spores pigmented, powdery ..... 2
- 2 Spores agglutinated in permanent balls surrounded by sterile cells ..... 3
- 2\* Spores not in balls ..... 4
- 3 Spore balls composed of 1–5 spores ..... *Ur. calamagrostidis*
- 3\* Spore balls composed of 1–6 (–8) spores ..... *Ur. dunhuangensis*
- 4 Sori naked surrounding the internodes; spores 4–6 (–7) µm long ..... *Tranzscheliella hypodytes*
- 4\* Sori otherwise; spores larger ..... 5
- 5 Sori in the seeds; spores longer than 19 µm, tuberculate ..... 6
- 5\* Sori in the leaves forming striae; spores shorter than 19 µm, verrucose or echinulate ..... 7
- 6 Spores 19–26 µm long, tubercles 1.5–2 µm high ..... *T. deyeuxiae*
- 6\* Spores 36–44 µm long, tubercles up to 5 µm high ..... *T. inolens*
- 7 Spores 12–19 µm long ..... 8
- 7\* Spores smaller ..... 9
- 8 Spores with irregular warts the bases of which are confluent into irregular, interrupted meshes ..... *U. scrobiculata* (incl. *U. deyeuxiae*)
- 8\* Spores with regular, isolated, prominent, densely situated spines which are not fusing ..... *U. calamagrostidis*
- 9 Spores 9–15 (–16) µm long, finely to prominently, densely echinulate; spore profile finely serrulate ..... *U. striiformis* (incl. *U. corcontica*)
- 9\* Spores 6.5–10 µm long, sparsely, finely verruculose; spore profile smooth ..... *U. deyeuxicola*

**Key to the smut fungi of *Capillipedium*, see *Bothriochloa***

**Key to the smut fungi of *Carex* (excepting species of *Anthracoidea* and *Farysia*)**

- 1 Sori forming galls on the roots; spores poorly pigmented ..... 2
- 1\* Sori not so; spores pigmented ..... 3
- 2 Exospore 1–2.5 µm thick, low verrucose-tuberculate ..... *Entorrhiza guttiformis*
- 2\* Spore wall almost smooth ..... *Entorrhiza caricicola*

3	Sori on the leaves . . . . .	4
3*	Sori in and around ovaries or in the flowers . . . . .	11
4	Spores forming spore balls surrounded by sterile cells . . . . .	5
4*	Spores single, in pairs or in balls, no sterile cells . . . . .	6
5	Spore balls 20–40 µm long, composed of 1–3 (–4) spores . . . . .	<i>Ur. fischeri</i>
5*	Spore balls 25–50 µm long, composed of (1–) 2–6 (–9) spores. . . . .	<i>Ur. littoralis</i>
6	Sori as black crusts on the leaves; spores single or in balls . . . . .	7
6*	Sori as black, pustular streaks with intracellular spores . . . . .	9
7	Spores single, foveolate-reticulate . . . . .	<i>Orphanomyces arcticus</i>
7*	Spores forming balls, single spores verrucose or irregularly verrucose-reticulate. . . . .	8
8	Spore balls 45–80 (–100) µm long; spores 14–23 µm long, verrucose to irregularly, incompletely reticulate. . . . .	<i>Orphanomyces hungaricus</i>
8*	Spore balls (60–) 80–120 (–165) µm long; spores 17–26 (–28) µm long, finely, irregularly verruculose-reticulate . . . . .	<i>Orphanomyces vankyi</i>
9	Spores in irregular spore balls . . . . .	<i>Schizonella cocconii</i>
9*	Spores in pairs or in small groups . . . . .	10
10	Spores in pairs; basidiospores mostly ovoid. . . . .	<i>Schizonella melanogramma</i>
10*	Spores in pairs and in small groups; basidiospores mostly long ellipsoidal. . . . .	<i>Schizonella intercedens</i>
11(3)	Spore mass brown, powdery, mixed with fascicles of sterile fungal filaments . . . . .	<i>Farysia</i> (20 species)
11*	Spore mass black, granular powdery or agglutinated, no fascicles of fungal filaments . . . . .	12
12	Sori granular powdery; spores in permanent spore balls . . . . .	13
12*	Sori agglutinated with powdery surface; spores single . . . . .	14
13	Sori in nutlets; spore balls 12–30 µm long; spores 6.5–14.5 µm long. . . . .	<i>Moreaua apicis</i>
13*	Sori on the filaments; spore balls 16–45 µm long; spores 10–16 µm long. . . . .	<i>Moreaua aterrima</i>
14	Spores with a dark equatorial band and two light polar areas . . . . .	<i>Planetella lironis</i>
14*	Spores uniformly pigmented. . . . .	<i>Anthracoidea</i> (74 species)

Key to the smut fungi of *Cathestecum*, see *Aegopogon*

Key to the smut fungi of *Chamaeraphis*, see *Pseudoraphis*

Key to the smut fungi of *Chionachne*, *Polytoxa* and *Sclerachne*

1	Sori in the ovaries . . . . .	2
1*	Sori in the spikelets or in the whole inflorescence . . . . .	5
2	Spores 32–50 µm long . . . . .	<i>T. puneana</i>
2*	Spores smaller. . . . .	3
3	Spores 23–36 µm long . . . . .	<i>T. chionachnes</i>
3*	Spores smaller. . . . .	4
4	Spores 16–24 (–26) µm long . . . . .	<i>T. kimberleyensis</i>
4*	Spores 5.5–6.5 µm long . . . . .	<i>U. sclerachnes</i>
5	Sori in the whole inflorescence or whole raceme . . . . .	6
5*	Sori in some or all spikelets of a raceme . . . . .	7
6	Sori in the inflorescence; spores 10.5–14.5 µm long . . . . .	<i>Spor. reilianum</i>
6*	Sori in the racemes; spores 8–10.5 µm long . . . . .	<i>Spor. simile</i>
7	Spores 6.5–11 µm long. . . . .	<i>Spor. polytocae-barbatae</i>
7*	Spores larger. . . . .	8

- 8 Sori in some spikelets of a raceme; spores 11–15  $\mu\text{m}$  long, finely punctate-echinulate . . . . . *Spor. polytocae*  
 8\* Sori in all spikelets of a raceme; spores 9.5–16 (–19)  $\mu\text{m}$  long, evidently echinulate . . . . . *Spor. polytocae-digitatae*

#### Key to the smut fungi of *Chrysopogon*

- 1 Sori tubular, in the distal part of the stems . . . . . 2  
 1\* Sori not tubular, not in the distal part of the stems . . . . . 3  
 2 Spores 8–11  $\mu\text{m}$  long, densely echinulate . . . . . *Mac. chrysopogonicola*  
 2\* Spores 4–6 (–6.5)  $\mu\text{m}$  long, verrucose . . . . . *Mac. effusus*  
 3 Sori in some sessile and pedicelled spikelets of an inflorescence, cylindrical . . . . . 4  
 3\* Sori in the whole inflorescence . . . . . 5  
 4 Spores in balls, dimorphic, outer spores verrucose . . . . . *Spor. chrysopogonis-fulvi*  
 4\* Spores not in balls, uniform, with acute, pyramidal warts . . . . . *Mac. tubiformis*  
 5 Spores dimorphic, i.e. outer and inner spores in a ball different . . . . . 6  
 5\* Spores not dimorphic . . . . . 9  
 6 Spore balls 60–130  $\mu\text{m}$  long, outer spores 13–17.5  $\mu\text{m}$  long . . . . . *Spor. chrysopogonicola*  
 6\* Spore balls and outer spores smaller . . . . . 7  
 7 Spore balls 35–90  $\mu\text{m}$  long, outer spores 9–14 (–16)  $\mu\text{m}$  long . . . . . *Spor. chrysopogonis*  
 7\* Spores smaller . . . . . 8  
 8 Spores 7–10.5  $\mu\text{m}$  long; columella one . . . . . *Spor. azmatii*  
 8\* Spores 6–10  $\mu\text{m}$  long; columellae several . . . . . *Spor. fallax*  
 9 Spores 5–6.5  $\mu\text{m}$  long . . . . . *Spor. andropogonis-aciculati*  
 9\* Spores larger . . . . . 10  
 10 Spores 10–15  $\mu\text{m}$  long; columella one . . . . . *Spor. chrysopogonis-grylli*  
 10\* Spores 6.5–13  $\mu\text{m}$  long; columellae several . . . . . *Spor. tumefaciens*

#### Key to the smut fungi of *Coelorachis*, *Eremochloa*, *Hackelochloa*, *Lasiurus* and *Rhytachne* (*Rottboelliinae*)

- 1 Sori on the leaves; spore wall 2–8  $\mu\text{m}$  thick, multilayered . . . . . *Tolyposporella rhytachnes*  
 1\* Sori not on the leaves; spore wall less than 2  $\mu\text{m}$  thick, not multilayered . . . . . 2  
 2 Sori in the ovaries, cylindrical . . . . . 3  
 2\* Sori in the flowers, spikelets or inflorescence . . . . . 4  
 3 Sori 3–5 mm long; spores 7.5–13.5  $\mu\text{m}$  long . . . . . *Spor. rhytachnes-rottboellioidis*  
 3\* Sori 10–20 mm long; spores 7–9  $\mu\text{m}$  long . . . . . *Mac. siamensis*  
 4 Sori usually destroying the whole inflorescence or the racemes. Not on *Eremochloa* . . . . . 5  
 4\* Sori usually restricted to the flowers or spikelets. On *Eremochloa* . . . . . 8  
 5 Columellae several, filiform. On *Lasiurus* . . . . . *Spor. desertorum*  
 5\* Columella one . . . . . 6  
 6 Columella branched; spores 9.5–12  $\mu\text{m}$  long, wall ca 0.8  $\mu\text{m}$  thick, minutely echinulate. On *Hackelochloa* . . . . .  
 . . . . . *Spor. erythraeense*  
 6\* Columella simple; spores larger. Not on *Hackelochloa* . . . . . 7  
 7 Spores 11–15 (–16)  $\mu\text{m}$  long, dimorphic; sterile cells absent. On *Rhytachne* . . . . . *Spor. rhytachnes*  
 7\* Spores 11–13.5  $\mu\text{m}$  long, all similar; sterile cells present. On *Coelorachis* . . . . . *Spor. coelorachidis*  
 8 Sori in the flowers; columella simple; spores 6.5–8 (–9)  $\mu\text{m}$  long; wall ca 0.5  $\mu\text{m}$  thick, smooth to finely punctate . . .  
 . . . . . *Spor. polycarpum*  
 8\* Sori in the spikelets (rarely in the whole inflorescence); columella with short branches; spores 7–11 (–12)  $\mu\text{m}$  long; wall  
 ca 1  $\mu\text{m}$  thick, verrucose-echinulate . . . . . *Spor. eremochloae*

Key to the smut fungi of *Coix*

- 1 Sori with numerous, long, slender, fragile chains of sterile fungal cells; spores reticulate . . . . *Franzpetrakia okudairae*  
 1\* Sori without chains of sterile fungal cells; spores not reticulate . . . . . 2  
 2 Spore mass black; spores 20–28 µm long, tuberculate . . . . . *T. sumatiae*  
 2\* Spore mass dark brown; spores 8–13 µm long, echinulate . . . . . 3  
 3 Spores in loose balls, punctate-echinulate; sterile cells present . . . . . *Spor. lachrymae-jobi*  
 3\* Spores not in balls, evidently echinulate; sterile cells absent . . . . . *U. coicis*

Key to the smut fungi of *Cynodon*

- 1 Sori in the ovaries; spores with coarse warts . . . . . *T. montemartinii*  
 1\* Sori elsewhere, spores smooth, punctate or finely verrucose-echinulate . . . . . 2  
 2 Sori in some spikelets; spores finely verrucose-echinulate . . . . . *Spor. incompletum*  
 2\* Sori elsewhere, not in the spikelets . . . . . 3  
 3 Spore balls present . . . . . 4  
 3\* Spore balls absent . . . . . 5  
 4 Spores 10.5–17.5 µm long . . . . . *Spor. cynodontis*  
 4\* Spores 8–12 µm long . . . . . *Spor. normanense*  
 5 Sori on distal internodes; spores 7–11 µm long . . . . . *U. paraguariensis*  
 5\* Sori on top of sterile shoots or in the inflorescence; spores smaller . . . . . 6  
 6 Sori on top of sterile shoots; spores 6.5–9.5 µm long, punctate-verruculose . . . . . *U. cynodonticola*  
 6\* Sori in the inflorescence or also in leaf sheaths; spores smaller, smooth . . . . . 7  
 7 Sori in the inflorescence; spores 6–8 (–8.5) µm long . . . . . *U. cynodontis*  
 7\* Sori in the inflorescence and distal leaf sheaths; spores 5–6.5 µm long . . . . . *U. hitchcockiana*

Key to the smut fungi of *Dactyloctenium*

- 1 Spores more than 15 µm long . . . . . 2  
 1\* Spores less than 15 µm long . . . . . 4  
 2 Spores echinulate-reticulate, muri weak . . . . . *T. dactyloctenii*  
 2\* Spores reticulate, muri well-developed . . . . . 3  
 3 Spores 20–25 (–28) µm long, muri 1–1.5 (–2) µm high . . . . . *T. eleusines*  
 3\* Spores (22–) 24–33 (–36) µm long, muri 1.5–2.5 µm high . . . . . *T. tanzanica*  
 4 Sori in the distal part of the shoots, or as globoid witches' brooms . . . . . 5  
 4\* Sori in the spikelets or in the ovaries . . . . . 9  
 5 Sori as globoid witches' brooms in the inflorescence or also destroying the young inflorescence still enclosed by leaf sheaths . . . . . *U. aldabrensis*  
 5\* Sori not as witches' brooms . . . . . 6  
 6 Spores (7–) 8–11 µm long, finely, moderately densely echinulate . . . . . *U. idonea*  
 6\* Spores *ca* 10–14 µm long . . . . . 7  
 7 Spores very finely, densely punctate . . . . . *U. dactyloctenii*  
 7\* Spores echinulate . . . . . 8  
 8 Spores sparsely echinulate . . . . . *U. radulans*  
 8\* Spores densely echinulate . . . . . *U. dactyloctenii-gigantei*  
 9 Sori in the spikelets . . . . . 10  
 9\* Sori in the ovaries . . . . . 11  
 10 The fungus produces vivipary-like hypertrophy; spores 8–12 µm long, prominently echinulate . . . . . *U. viviparifera*



- 10\* The fungus does not produce vivipary-like hypertrophy; spores 9–14 µm long, finely, sparsely punctate-echinulate . . .  
 . . . . . *U. dactylocteniophila*
- 11 Spores 9–13 µm long, coarsely verrucose-echinulate . . . . . *U. ctenioides*
- 11\* Spores 6–10 µm long, finely, sparsely punctate-verruculose . . . . . *U. sparsa*

**Key to the smut fungi of *Danthonia* s. lat.**

- 1 Sori only in the leaves as long striae; spores 9–16 µm long, finely to prominently echinulate . . . . . *U. striiformis*
- 1\* Sori in the inflorescence, rarely also in the uppermost leaves. . . . . 2
- 2 Peridium, columella, spore balls and sterile cells present . . . . . *Spor. algeriense*
- 2\* Peridium, columella, spore balls and sterile cells absent . . . . . 3
- 3 Spores 2.5–5 µm long. . . . . *U. comburens*
- 3\* Spores larger . . . . . 4
- 4 Spores 4–7 µm long . . . . . 5
- 4\* Spores larger . . . . . 7
- 5 Spores in LM smooth, usually with hyaline caps at the poles . . . . . *Tranzscheliella hypodytes*
- 5\* Spores in LM verrucose or tuberculate . . . . . 6
- 6 Spores in LM tuberculate, without thinner polar areas . . . . . *U. dregeana*
- 6\* Spores in LM verrucose, with two, thinner polar areas . . . . . *U. dregeanoides*
- 7 Spores 8–11 µm long, evidently, irregularly verrucose. . . . . *U. residua*
- 7\* Spores 9.5–13.5 µm long, finely, regularly echinulate . . . . . *U. agropyri*

**Key to the smut fungi of *Dichanthium*, see *Bothriochloa***

**Key to the smut fungi of *Digitaria* (incl. *Trichachne*)**

- 1 Sori in the ovaries or innermost floral organs . . . . . 2
- 1\* Sori comprise more than the ovaries and innermost floral organs . . . . . 8
- 2 Sori comprise the innermost floral organs; spores 9.5–13.5 µm long, prominently echinulate . . . . . *Spor. gibbosum*
- 2\* Sori in the ovaries . . . . . 3
- 3 Spores 7–12 µm long . . . . . 4
- 3\* Spores over 17 µm long . . . . . 7
- 4 Sori in all ovaries of an inflorescence. . . . . *Spor. linderi*
- 4\* Sori in some ovaries of an inflorescence . . . . . 5
- 5 Columella present . . . . . *Spor. diplosporum*
- 5\* Columella absent . . . . . 6
- 6 Sterile cells ovoid, ellipsoidal or irregular, 8–14 µm long; wall 1–1.5 (–2) µm thick . . . . . *Mac. digitariae*
- 6\* Sterile cells globose or subglobose, 10–28 µm long; wall ca 0.5 µm thick . . . . . *Mac patilorum*
- 7 Spores 17.5–24 µm long, with coarse, cylindrical, 1.5–2.5 µm high warts . . . . . *T. digitariicola*
- 7\* Spores 20–29.5 µm long, with blunt, 1–1.5 µm high warts . . . . . *T. pulcherrima*
- 8 Sori in the rachis and/or spikelets, pustular. . . . . *U. royleani*
- 8\* Sori in the racemes, in the whole inflorescence or in the distal part of sterile shoots, not pustular. . . . . 9
- 9 Sori in the racemes; spores 5–6.5 (–7) µm long . . . . . *U. drakensbergiana*
- 9\* Sori in the whole inflorescence or in the distal part of sterile shoots; spores larger. . . . . 10
- 10 Sori in the inflorescence . . . . . 11
- 10\* Sori in the distal part of sterile shoots; spores smaller, not echinulate . . . . . 12
- 11 Spores 9–15 µm long, echinulate . . . . . *U. syntherismae*
- 11\* Spores 12–17 (–18) µm long, punctate-verruculose . . . . . *Spor. assamense*

- 12 Spores 6–8  $\mu\text{m}$  long, smooth or punctate . . . . . *Spor. panici-leucophaei*  
 12\* Spores 7–12  $\mu\text{m}$  long, punctate-verruculose . . . . . *Spor. ugandense*

**Key to the smut fungi of *Dimeria***

- 1 Sori in the leaves; spores not powdery. . . . . “*Mel.*” *dimeriae*  
 1\* Sori not in the leaves; spores powdery. . . . . 2  
 2 Sori in the flowers; spores 7–12  $\mu\text{m}$  in diam., finely punctate-echinulate . . . . . *Spor. dimeriae*  
 2\* Sori in the whole inflorescence; spores 9–14.5 (–16)  $\mu\text{m}$  in diam., prominently echinulate . . . . .  
 . . . . . *Spor. dimeriae-ornithopodae*

**Key to the smut fungi of *Elionurus***

- 1 Sori in some ovaries of an inflorescence, cylindrical; columella absent; spores with short, conical warts . . . . .  
 . . . . . *Mac. elionuri-tripsacoidis*  
 1\* Sori in some or all spikelets of an inflorescence; columella present; spores otherwise ornamented. . . . . 2  
 2 Sori in some spikelets of an inflorescence; columella conical, with longitudinal furrows . . . . . *Spor. ciccaronei*  
 2\* Sori in all spikelets of an inflorescence; columella without longitudinal furrows . . . . . 3  
 3 Columella long, filiform; sterile cells absent; spores 6.5–9.5 (–10.5)  $\mu\text{m}$  long. . . . . *Spor. elionuri*  
 3\* Columella short, simple; sterile cells present; spores 10–13  $\mu\text{m}$  long . . . . . *Spor. elionuri-tristis*

**Key to the smut fungi of *Enneapogon*, *Pappophorum*, *Schmidtia* (*Pappophoreae*)**

- 1 Sori in the whole inflorescence . . . . . 2  
 1\* Sori not so . . . . . 3  
 2 Sori also comprise the basal part of the uppermost leaves; spores 9.5–12  $\mu\text{m}$  long . . . . . *U. pappophori*  
 2\* Sori only in the inflorescence; spores 10.5–13.5 (–14.5)  $\mu\text{m}$  long. . . . . *U. enneapogonis*  
 3 Sori in the basal part of the uppermost, congested, swollen leaf sheaths . . . . . *U. schlechteri*  
 3\* Sori in the flowers or ovaries . . . . . 4  
 4 Sori in all flowers of an inflorescence; columella and sterile cells present; spores 11–14  $\mu\text{m}$  long . . . . . *Spor. modestum*  
 4\* Sori in some of the flowers or ovaries of an inflorescence; columella and sterile cells absent; spores smaller . . . . . 5  
 5 Sori in the ovaries; spores 9–12  $\mu\text{m}$  long . . . . . *U. schmidtiae*  
 5\* Sori in the flowers; spores 6.5–9 (–10)  $\mu\text{m}$  long . . . . . *U. austroafricana*

**Key to the smut fungi of *Eragrostis***

- 1 Sori on the top of shoots, up to 2–3 cm long . . . . . *Spor. montaniense*  
 1\* Sori in the spikelets or ovaries, much smaller . . . . . 2  
 2 Sori in the spikelets; spores with a darker equatorial band . . . . . *U. planetella*  
 2\* Sori in the ovaries; spores without a darker equatorial band . . . . . 3  
 3 Spores over 17.5  $\mu\text{m}$  long . . . . . 4  
 3\* Spores less than 19  $\mu\text{m}$  long . . . . . 7  
 4 Spores reticulate . . . . . *T. baldratii*  
 4\* Spores with pointed, subacute or truncate pyramidal or cylindrical warts . . . . . 5  
 5 Spores 28–40  $\mu\text{m}$  long, warts 2.5–5.5  $\mu\text{m}$  high . . . . . *T. eragrostidis*  
 5\* Spores less than 25  $\mu\text{m}$  long, warts lower . . . . . 6  
 6 Warts 2–2.5  $\mu\text{m}$  high, flattened, 5–7 per spore diam. . . . . *T. thailandica*  
 6\* Warts 2.5–4  $\mu\text{m}$  high, pointed, pyramidal, 3–5 per spore diam. . . . . *T. transvaalensis*  
 7 Spores with 1.5–2.5 (–3)  $\mu\text{m}$  high, subpyramidal warts . . . . . *T. kenyana*  
 7\* Spores punctate, verruculose or finely echinulate . . . . . 8

- 8 Sori often with an acute remnant of the caryopsis; spores 8–11 (–13)  $\mu\text{m}$  long; wall even, ca 0.5  $\mu\text{m}$  thick, without brighter spots . . . . . *Mac. spermophorus*
- 8\* Sori without an acute remnant of the caryopsis; spores 10–14 (–16)  $\mu\text{m}$  long; wall uneven, 0.5–1  $\mu\text{m}$  thick, often with brighter spots . . . . . *U. egenula*

Key to the smut fungi of *Eremochloa*, see *Coelorachis*

Key to the smut fungi of *Eriochloa*, see *Brachiaria*

Key to the smut fungi of *Fimbristylis*

- 1 Spores in balls . . . . . 2
- 1\* Spores single . . . . . 5
- 2 Spore balls composed of spores, separated by spore wall processes, and a cortex of sterile cells . . . . . *Dermatosorus fimbristylidis*
- 2\* Spore balls composed of spores only . . . . . 3
- 3 Spore balls loose; free surface of the spores minutely foveolate-reticulate . . . . . *Ustanc. kuwanoanum*
- 3\* Spore balls firmly united; free surface of the spores verrucose . . . . . 4
- 4 Spore balls (16–) 20–50  $\mu\text{m}$  long, composed mostly of 2–16 (–20) spores . . . . . *Mor. mauritiana*
- 4\* Spore balls 40–100  $\mu\text{m}$  long, composed mostly of 20–?100 spores . . . . . *Mor. fimbristylidis*
- 5 Sori around the floral pedicels; spores 12–18  $\mu\text{m}$  long . . . . . *Cintractia axicola*
- 5\* Sori in flowers or spikelets; spores smaller . . . . . 6
- 6 Sori in all flowers of an inflorescence; spores 10.5–15 (–16)  $\mu\text{m}$  long . . . . . *Cintractia majewskii*
- 6\* Sori in some flowers or spikelets of an inflorescence; spores smaller . . . . . 7
- 7 Sori with powdery surface . . . . . *Cintractia mitchellii*
- 7\* Sori agglutinated, not powdery on their surface . . . . . 8
- 8 Fungal filaments between the spores with not gelatinised wall; spores evidently verrucose-echinulate . . . . . *Cintractia fimbristylidis-miliaceae*
- 8\* Fungal filaments between the spores with gelatinised wall; spores finely ornamented . . . . . 9
- 9 Spores 11.5–16 (–17)  $\mu\text{m}$  long, apparently smooth to finely punctate . . . . . *Pilocintractia adrianae*
- 9\* Spores 9–12 (–13)  $\mu\text{m}$  long, finely granular-verruculose . . . . . *Pilocintractia fimbristylidicola*

Key to the smut fungi of *Gabnia*

- 1 Sori surrounding the floral stems or pedicels, traversed by fascicles of sterile hyphae . . . . . *Farysporium endotrichum*
- 1\* Sori in the spikelets, not traversed by fascicles of sterile hyphae . . . . . 2
- 2 Spore balls 15–50  $\mu\text{m}$  long, composed of (3–) 5 to numerous spores . . . . . *Mor. tristis*
- 2\* Spore balls 30–100  $\mu\text{m}$  long, composed of dozens of spores . . . . . 3
- 3 Spores tightly agglomerated, subcuneiform or subpolyhedrally irregular; spore wall of the free surface 2–4  $\mu\text{m}$  thick . . . . . *Mor. muelleriana*
- 3\* Spores loosely agglomerated, rounded; spore wall of the free surface 1–1.5  $\mu\text{m}$  thick . . . . . *Mor. gabniae*

Key to the smut fungi of *Hackelochloa*, see *Coelorachis*

Key to the smut fungi of *Hainardia*, see *Lepturus*

Key to the smut fungi of *Hemarthria*, see *Lepturus*

Key to the smut fungi of *Hilaria*, see *Aegopogon*

Key to the smut fungi of *Hyparrhenia* and *Hyperthelia*

- 1 Sori in the ovaries; spores more than 18.5  $\mu\text{m}$  long. . . . . 2
- 1\* Sori elsewhere; spores smaller . . . . . 3
- 2 Sori oblong, up to 10 mm long; spores (22–) 26–32 (–36)  $\mu\text{m}$  long. . . . . *T. hyparrheniae*
- 2\* Sori flask-shaped, up to 5 mm long; spores 18.5–27  $\mu\text{m}$  long. . . . . *T. lageniformis*
- 3 Sori in the leaves; spore wall 3–6.5  $\mu\text{m}$  thick, multilayered. . . . . *Jamesdicksonia obesa*
- 3\* Sori not in the leaves; spore wall thinner, not multilayered . . . . . 4
- 4 Sori producing witches' brooms . . . . . 5
- 4\* Sori not producing witches' brooms . . . . . 7
- 5 Witches' brooms on the stems; spore balls rather permanent; outer spores prominently, low verrucose-echinulate, inner spores smooth. . . . . *Spor. tembuti*
- 5\* Witches' brooms in the racemes; spore balls ephemeral or easily separating into spores; all spores ornamented . . . . . 6
- 6 Spores 5.5–8  $\mu\text{m}$  long; spore wall 0.5–1  $\mu\text{m}$  thick, moderately densely verrucose . . . . . *Spor. congensis*
- 6\* Spores 9–13 (–14)  $\mu\text{m}$  long; spore wall 2.5–3.5  $\mu\text{m}$  thick, irregularly verrucose-reticulate . *Spor. andropogonis-finitimi*
- 7 Sori comprise the whole inflorescence; spores with inconspicuous, darker and lighter spots . . . . . *Spor. maranguense*
- 7\* Sori do not comprise the whole inflorescence; spores without spots . . . . . 8
- 8 Sori comprise the racemes or raceme-pairs . . . . . 9
- 8\* Sori in the flowers or spikelets; columella filiform or flagelliform . . . . . 10
- 9 Columella stout, one, simple or bifurcate; spores (7.5–) 8–11 (–12)  $\mu\text{m}$  long, finely punctate-verruculose; spore profile smooth. . . . . *Spor. vanderystii*
- 9\* Columella(-ae) narrowing, 1–2, simple or forked; spores 11–13.5  $\mu\text{m}$  long, echinulate; spore profile serrulate. . . . . *Spor. niariense*
- 10 Columellae several, filiform; sori in some or all flowers of an inflorescence . . . . . 11
- 10\* Columella single, flagelliform; sori in all flowers of an inflorescence . . . . . 12
- 11 Sori in some flowers of an inflorescence, 8–15 mm long; spore balls permanent; spores dimorphic . . *Spor. ischaemoides*
- 11\* Sori in all spikelets of an inflorescence, 24–40 mm long; spore balls ephemeral; spores not dimorphic . . *Spor. vankyi*
- 12 Spore balls rather permanent; spores dimorphic; no sterile cells . . . . . *Spor. dembianense*
- 12\* Spore balls apparently absent; spores not dimorphic; sterile cells present . . . . . 13
- 13 Spores 13–18 (–20)  $\mu\text{m}$  long . . . . . *Spor. barcinonense*
- 13\* Spores 10–15 (–16)  $\mu\text{m}$  long . . . . . *Spor. transfissum*

Key to the smut fungi of *Hyperthelia*, see *Hyparrhenia*Key to the smut fungi of *Imperata*, see *Saccharum*Key to the smut fungi of *Isachne*

- 1 Sori in the whole inflorescence . . . . . *Spor. isachnes*
- 1\* Sori in the ovaries . . . . . 2
- 2 Spores 9–13.5  $\mu\text{m}$  long. . . . . *Spor. monakai*
- 2\* Spores larger . . . . . 3
- 3 Spores 17–26  $\mu\text{m}$  long; warts 1–2  $\mu\text{m}$  high, 10–16 per spore diam. . . . . *T. isachmeicola*
- 3\* Spores 21.5–29  $\mu\text{m}$  long; warts 1.5–2.5  $\mu\text{m}$  high, 8–12 per spore diam. . . . . *T. isachnes*

Key to the smut fungi of *Ischaemum*

- 1 Sori on the leaves forming blackish spots . . . . . 2
- 1\* Sori elsewhere, not forming blackish spots . . . . . 3

2	Sori 1–5 mm wide; spores 9–18 µm long; wall 1–5 (–8) µm thick . . . . .	<i>Jamesdicksonia ischaemiana</i>
2*	Sori 0.2–0.5 mm wide; spores 8–13 µm long; wall 1–2.5 (–3) µm thick . . . . .	<i>Phragmotaeonium indicum</i>
3	Sori in the ovaries or spikelets. . . . .	4
3*	Sori in the whole inflorescence . . . . .	13
4	Spores 18–26 (–30) µm long, with 1.5–3 µm high warts . . . . .	<i>T. ischaemi</i>
4*	Spores smaller. . . . .	5
5	Sori in some spikelets . . . . .	<i>Spor. semisagittatum</i>
5*	Sori in all spikelets or ovaries of an inflorescence . . . . .	6
6	Spore balls rather permanent . . . . .	7
6*	Spore balls ephemeral or loose . . . . .	8
7	Columellae several, filiform, often anastomosing; spores dimorphic; sterile cells absent . . . . .	<i>Spor. likhitekarajae</i>
7*	Columella one, stout; spores not dimorphic; sterile cells present. . . . .	<i>Spor. furcatum</i>
8	Spores 5–7.5 (–8) µm long. . . . .	<i>Spor. austroafricanum</i>
8*	Spores larger. . . . .	9
9	Spores 7–11 µm long . . . . .	<i>Spor. hainanae</i>
9*	Spores larger. . . . .	10
10	Spores 10.5–15 µm long; wall unevenly thick, thin on a restricted area . . . . .	<i>Spor. ischaemicola</i>
10*	Spores smaller or equally long but spore wall evenly thick . . . . .	11
11	Spores prominently echinulate, profile serrate (spores 9–12 µm long). . . . .	<i>Spor. tonglinense</i>
11*	Spores finely echinulate, profile finely serrulate. . . . .	12
12	Sori 4–6 mm long; spores mostly subpolyhedral (9–13 µm long) . . . . .	<i>Spor. ischaemi</i>
12*	Sori 1.5–2 mm long; spores globose to broadly ellipsoidal (9–14.5 µm long) . . . . .	<i>Spor. myanmarensense</i>
13	Spores 5–7 µm long, flattened on one side, apparently smooth to very finely punctate. . . . .	<i>Spor. ischaemi-anthephoroidis</i>
13*	Spores larger, not flattened on one side, evidently ornamented . . . . .	14
14	Columellae several, filiform; spores dimorphic; sterile cells absent . . . . .	<i>Spor. ischaemianum</i>
14*	Columella one; spores not dimorphic; sterile cells present . . . . .	15
15	Columella long, flagelliform; spores 12–19 µm long. . . . .	<i>Spor. flagellatum</i>
15*	Columella stout, with shortly bifurcate tip; spores 11–13.5 µm long . . . . .	<i>Spor. ischaemi-rugosi</i>

Key to the smut fungi of *Lasiurus*, see *Coelorachis*

Key to the smut fungi of *Lepidosperma*

1	Sori grey, with two kinds of spores . . . . .	<i>Heterotolyposporium lepidospermae</i>
1*	Sori black, with one kind of spores . . . . .	2
2	Spore balls (25–) 30–60 µm long, composed of (3–) 6–30 or more spores; spores densely, coarsely verrucose . . . . .	<i>Moreaua lepidospermatis</i>
2*	Spore balls larger, with more spores . . . . .	3
3	Spore balls 35–100 (–110) µm long, composed of 20–100 or more spores; spores finely, sparsely verruculose . . . . .	<i>Moreaua rodwayi</i>
3*	Spore balls larger, composed of tens to hundreds of spores; spores moderately densely verruculose . . . . .	4
4	Spore balls 60–150 (–160) µm long, opaque . . . . .	<i>Moreaua megaglomerulosa</i>
4*	Spore balls 60–220 µm long, dark reddish brown. . . . .	<i>Moreaua gigaglomerulosa</i>

Key to the smut fungi of *Leptochloa*, see *Tripogon*

Key to the smut fungi of *Lepturus* and similar grass genera (*Hainardia*, *Hemarthria*, *Manisuris*, *Mnesithea*, *Monerma*, *Parapholis*, *Pholiurus*, *Rottboellia*)

- 1 Sori in the axis of aborted inflorescence, tubular, 20–25 cm long; spores with prismatic warts . . . . . *Tolyposporella pachycarpa*
- 1\* Sori not so, shorter; spores otherwise ornamented . . . . . 2
- 2 Sori in the ovaries or spikelets . . . . . 3
- 2\* Sori in the whole inflorescence . . . . . 8
- 3 Sori in the ovaries . . . . . 4
- 3\* Sori in the spikelets . . . . . 5
- 4 Spores reticulate, 21–25 µm long . . . . . *T. lepturi*
- 4\* Spores punctate-echinulate, 8–13 µm long . . . . . *U. lepturi-xerophile*
- 5 Spores 12–17 µm long, verrucose . . . . . *U. monermiae*
- 5\* Spores smaller . . . . . 6
- 6 Spores 9.5–13 (–14.5) µm long . . . . . *Spor. mnesitheae*
- 6\* Spores ca 5.5–9.5 µm long . . . . . 7
- 7 Columella and sterile cells present . . . . . *Spor. perforatum*
- 7\* Columella and sterile cells absent . . . . . *U. paraguayensis*
- 8 Spores with an operculum . . . . . *Spor. operculatum*
- 8\* Spores without operculum . . . . . 9
- 9 Spores echinulate, 9.5–12 µm long . . . . . *Spor. erythraeense*
- 9\* Spores apparently smooth to minutely verruculose or echinulate . . . . . 10
- 10 Spores 9–14 µm long . . . . . *Spor. ophiuri*
- 10\* Spores smaller . . . . . 11
- 11 Spores 3–5 µm long . . . . . *U. paraspathii*
- 11\* Spores larger . . . . . 12
- 12 Spores 5.5–8 µm long, finely, sparsely punctate-verruculose . . . . . *Spor. cornutum*
- 12\* Spores 6–9 (–10) µm long, in LM smooth . . . . . 13
- 13 Columella and sterile cells present . . . . . *Spor. lepturi*
- 13\* Columella and sterile cells absent . . . . . *U. paraguayensis*

Key to the smut fungi of *Limnanthemum*

- 1 Spores radially elongated, 15–19 µm long, surrounding a central mass of sterile, parenchymatous cells . . . . . *Doassansiopsis limnanthemii*
- 1\* Spores rounded, 8–13.5 µm long, forming the centre of the spore balls, surrounded by a thin cortex of flattened sterile cells . . . . . *Doassansia decipiens*

Key to the smut fungi of *Loudetia*, *Trichopteryx*, *Tristachya* and *Zonotriche*

- 1 Sori in the distal part of the stems as long tubes, later as twisted bands . . . . . 2
- 1\* Sori elsewhere . . . . . 5
- 2 Sori up to 100 cm long; spores densely, prominently echinulate . . . . . *Mac. ugandensis*
- 2\* Sori much shorter; spores finely punctate or verruculose . . . . . 3
- 3 Spores 7–9 µm long . . . . . *Mac. tristachyae*
- 3\* Spores larger . . . . . 4
- 4 Spores 8–12 µm long; wall of the sterile cells 2.5–3 µm thick . . . . . *Mac. trichopterygis*
- 4\* Spores 9.5–15 µm long; wall of the sterile cells 1–2 µm thick . . . . . *Mac. simplex*

5	Sori on the stems, forming witches' brooms at the nodes . . . . .	<i>Mac. magicus</i>
5*	Sori elsewhere, not forming witches' brooms . . . . .	6
6	Sori comprise the whole inflorescence. . . . .	<i>Spor. loudetiae-pedicellatae</i>
6*	Sori do not comprise the whole inflorescence . . . . .	7
7	Sori comprise the central part of the spikelets, tubular, filiform, later as twisted or looped, 4–6 cm long bands; sterile cells up to 13 µm long . . . . .	<i>Mac. loudetiae</i>
7*	Sori in the ovaries or florets, not as above . . . . .	8
8	Sterile cells present, up to 26–30 µm long; columella, spore balls absent . . . . .	9
8*	Sterile cells absent; columella and spore balls, though sometimes evanescent, present . . . . .	10
9	Spores 5–9 µm long; wall of sterile cells 4–7 µm thick . . . . .	<i>Mac. zonotriches</i>
9*	Spores 7–10.5 µm long; wall of sterile cells 1–3 µm thick. . . . .	<i>Mac. nodiglumis</i>
10	Columellae more than 8; spore balls evanescent; spores all alike, 6–11 µm long . . . . .	<i>Spor. catinatum</i>
10*	Columellae less than 5; spore balls more or less permanent; spores more or less dimorphic, larger . . . . .	11
11	Spores 11–22 µm long . . . . .	<i>Spor. loudetiae-superbae</i>
11*	Spores smaller. . . . .	12
12	Spores 12–17 µm long; contact wall of the outer spores thicker ( <i>ca</i> 1.5 µm) than the free wall ( <i>ca</i> 1 µm) . . . . .	<i>Spor. tristachydis</i>
12*	Spores smaller; free wall of the outer spores thicker than or equalling the thickness of the contact walls . . . . .	13
13	Columellae 1–3; spore balls 25–65 µm long. . . . .	<i>Spor. decorsei</i>
13*	Columellae 3–5; spore balls larger . . . . .	14
14	Spore balls 35–90 µm long; free surface of the spores finely verruculose, spore profile nearly smooth . . . . .	<i>Spor. tristachyae-hispidae</i>
14*	Spore balls 40–110 (–140) µm long; free surface of the spores verruculose-echinulate, spore profile densely serrulate . . . . .	<i>Spor. tristachyae-nodiglumis</i>

Key to the smut fungi of *Manisuris*, see *Lepturus*

Key to the smut fungi of *Melinis*, *Rhynchelytrum*, *Tricholaena* (*Melinidinae*)

1	Sori on leaves as spots; spores embedded in the host tissue, not powdery . . . . .	2
1*	Sori elsewhere; spores powdery . . . . .	3
2	Sori pale coloured; spores subhyaline . . . . .	<i>“Entyloma” farisii</i>
2*	Sori lead-coloured; spores brown . . . . .	<i>Jamesdicksonia melinidis</i>
3	Sori in some of the spikelets, on the leaves and stems, forming up to several cm long, hispid swellings . . . . .	(?) <i>U. trichophora</i>
3*	Sori in all spikelets or in the whole inflorescence, not hispid. . . . .	4
4	Sori replacing the whole inflorescence, flagelliform, several cm long . . . . .	<i>Spor. rhynchelytri</i>
4*	Sori in the spikelets, less than 1 cm long. . . . .	5
5	Spores <i>ca</i> 6–11 (–12) µm long . . . . .	6
5*	Spores <i>ca</i> 9–14 (–16) µm long . . . . .	7
6	Peridium and columella present; spores 7–11 (–12) µm long, punctate to verruculose-echinulate . . . . .	<i>Spor. tricholaenae</i>
6*	Peridium and columella lacking; spores 6–10 µm long, apparently smooth to minutely punctate. . . . .	<i>U. delicatula</i>
7	Spores subpolyhedrally irregular, 9.5–13 µm long, reddish-brown, finely punctate to verruculose-echinulate, dimorphic . . . . .	<i>Spor. monachnes</i>
7*	Spores broadly ellipsoidal to elongate, 9–14 (–16) µm long, yellowish-brown, finely punctate-verruculose to echinulate, alike . . . . .	<i>Spor. melinis</i>

Key to the smut fungi of *Mesosetum*, see *Axonopus*

Key to the smut fungi of *Miscanthus*, see *Saccharum*Key to the smut fungi of *Mnesithea*, see *Lepturus*Key to the smut fungi of *Monerma*, see *Lepturus*Key to the smut fungi of *Muhlenbergia*

1	Sori in the ovaries . . . . .	2
1*	Sori elsewhere. . . . .	12
2	Spores verrucose-tuberculate. . . . .	3
2*	Spores reticulate . . . . .	6
3	Spores with inconspicuous, pale, blunt, subpyramidal tubercles, 2–3 µm high . . . . .	<i>Salmacisia</i> / <i>T. buchloëana</i>
3*	Spores with conspicuous tubercles or warts. . . . .	4
4	Tubercles 2.5–4 µm high; spores 21–24 (–28) µm long . . . . .	<i>T. macrotuberculata</i>
4*	Tubercles or warts lower; spores smaller . . . . .	5
5	Tubercles 1–2.5 µm high, conical, with subacute or blunt tip, (3–) 4–6 (–8) per spore diam.; spores 15–21 (–23) µm long . . . . .	<i>T. tuberculata</i>
5*	Warts 1.5–2.5 µm high, irregularly polyangular, with a flattened tip, 6–8 per spore diam.; spores 18.5–26.5 µm long . . . . .	<i>T. microtuberculata</i>
6	Spores 29–36 (–38) µm long (muri 2–4 µm high) . . . . .	<i>T. muhlenbergiae</i>
6*	Spores smaller. . . . .	7
7	Spores 24–30 (–34) µm long (muri 1.5–2.5 µm high) . . . . .	<i>T. asperifolioides</i>
7*	Spores smaller. . . . .	8
8	Spores 21–26 (–27) µm long (muri 2–3 (–4) µm high) . . . . .	<i>T. pachyderma</i>
8*	Spores <i>ca</i> 19–24 µm long . . . . .	9
9	Spores incompletely, irregularly reticulate, in SEM cerebriform . . . . .	<i>T. montana</i>
9*	Spores clearly reticulate, in SEM not cerebriform . . . . .	10
10	Meshes 6–8 per spore diam. (muri 1.5–2.5 µm high) . . . . .	<i>T. asperifolia</i>
10*	Meshes 3–5 per spore diam. . . . .	11
11	Spores 20–24 µm long, lacking sheath . . . . .	<i>T. brefeldii</i>
11*	Spores 19–24 µm long, including the 2–3 µm thick sheath . . . . .	<i>T. zonata</i>
12(1)	Sori predominantly on leaves or also on leaf sheaths forming pustules or striae. . . . .	13
12*	Sori not so . . . . .	14
13	Sori on leaves forming slightly swollen striae . . . . .	<i>U. bethelii</i>
13*	Sori on leaves and sheaths forming bullate pustules or sausage-shaped striae. . . . .	<i>U. buchloës</i>
14	Sori in spikelets . . . . .	15
14*	Sori comprising the distal part of the shoots or the inflorescence . . . . .	18
15	Spores with a darker band . . . . .	16
15*	Spores without a darker band . . . . .	17
16	Spores 5.5–7 (–8) µm long, in LM verrucose . . . . .	<i>U. circumdata</i>
16*	Spores 6–9 µm long, in LM smooth . . . . .	<i>U. sonoriana</i>
17	Spores 11–14.5 (–15) µm long; spore wall unevenly thick . . . . .	<i>Spor. ustilaginiforme</i>
17*	Spores 5.5–9 µm long, paler and flattened on one side . . . . .	<i>U. mexicana</i>
18	Columella present; spores up to 15 µm long. . . . .	19
18*	Columella absent; spores 5–6.5 µm long . . . . .	20
19	Columella one, stout; spores echinulate . . . . .	<i>Spor. montaniense</i>



- 19\* Columellae 8–12, filiform; spores verruculose . . . . . *Spor. parodii*  
 20 Spores finely, rather densely punctate . . . . . *U. mühlenbergiae*  
 20\* Spores evidently verrucose-echinulate . . . . . *U. hyalinobipolaris*

**Key to the smut fungi of *Neurachne* and *Paraneurachne* (*Neurachninae*)**

- 1 The fungus produces witches' brooms; peridium and spore balls present. On *Paraneurachne* . . . . . *Spor. paraneurachnis*  
 1\* Witches' brooms, peridium and spore balls absent. On *Neurachne* . . . . . 2  
 2 Spores (6.5–) 7–9 (–9.5)  $\mu\text{m}$  long, verrucose . . . . . *U. neurachnis*  
 2\* Spores 13–17 (–18.5)  $\mu\text{m}$  long, echinulate . . . . . *U. tepperi*

**Key to the smut fungi of *Opizia*, see *Aegopogon***

**Key to the smut fungi of *Oropetium*, see *Tripogon***

**Key to the smut fungi of *Panicum* (incl. *Thrasya*)**

- 1 Spores associated with Y-shaped conidia . . . . . *Conidiosporomyces ayresii*  
 1\* Spores not associated with conidia . . . . . 2  
 2 Sori as dark spots on the leaves; spores embedded in the host tissue . . . . . 3  
 2\* Sori and spores not so . . . . . 4  
 3 Spores 8–14 (–16)  $\mu\text{m}$  long, wall 1–3  $\mu\text{m}$  thick . . . . . *Eballistra brachiariae*  
 3\* Spores 6–15 (–20)  $\mu\text{m}$  long, wall 1–2  $\mu\text{m}$  thick . . . . . "*Entyloma*" *speciosum*  
 4 Sori forming witches' brooms and/or swellings on stems . . . . . 5  
 4\* Sori not so . . . . . 7  
 5 Spores on the surface of congested leaves, reticulate, 17–24  $\mu\text{m}$  long . . . . . *T. tumefaciens*  
 5\* Spores in bullate swellings, subepidermal, verrucose or finely echinulate, smaller . . . . . 6  
 6 Spores extremely irregular, 7–13.5 (–17.5)  $\mu\text{m}$  long . . . . . *U. perirregularis*  
 6\* Spores rather regular, 5.5–11 (–12)  $\mu\text{m}$  long . . . . . *U. ignota*  
 7 Sori on the surface of distal internodes . . . . . *Tranzscheliella hypodytes*  
 7\* Sori not so . . . . . 8  
 8 Sori in the ovaries; spores over 15  $\mu\text{m}$  long . . . . . 9  
 8\* Sori in various parts of the host; spores less than 15  $\mu\text{m}$  long . . . . . 19  
 9 Sori in all ovaries of an inflorescence . . . . . *T. maclaganii*  
 9\* Sori in some ovaries of an inflorescence . . . . . 10  
 10 Sori much hypertrophied, up to 20 mm long, hispid . . . . . *T. vittata*  
 10\* Sori only little or not hypertrophied, up to 5 mm long, not hispid . . . . . 11  
 11 Spores reticulate . . . . . 12  
 11\* Spores otherwise ornamented . . . . . 14  
 12 Spores 25–29  $\mu\text{m}$  long . . . . . *T. mexicana*  
 12\* Spores up to 26  $\mu\text{m}$  long . . . . . 13  
 13 Meshes per spore diam. 3–5, muri 1.5–2.5  $\mu\text{m}$  high . . . . . *T. courtetiana*  
 13\* Meshes per spore diam. 4–6, muri 1–1.5  $\mu\text{m}$  high . . . . . *T. narasimhanii*  
 14 Spores with long, filiform warts, agglutinated into groups . . . . . *T. narayanaraoana*  
 14\* Spores with coarser, acute, blunt or flattened warts, not agglutinated into groups . . . . . 15  
 15 Spores 20–29.5  $\mu\text{m}$  long . . . . . *T. pulcherrima*  
 15\* Spores smaller, between 16 and 27  $\mu\text{m}$  long . . . . . 16  
 16 Spores very pale, warts acute, coarse, pyramidal, 19–25 on the spore circumference . . . . . *T. verrucosa*

16*	Spores not very pale, spines not pyramidal, more on the circumference . . . . .	17
17	Warts 1–1.5 (–2) $\mu\text{m}$ high, 9–13 per spore diameter, 30–50 on the spore circumference . . . . .	<i>T. biharica</i>
17*	Warts higher, less per spore diameter and on the circumference . . . . .	18
18	Warts coarse, blunt, 1.5–3 $\mu\text{m}$ high, 5–10 per spore diameter, 21–30 on the spore circumference . . . . .	<i>T. banarasiae</i>
18*	Warts narrower, acute, subacute or flattened, 1.5–2.5 $\mu\text{m}$ high, 7–12 per spore diameter, 26–37 on the spore circumference . . . . .	<i>T. panici-humilis</i>
19(8)	Sori as striae on leaves or also in distorted inflorescence; spores 4–7 $\mu\text{m}$ long . . . . .	20
19*	Sori not so; spores larger . . . . .	21
20	Sori on leaves as long, pale brown striae . . . . .	<i>U. filiformis</i>
20*	Sori in upper leaves as long, dark striae, but also in distorted inflorescence . . . . .	<i>U. trebouxi</i>
21	Sori in the whole inflorescence, or in leaves on top of sterile shoots . . . . .	22
21*	Sori in spikelets, flowers or ovaries . . . . .	33
22	Sori on the top of sterile shoots, in leaves or leaf sheaths. . . . .	23
22*	Sori in the whole inflorescence . . . . .	26
23	Spore balls present . . . . .	<i>Spor. panici-leucophaei</i>
23*	Spore balls absent . . . . .	24
24	Spores 7.5–9.5 $\mu\text{m}$ long, finely, densely punctate . . . . .	<i>U. panici-prolifici</i>
24*	Spores 11–15 $\mu\text{m}$ long, echinulate . . . . .	25
25	Sori in hypertrophied leaves, no peridium; spines 0.5–0.8 $\mu\text{m}$ high . . . . .	<i>U. panici-virgati</i>
25*	Sori on base of peduncles and leaf sheaths, peridium hispid; spines ca 0.5 $\mu\text{m}$ high . . . . .	<i>U. vastatoria</i>
26	Spores between 8–14 $\mu\text{m}$ long . . . . .	27
26*	Spores smaller. . . . .	32
27	Spores with several lighter areas . . . . .	<i>Spor. hodsonii</i>
27*	Spores lighter only on one side or uniformly pigmented. . . . .	28
28	Spores lighter on one side, where the spore wall is thinner . . . . .	29
28*	Spores uniformly pigmented, wall even or slightly unevenly thick . . . . .	30
29	Sori globose, 3–5 mm long, with an acute tip; spores finely verrucose-echinulate. . . . .	<i>Spor. vesiculosum</i>
29*	Sori elongate, 3–10 cm long; spores minutely punctate-verruculose . . . . .	<i>U. panici-petrosi</i>
30	Spores in LM smooth . . . . .	<i>Spor. destruens</i>
30*	Spores in LM ornamented . . . . .	31
31	Spores 8–12 $\mu\text{m}$ long, densely punctate-verruculose . . . . .	<i>Spor. scheffleri</i>
31*	Spores 9–13 (–14.5) $\mu\text{m}$ long, densely low echinulate . . . . .	<i>Spor. panicicola</i>
32	Spores 5.5–7 $\mu\text{m}$ long, nearly smooth to finely, sparsely punctate. . . . .	<i>Spor. formosanum</i>
32*	Spores 6.5–9.5 $\mu\text{m}$ long, finely, densely punctate-verruculose. . . . .	<i>Spor. tanganyikeanum</i>
33(21)	Sori in some spikelets, flowers or ovaries of an inflorescence . . . . .	34
33*	Sori in all spikelets, flowers or ovaries of an inflorescence . . . . .	39
34	Sori in some spikelets or flowers of an inflorescence . . . . .	35
34*	Sori in some ovaries of an inflorescence . . . . .	37
35	Sori horn-shaped or cylindrical, 5–40 mm long; spores prominently echinulate. . . . .	<i>Mac. pretoriensis</i>
35*	Sori globose to ovoid, 1–2 mm long; spores finely verrucose-echinulate. . . . .	36
36	Columella and sterile cells present; spores 5.5–9.5 (–12) $\mu\text{m}$ long . . . . .	<i>Spor. panici-hirticaulis</i>
36*	Columella and sterile cells absent; spores 8–13 $\mu\text{m}$ long. . . . .	<i>U. togata</i>
37	Spore balls permanent, composed of spores and sterile cells . . . . .	<i>Moesziomyces bullatus</i>
37*	No true spore balls present; spores mixed with sterile cells . . . . .	38
38	Sterile cells 11–17 $\mu\text{m}$ long . . . . .	<i>Mac. sharmae</i>

38*	Sterile cells 6–11 µm long . . . . .	<i>Mac. spermophorus</i>
39(33)	Sori globoid, 1–1.5 mm in diam., with acute tip . . . . .	<i>Mac. panici</i>
39*	Sori not so . . . . .	40
40	Sori 1–15 mm long; spores 8–10.5 µm long, often mamillate . . . . .	<i>Spor. cryptum</i>
40*	Sori 1.5–4 (–5) mm long; spores larger, not mamillate . . . . .	41
41	Spores punctate-verruculose to echinulate . . . . .	42
41*	Spores apparently smooth to finely punctate-verruculose . . . . .	43
42	Spores 11–14 µm long, prominently low echinulate . . . . .	<i>Spor. panici-fasciculati</i>
42*	Spores 8.5–13 µm long; wall 0.5–0.8 µm thick, finely echinulate . . . . .	<i>Spor. magnusianum</i>
43	Columellae 3; spores 9–12 (–13) µm long; wall <i>ca</i> 0.5 µm thick, in LM smooth . . . . .	<i>Spor. spgazzinii</i>
43*	Columella 1; spores 8.5–14.5 µm long; wall 0.4–1 µm thick, in LM finely punctate . . . . .	<i>Spor. nyalalandicum</i>

**Key to the smut fungi of *Pappophorum*, see *Enneapogon***

**Key to the smut fungi of *Parapholis*, see *Lepturus***

**Key to the smut fungi of *Paspalum***

1	Sori in the ovaries . . . . .	2
1*	Sori in the spikelets, racemes or inflorescence . . . . .	3
2	Spores 18.5–26 µm long, single . . . . .	<i>T. rugispora</i>
2*	Spores 7–13 µm long, forming permanent spore balls . . . . .	<i>Moesziomyces bullatus</i>
3	Sori in the whole inflorescence . . . . .	4
3*	Sori in the racemes or spikelets . . . . .	6
4	Spores 10.5–20 µm long, punctate-verruculose . . . . .	<i>Spor. paspali-thunbergii</i>
4*	Spores 12–16 µm long . . . . .	5
5	Spores echinulate . . . . .	<i>U. holwayana</i>
5*	Spores smooth . . . . .	<i>U. paspali-dilatati</i>
6	Sori in the racemes; sterile cells present; spores 6–9.5 µm long . . . . .	<i>Spor. paspali</i>
6*	Sori in the spikelets; sterile cells absent . . . . .	7
7	Spores 13.5–20 µm long . . . . .	<i>U. schroeteriana</i>
7*	Spores 7–9 µm long . . . . .	<i>U. venezuelana</i>

**Key to the smut fungi of *Pennisetum* (incl. *Beckeropsis*)**

1	Sori restricted to the ovaries . . . . .	2
1*	Sori not restricted to the ovaries . . . . .	8
2	Spores single . . . . .	3
2*	Spores forming spore balls . . . . .	6
3	Spores smaller than 13.5 µm long . . . . .	4
3*	Spores larger than 13 µm long . . . . .	5
4	Spores 6.5–13.5 µm long, often kidney-shaped; sterile cells absent . . . . .	<i>U. penniseti-purpurei</i>
4*	Spores 9.5–12 (–13) µm long, not kidney-shaped; sterile cells present . . . . .	<i>Mac. tilletioides</i>
5	Sori evident, swollen, obovoid; spores 22.5–29 µm long . . . . .	<i>T. barclayana</i>
5*	Sori inconspicuous, filiform; spores 13–24 µm long . . . . .	<i>T. filisora</i>
6	Spores in the balls mixed with sterile cells; columella absent . . . . .	<i>Moesziomyces bullatus</i>
6*	Spores in the balls not mixed with sterile cells; columella present . . . . .	7
7	Columella one, short; spores all alike, 8–11 (–12) µm long, smooth . . . . .	<i>Spor. tothii</i>

7*	Columellae several, filiform; spores dimorphic, 9.5–15 µm long, outer spores verrucose . . . . .	<i>Spor. ebrenbergii</i>
8(1)	Sori on the leaves or leaf sheaths . . . . .	9
8*	Sori not on the leaves . . . . .	10
9	Sori on the inner surface of leaf sheaths; spores 6.5–10.5 (–11) µm long . . . . .	<i>U. bahuichivoensis</i>
9*	Sori as striae on leaves and leaf sheaths; spores 9–15 (–16) µm long . . . . .	<i>U. striiformis</i>
10	Sori destroying the whole inflorescence . . . . .	11
10*	Sori restricted to the spikelets . . . . .	14
11	Spores 5.5–7.5 µm long, paler on one side . . . . .	<i>Spor. sphacelatum</i>
11*	Spores larger, not paler on one side . . . . .	12
12	Spores 10–14.5 (–16) µm long, when mature single . . . . .	<i>Spor. pennisetinum</i>
12*	Spores 8–12 (–13) µm long, in spore balls . . . . .	13
13	Spore balls (25–) 40–80 (–100) µm long, spores slightly dimorphic . . . . .	<i>Spor. cenchri</i>
13*	Spore balls 30–130 (–150) µm long; spores not dimorphic . . . . .	<i>Spor. penniseticola</i>
14	Columella and spore balls absent . . . . .	15
14*	Columella and spore balls present . . . . .	16
15	Sori filiform, 3–7 in each spikelet; spores (8–) 9.5–12 (–13.5) µm long . . . . .	<i>Mac. flaccidus</i>
15*	Sori not so; spores 6.5–8 µm long . . . . .	<i>U. kamerunensis</i>
16	Plants stunted, forming witches' brooms; spores 7–11 µm long . . . . .	<i>Spor. dubiosum</i>
16*	Plants not so; spores larger . . . . .	17
17	Columella one, stout; spores (9–) 10–13.5 (–14.5) µm long . . . . .	<i>Spor. penniseti</i>
17*	Columellae several . . . . .	18
18	Spores 9–12 µm long . . . . .	<i>Spor. divisum</i>
18*	Spores 12–16 µm long . . . . .	<i>Spor. penniseti-japonici</i>

Key to the smut fungi of *Pholiurus*, see *Lepturus*

Key to the smut fungi of *Phragmites*

1	Sori on the surface of the leaves as dark brown, powdery cover . . . . .	<i>T. nigrifaciens</i>
1*	Sori not so . . . . .	2
2	Sori surrounding the culms . . . . .	<i>U. grandis</i>
2*	Sori in the ovaries or inner floral organs . . . . .	3
3	Sori in the ovaries; spores 17–32 µm long, with a long, hyaline appendage . . . . .	<i>Neovossia molinia</i>
3*	Sori in the inner floral organs; spores smaller, without appendage . . . . .	4
4	Sori pubescent; spores 5.5–9.5 (–11) µm long . . . . .	<i>U. mauritiana</i>
4*	Sori not pubescent; spores 8–13.5 µm long . . . . .	<i>U. phragmitis</i>

Key to the smut fungi of *Polytoca*, see *Chionachne*

Key to the smut fungi of *Rottboellia*, see *Lepturus*

Key to the smut fungi of *Rhynchelytrum*, see *Melinis*

Key to the smut fungi of *Rhynchospora*

1	Spores forming firm spore balls . . . . .	2
1*	Spores single or in loose spore balls . . . . .	7
2	Spore balls composed of spores only . . . . .	3
2*	Spore balls composed of sterile cells surrounded by spores . . . . .	5

3	Spores apparently smooth; spore balls of 1–20 (–?25) spores . . . . .	<i>Moreaua fischeri</i>
3*	Spores evidently ornamented; spore balls of up to 35–50 spores . . . . .	4
4	Spore balls irregular, mainly 25–40 $\mu\text{m}$ long, composed of (1–) 4–25 (–?35) subglobose, hemispherical or subpolyhedral spores . . . . .	<i>Moreaua rhynchosporae-cephalotis</i>
4*	Spore balls more regular, mainly 30–45 $\mu\text{m}$ long, composed of (6–) 10–30 (–?50), mainly subcuneiform spores . . . . .	<i>Moreaua rhynchosporae</i>
5	Sori up to 20 mm long; spore balls 75–320 (–350) $\mu\text{m}$ long; spore wall 1–3 $\mu\text{m}$ thick; sterile cells polyhedral . . . . .	<i>Testicularia cyperi</i>
5*	Sori smaller; spore balls 50–110 $\mu\text{m}$ long; spore wall 0.5–1 $\mu\text{m}$ thick; sterile cells globoid or ellipsoidal . . . . .	6
6	Spores 11–21.5 (–25) $\mu\text{m}$ long . . . . .	<i>Testicularia minor</i>
6*	Spores 11.5–14.5 $\mu\text{m}$ long . . . . .	<i>Testicularia africana</i>
7(1)	Sori in some spikelets in the inflorescence, surrounded by a thick, sack-like, fungal peridium filled by powdery spore masses . . . . .	8
7*	Sori not so, spore masses agglutinated . . . . .	10
8	Long sterile fungal cells between the spores present; spore wall not separated into two layers . . . . .	<i>Trichocintractia utriculicola</i>
8*	No sterile fungal cells between the spores; spore wall separated into two layers by a hyaline, gelatinous mass . . . . .	9
9	Spores 20–28 $\mu\text{m}$ long . . . . .	<i>Kuntzeomyces ruizianae</i>
9*	Spores 24–35 $\mu\text{m}$ long . . . . .	<i>Kuntzeomyces ustilaginoideus</i>
10(7)	Sori around floral pedunculi or around the stems, cylindrical, several cm long . . . . .	11
10*	Sori in the spikelets, a few mm long . . . . .	14
11	Sori surrounding all the peduncles of an inflorescence . . . . .	12
11*	Sori surrounding the culms . . . . .	13
12	Spores (11–) 12–16 (–17) $\mu\text{m}$ long; wall 0.5–1 $\mu\text{m}$ thick . . . . .	<i>Leucocintractia scleriae</i>
12*	Spores 20–28 $\mu\text{m}$ long; wall 2.5–5 $\mu\text{m}$ thick . . . . .	<i>Leucocintractia pachyderma</i>
13	Spore wall 1–2.5 $\mu\text{m}$ thick, with 5–8 parallel ridges . . . . .	<i>Leucocintractia leucoderma</i>
13*	Spore wall (1–) 1.5–2.5 (–3) $\mu\text{m}$ thick, with 8–10 parallel ridges . . . . .	<i>Leucocintractia portus-argenti</i>
14(10)	Mature sori agglutinated, with powdery surface; spores single, finely verruculose, without a hyaline appendage . . . . .	<i>Cintractia amazonica</i>
14*	Mature sori powdery; spores single or in balls; commonly foveolate, often with a hyaline appendage . . . . .	15
15	Only groups of spikelets in the inflorescence infected, appearing as small witches' brooms . . . . .	16
15*	All spikelets in the inflorescence infected, no witches' brooms . . . . .	19
16	Spores 9.5–12 $\mu\text{m}$ long, transversally deeply impressed appearing as folded, densely, minutely, verruculose, no appendage . . . . .	<i>Ustanc. farlowii</i>
16*	Spores larger, not folded, otherwise ornamented, with one appendage . . . . .	17
17	Spores 16–27 $\mu\text{m}$ long, with coarse, rounded warts . . . . .	<i>Ustanc. nova-guineae</i>
17*	Spores smaller, foveolate . . . . .	18
18	Spores 13–19 (–20) $\mu\text{m}$ long, appendage conical, 5–7 (–8) $\mu\text{m}$ high . . . . .	<i>Ustanc. conophorum</i>
18*	Spores 13.5–17.5 $\mu\text{m}$ long, appendage ovoid, 4–5 $\mu\text{m}$ high . . . . .	<i>Ustanc. standleyanum</i>
19(15)	Spores in more or less loose spore balls . . . . .	20
19*	Spores single . . . . .	22
20	Spores 9.5–15 (–16) $\mu\text{m}$ long; spore wall 0.5–1 (–1.5) $\mu\text{m}$ thick . . . . .	<i>Ustanc. virginianum</i>
20*	Spores larger; spore wall thicker . . . . .	21
21	Spores extremely irregular, often bent and with acute tips, 14–22 (–25) $\mu\text{m}$ long, medium reddish brown; spore wall 1–1.5 (–3) $\mu\text{m}$ thick . . . . .	<i>Ustanc. rhynchosporae</i>
21*	Spores less irregular, usually with blunt angles, (12–) 13.5–20 (–21.5) $\mu\text{m}$ long, dark reddish brown; spore wall 1–3 $\mu\text{m}$ thick . . . . .	<i>Ustanc. cubense</i>

22	Spores with two, 3.5–6.5 $\mu\text{m}$ high appendages . . . . .	<i>Ustanc. appendiculatum</i>
22*	Spores with shorter appendages or appendages lacking . . . . .	23
23	Spore wall 1–2.5 $\mu\text{m}$ thick, with few, deep foveolae only on the circumference . . . . .	<i>Ustanc. psilocaryae</i>
23*	Spore wall thinner, foveolae not so . . . . .	24
24	Spore wall 0.5–2 $\mu\text{m}$ thick . . . . .	25
24*	Spore wall up to 1 $\mu\text{m}$ thick . . . . .	26
25	Spores 12–17 $\mu\text{m}$ long, sparsely deep foveolate; spore wall often with wart-like thickenings . . . . .	<i>Ustanc. ekmanii</i>
25*	Spores 15–21 $\mu\text{m}$ long, very finely, irregularly, verruculose foveolate; spore wall without wart-like thickenings . . . . .	<i>Ustanc. gigantosporum</i>
26	Spores (12–) 13–17.5 (–19) $\mu\text{m}$ long, with two, often inconspicuous appendages . . . . .	<i>Ustanc. eximium</i>
26*	Spores smaller, appendage one or lacking . . . . .	27
27	Spores 9–13 (–14) $\mu\text{m}$ long . . . . .	<i>Ustanc. montagnei</i> s. lat.
27*	Spores (11–) 12–17 $\mu\text{m}$ long . . . . .	<i>Ustanc. majus</i> s. lat.

Key to the smut fungi of *Rhynchaceae*, see *Coelorachis*

Key to the smut fungi of *Saccharum*, *Imperata* and *Miscanthus*

1	Sori in the whole inflorescence . . . . .	2
1*	Sori in the ovaries (and flowers) . . . . .	5
2	Spores 3.5–6.5 $\mu\text{m}$ long . . . . .	<i>Spor. kusanoi</i>
2*	Spores larger . . . . .	3
3	Spores 6.5–8 (–10) $\mu\text{m}$ long . . . . .	<i>U. scitaminea</i>
3*	Spores 14–20 $\mu\text{m}$ long . . . . .	4
4	Spore wall uniform, 0.5–1 $\mu\text{m}$ thick, smooth . . . . .	<i>U. imperatae</i>
4*	Spore wall uneven, 1–1.5 $\mu\text{m}$ thick, verruculose . . . . .	<i>Spor. assamicum</i>
5	Sori in a few ovaries of an inflorescence; spores large, up to 21 $\mu\text{m}$ long . . . . .	6
5*	Sori in all ovaries of an inflorescence; spores smaller, up to 14 $\mu\text{m}$ long . . . . .	7
6	Spores 13–21.5 $\mu\text{m}$ long, smooth . . . . .	<i>U. gigaspora</i>
6*	Spores 11.5–16 (–18.5) $\mu\text{m}$ long, densely echinulate . . . . .	<i>Spor. macrosporum</i>
7	Spores finely punctate-verruculose; spore profile smooth . . . . .	8
7*	Spores finely verrucose-echinulate; spore profile serrulate . . . . .	10
8	Spores 5–9 (–10) $\mu\text{m}$ long . . . . .	<i>Spor. erianthi</i>
8*	Spores larger . . . . .	9
9	Spores 7–11 (–12) $\mu\text{m}$ long . . . . .	<i>Spor. sacchari</i>
9*	Spores 11–14 $\mu\text{m}$ long . . . . .	<i>Spor. schweinfurthianum</i>
10	Spores 8.5–11 $\mu\text{m}$ long . . . . .	<i>Spor. microthelis</i>
10*	Spores 9.5–13 (–14) $\mu\text{m}$ long . . . . .	<i>Spor. pulverulentum</i>

Key to the smut fungi of *Sarga*, see *Sorghum*

Key to the smut fungi of *Schizachyrium*, see *Andropogon*

Key to the smut fungi of *Schmidtia*, see *Enneapogon*

Key to the smut fungi of *Schoenus*

1	Spores single . . . . .	2
1*	Spores in balls . . . . .	3

2	Spore wall unevenly 1–4 µm thick, light-refractive spots common . . . . .	<i>Anthracoidea schoenus</i>
2*	Spore wall evenly or slightly unevenly 1–2.5 µm thick, light-refractive spots absent . . . . .	<i>Anthracoidea andina</i>
3	Spore balls loose, of (1–) 2–15 spores . . . . .	<i>Tolyposporium solidum</i>
3*	Spore balls compact, permanent . . . . .	4
4	Spore balls 60–150 µm long, spores 12–35 µm long . . . . .	<i>Mor. schoeni</i>
4*	Spore balls up to 85 µm long, spores up to 25 µm long . . . . .	5
5	Spore balls of (2–) 10–50 or more spores . . . . .	<i>Mor. kochiana</i>
5*	Spore balls of 40–100 or more spores . . . . .	<i>Mor. laevigata</i>

#### Key to the smut fungi of *Sebima*

1	Sori in the leaves as dark spots; spores embedded in the host tissue, not pulverulent. . . . .	<i>Jamesdicksonia dactylidis</i>
1*	Sori not in the leaves; spores pulverulent . . . . .	2
2	Sori in the ovaries; spores up to 30 or 37 µm long . . . . .	3
2*	Sori not in the ovaries; spores smaller . . . . .	4
3	Spores 30–37 µm long . . . . .	<i>T. sehimatis</i>
3*	Spores 21–30 µm long . . . . .	<i>T. sehimicola</i>
4	Sori partially or totally destroying the inflorescence, several cm long . . . . .	5
4*	Sori restricted to the spikelets, less than 1.5 cm long . . . . .	6
5	Sori destroying the whole inflorescence; spores 5.5–10 µm long. . . . .	<i>Spor. queenslandicum</i>
5*	Sori usually destroying the proximal part of the inflorescence; spores 8.5–11 (–12) µm long . . . . .	<i>Spor. mandlaicum</i>
6	Spore balls ephemeral; sterile cells present . . . . .	<i>Spor. sehimicola</i>
6*	Spore balls rather persistent; sterile cells absent . . . . .	7
7	Sori in some sessile spikelets; columellae 5–7; spore balls 50–160 (–200) µm long . . . . .	<i>Spor. sehimatis</i>
7*	Sori in all sessile and pedicelled spikelets; columella 1; spore balls smaller. . . . .	8
8	Spore balls 30–70 (–100) µm long; spore wall uneven, 1–2 (–2.5) µm thick, free surface finely punctate. . . . .	<i>Spor. sulcati</i>
8*	Spore balls 25–50 (–55) µm long; spore wall even, 0.5–0.8 µm, free surface coarsely verruculose. . . . .	<i>Spor. nervosum</i>

#### Key to the smut fungi of *Setaria*

1	Sori on the leaves . . . . .	2
1*	Sori not on the leaves . . . . .	4
2	Sori forming dark brown striae; spores powdery . . . . .	<i>U. striiformis</i>
2*	Sori forming lead-coloured spots or confluent striae; spores not powdery . . . . .	3
3	Spores 6–15 (–20) µm long; spore wall 1–2 µm thick . . . . .	<i>Jamesdicksonia dactylidis</i>
3*	Spores 9.5–16.5 µm long; spore wall 1–3 (–4) µm thick . . . . .	“ <i>Entyloma</i> ” <i>speciosum</i>
4(1)	Sori in the distal part of sterile shoots, up to 7 cm long . . . . .	5
4*	Sori in the ovaries or spikelets, much shorter . . . . .	6
5	Spore balls present; spores 5–6 (–6.5) µm long. . . . .	<i>Spor. kenyanum</i>
5*	Spore balls absent; spores 7.5–9.5 µm long. . . . .	<i>U. panici-proliferi</i>
6	Conidia present between the spores; sori sack-like, opened . . . . .	7
6*	Conidia absent between the spores; sori not so . . . . .	9
7	Spore mass grey to pale chestnut-brown; immature spores and conidia between the spores abundant . . . . .	8
7*	Spore mass reddish-brown; immature spores and conidia relatively few; spores coarsely conical-echinulate. . . . .	<i>Conidiosporomyces verruculosus</i>
8	Spores 13–17 µm long, predominantly verrucose or verrucose-echinulate, warts 1–2 µm high, often flattened. . . . .	<i>Conidiosporomyces ayresii</i>

8*	Spores (14.5–) 16–20 (–23) $\mu\text{m}$ long, predominantly filamentously verrucose, warts 1.5–3 (–5) $\mu\text{m}$ high . . . . .	<i>Conidiosporomyces echinospermus</i>
9(6)	Spores over 13 $\mu\text{m}$ long . . . . .	10
9*	Spores less than 13 $\mu\text{m}$ long . . . . .	17
10	Sori pubescent . . . . .	11
10*	Sori smooth to rough, not pubescent . . . . .	12
11	Spores reticulate, 18–23 $\mu\text{m}$ long . . . . .	<i>T. setariicola</i>
11*	Spores finely, densely verrucose, 13–18 $\mu\text{m}$ long. . . . .	<i>T. zundelii</i>
12	Spores 13–19 (–22) $\mu\text{m}$ long; warts <i>ca</i> 1 $\mu\text{m}$ high, blunt . . . . .	<i>T. thirumalacharii</i>
12*	Spores larger; warts higher . . . . .	13
13	Spores 16–24 $\mu\text{m}$ long; warts delicate, 2–4 $\mu\text{m}$ high, subacute . . . . .	<i>T. setariae-palmifoliae</i>
13*	Spores larger . . . . .	14
14	Spores 18.5–25 (–26) $\mu\text{m}$ long; warts 1.5–2.5 $\mu\text{m}$ high, cylindrical or subpyramidal, with a flattened or rounded tip, 6–11 per spore diam. . . . .	<i>T. setariae-pumilae</i>
14*	Spores larger . . . . .	15
15	Spores 22.5–28 $\mu\text{m}$ long; warts delicate, acute, 1.5–2.5 $\mu\text{m}$ high, 11–17 per spore diam. . . . .	<i>T. setariae-viridis</i>
15*	Spores larger . . . . .	16
16	Spores 20–30 (–33) $\mu\text{m}$ long; warts subconical or cylindrical, 1.5–3 $\mu\text{m}$ high, 8–13 per spore diam.; hyaline sheath present . . . . .	<i>T. setariae</i>
16*	Spores 24–32 $\mu\text{m}$ long; warts cylindrical, 2–4 $\mu\text{m}$ high, 6–8 (–9) per spore diam.; hyaline sheath absent. . . . .	<i>T. setariae-parviflorae</i>
17(9)	Columellae several; spores dimorphic . . . . .	<i>Spor. setariae</i>
17*	Columella one or lacking; spores not dimorphic. . . . .	18
18	Sori bullate at their basal part; spores smooth . . . . .	<i>U. crameri</i>
18*	Sori not bullate; spores ornamented . . . . .	19
19	Sori hispid . . . . .	<i>U. trichogena</i>
19*	Sori not hispid . . . . .	20
20	Sori in some ovaries or spikelets of an inflorescence . . . . .	21
20*	Sori in all ovaries or spikelets of an inflorescence . . . . .	24
21	Spores 6–9 $\mu\text{m}$ long . . . . .	22
21*	Spores larger . . . . .	23
22	A short, stout columella present; spores sparsely echinulate . . . . .	<i>Spor. setariae-mombassanae</i>
22*	Columella absent; spores finely verrucose-echinulate . . . . .	<i>U. rickeri</i>
23	Spores 7–10.5 (–11) $\mu\text{m}$ long, finely, densely punctate-verruculose . . . . .	<i>Mac. sharmae</i>
23*	Spores 9–12 $\mu\text{m}$ long, densely echinulate . . . . .	<i>Mac. tanakae</i>
24	Spores firmly united in balls . . . . .	<i>Spor. absens</i>
24*	Spores single or in loose balls . . . . .	25
25	Columella stout, irregular, often with short apical branches . . . . .	<i>Spor. magnusianum</i>
25*	Columella short, stout, ovoid . . . . .	<i>Mac. neglectus</i>

#### Key to the smut fungi of *Sorghum* and *Sarga*

1	Spores darker on one side . . . . .	2
1*	Spores not darker on one side . . . . .	3
2	Sori in the whole inflorescence, sterile cells absent . . . . .	<i>U. porosa</i>
2*	Sori in the spikelets, sterile cells present . . . . .	<i>Spor. wynaadense</i>
3	Sori in the whole inflorescence . . . . .	4



3*	Sori in the ovaries or spikelets . . . . .	5
4	Columellae numerous; spores 10.5–14.5 $\mu\text{m}$ long . . . . .	<i>Spor. reilianum</i>
4*	Columella one; spores 4–5.5 $\mu\text{m}$ long . . . . .	<i>Spor. vermiculum</i>
5	Sori in considerably hypertrophied ovaries . . . . .	6
5*	Sori in the spikelets . . . . .	7
6	Sori cylindrical; spores in permanent balls; sterile cells absent . . . . .	<i>Spor. ehrenbergii</i>
6*	Sori obovoid; spores single; sterile cells present . . . . .	<i>Mac. ewartii</i>
7	Sori of polycystic structure . . . . .	<i>U. bulgarica</i>
7*	Sori not of polycystic structure . . . . .	8
8	Columella absent (spores 4–7.5 $\mu\text{m}$ long, verruculose) . . . . .	<i>U. kenjiana</i>
8*	Columella(-ae) present . . . . .	9
9	Columellae several, much branching, root-like . . . . .	<i>Spor. transvaalense</i>
9*	Columella one, simple or with short, apical branches . . . . .	10
10	Peridium thin, early dehiscent; spores 7.5–10 $\mu\text{m}$ long, verrucose-echinulate . . . . .	<i>Spor. cruentum</i>
10*	Peridium thick, rather persistent; spores finely verruculose . . . . .	11
11	Spores 8–11 $\mu\text{m}$ long, with a light germ pore . . . . .	<i>Spor. australasiaticum</i>
11*	Spores smaller, without evident germ pore . . . . .	12
12	Spores 5–8.5 $\mu\text{m}$ long . . . . .	<i>Spor. sorghi</i>
12*	Spores 4.5–6.5 (–7) $\mu\text{m}$ long . . . . .	<i>Spor. ryleyi</i>

#### Key to the smut fungi of *Sporobolus*

1	Sori surrounding upper internodes, naked . . . . .	2
1*	Sori elsewhere, not naked . . . . .	3
2	Spores often with small polar caps, in SEM minutely verruculose . . . . .	<i>Tranzscheliella hypodytes</i>
2*	Spores without polar caps, in SEM smooth . . . . .	<i>Tranzscheliella laevispora</i>
3	Sori in the leaves, or also in the stems . . . . .	4
3*	Sori in the ovaries, flowers or inflorescence . . . . .	9
4	Sori as lead coloured pustules or streaks; spore mass black, agglutinated . . . . .	5
4*	Sori not so; spore mass more or less pulverulent . . . . .	7
5	Spore wall 0.5–3 (–3.5) $\mu\text{m}$ thick, with very low tubercles; exospore subhyaline to pale yellowish-brown . . . . .	<i>Jamesdicksonia major</i>
5*	Spore wall 1.5–7 (–8) $\mu\text{m}$ thick, smooth; exospore olivaceous-brown . . . . .	6
6	Sori as swollen, elongated spots or striae; spores mostly rounded-irregular, 7–19 $\mu\text{m}$ long, pale olivaceous-brown . . . . .	<i>Jamesdicksonia sporoboli</i>
6*	Sori rounded or ellipsoidal; spores mostly elongated-irregular, 11–20 (–28) $\mu\text{m}$ long, dark olivaceous-brown . . . . .	<i>Jamesdicksonia tremuli</i>
7	Sori as bullate striae; spores 7–11.5 $\mu\text{m}$ long . . . . .	<i>U. sporoboli-indici</i>
7*	Sori on the basal part of uppermost leaves, swollen or bullate . . . . .	8
8	Spores 8–13 $\mu\text{m}$ long . . . . .	<i>U. deformis</i>
8*	Spores 14.5–19 (–20) $\mu\text{m}$ long . . . . .	<i>U. sporoboli-tremuli</i>
9(3)	Sori in the whole inflorescence . . . . .	10
9*	Sori in the flowers or ovaries . . . . .	11
10	Peridium, columella, spore balls present; spores densely, finely punctate-verruculose . . . . .	<i>Spor. sabarianum</i>
10*	Peridium, columella, spore balls absent; spores evidently echinulate . . . . .	<i>U. vilfae</i>
11	Sori in the flowers; columella and spore balls present . . . . .	<i>Spor. hwangense</i>
11*	Sori in the ovaries; columella and spore balls absent . . . . .	12

- 12 Spores 5–7 (–8)  $\mu\text{m}$  long, in LM smooth . . . . . *U. peruviana*
- 12\* Spores larger, ornamented. . . . . 13
- 13 Sterile cells absent; spores 9–11 (–12)  $\mu\text{m}$  long, finely verruculose; spore profile almost smooth. . . . . *U. utahensis*
- 13\* Sterile cells usually present; spores of various sizes, evidently to coarsely ornamented; spore profile serrulate or serrate . . . . . 14
- 14 Spores up to 25  $\mu\text{m}$  long . . . . . 15
- 14\* Spores less than 16  $\mu\text{m}$  long . . . . . 16
- 15 Sori in some ovaries of an inflorescence; spores 16–21  $\mu\text{m}$  long, with blunt, 1.5–2.5  $\mu\text{m}$  high warts . . . . . *T. sporoboli*
- 15\* Sori in all ovaries of an inflorescence; spores 20–25  $\mu\text{m}$  long, reticulate . . . . . *T. asperifolia*
- 16 Spores finely, moderately densely verrucose-echinulate . . . . . *Mac. spermophorus*
- 16\* Spores with coarse spines . . . . . 17
- 17 Spines densely situated, broadly conical, 1–2 (–2.5)  $\mu\text{m}$  high . . . . . *Mac. sporoboli*
- 17\* Spines sparsely situated, lower . . . . . 18
- 18 Spores 7.5–11.5  $\mu\text{m}$  long; spines 0.4–0.8  $\mu\text{m}$  high, in SEM composed of numerous, convergent filaments, united into a compact distal part with acute tip . . . . . *Mac. spinulosus*
- 18\* Spores 9–12  $\mu\text{m}$  long; spines 0.5–1.2  $\mu\text{m}$  high, in SEM compact, not composed of filaments . . . . . *Mac. viridans*

#### Key to the smut fungi of *Stenotaphrum*

- 1 Sori on the leaves and stems . . . . . (?) *U. stenotaphri*
- 1\* Sori in the flowers. . . . . 2
- 2 Sori in the whole inflorescence; columella present . . . . . *Spor. henningsii*
- 2\* Sori not comprising the whole inflorescence; columella absent . . . . . 3
- 3 Sori comprise the spikelets; spores finely punctate . . . . . *U. affinis*
- 3\* Sori in the filaments; spores punctate-verruculose. . . . . *U. bouriquetii*

#### Key to the smut fungi of *Stipagrostis*, see *Aristida*

#### Key to the smut fungi of *Themeda*

- 1 Spores more than 18  $\mu\text{m}$  long. . . . . 2
- 1\* Spores less than 18  $\mu\text{m}$  long . . . . . 3
- 2 Sori ovoid, 8–12 mm long; spore wall 3–4  $\mu\text{m}$  thick . . . . . *T. themedicola*
- 2\* Sori elongated, slightly curved, 10–15 mm long; spore wall 1.5–2.5  $\mu\text{m}$  thick . . . . . *T. themedae-anatherae*
- 3 Columella absent, sori globose, apiculate . . . . . *Mac. bursus*
- 3\* Columella present, sori not so . . . . . 4
- 4 Columella one . . . . . 5
- 4\* Columellae several, filiform . . . . . 13
- 5 Columella branched . . . . . 6
- 5\* Columella simple, unbranched. . . . . 8
- 6 Spores 8–12  $\mu\text{m}$  long . . . . . *Spor. lingii*
- 6\* Spores 6–9.5  $\mu\text{m}$  long. . . . . 7
- 7 Spore wall thin (ca 0.5  $\mu\text{m}$ ) . . . . . *Spor. exsertum*
- 7\* Spore wall thick (1.5–2.5  $\mu\text{m}$ ) . . . . . *Spor. exsertiformum*
- 8 Spores 5–7  $\mu\text{m}$  long (punctate). . . . . *Spor. themedicola*
- 8\* Spores larger. . . . . 9
- 9 Spores 7–11  $\mu\text{m}$  long . . . . . 10
- 9\* Spores larger. . . . . 11

10	Sori in all spikelets of an inflorescence; peridium thin; spores reddish-brown, finely punctate. . . . .	<i>Spor. centrale</i>
10*	Sori in some spikelets of an inflorescence; peridium thick; spores light brown, finely punctate-verruculose . . . . .	<i>Spor. punctatum</i>
11	Spores 9–12 µm long, verrucose-echinulate . . . . .	<i>Spor. themedae</i>
11*	Spores larger . . . . .	12
12	Spores 11–14.5 µm long, minutely echinulate; sterile cells about the size of the spores or larger; sori 10–20 mm long . . . . .	<i>Spor. benguetense</i>
12*	Spores 12.5–18 µm long, finely punctate; sterile cells smaller than the spores; sori 5–8 mm long. . . . .	<i>Spor. indehiscens</i>
13(4)	Sori comprise the whole inflorescence. . . . .	14
13*	Sori not so . . . . .	15
14	Spores 5.5–8 µm long. . . . .	<i>Spor. enteromorphum</i>
14*	Spores (7–) 8–11 (–12) µm long . . . . .	<i>Spor. langdonii</i>
15	Sori restricted to the ovaries (awn present) . . . . .	<i>Spor. anthistiriae</i>
15*	Sori comprise the spikelets (awn may be present), or the whole raceme (awn absent) . . . . .	16
16	Spores 5.5–8 µm long. . . . .	<i>Spor. enteromorphum</i>
16*	Spores larger . . . . .	17
17	Sori forming witches' brooms; spores 5.6–14 µm long . . . . .	<i>Spor. themedae-cymbariae</i>
17*	Sori not forming witches' brooms; spores 10–15 µm long . . . . .	18
18	Spore balls 20–60 µm long, rather loose, composed of (3–) 8–?35 spores . . . . .	<i>Spor. themedae-arguentis</i>
18*	Spore balls larger, rather permanent, composed of many more spores . . . . .	19
19	Spore balls 35–160 µm long, free surface of outer spores prominently echinulate. . . . .	<i>Spor. holstii</i>
19*	Spore balls 30–80 µm long, free surface of outer spores punctate-verruculose to finely echinulate . . . . .	<i>Spor. walkeri</i>

#### Key to the smut fungi of *Trachypogon*

1	Sori on the adaxial surface of the leaves . . . . .	<i>Tolyposporella puccinioides</i>
1*	Sori elsewhere. . . . .	2
2	Sori in the spikelets or in the whole inflorescence . . . . .	3
2*	Sori in the ovaries. . . . .	5
3	Sori in the spikelets; spores smooth . . . . .	<i>Spor. trachypogonis-spicati</i>
3*	Sori in the whole inflorescence; spores ornamented . . . . .	4
4	Spores irregular, finely punctate . . . . .	<i>Spor. trachypogonicola</i>
4*	Spores regular, punctate-echinulate. . . . .	<i>Spor. amphiphis</i>
5	Spores 20–30 µm long . . . . .	<i>T. trachypogonis</i>
5*	Spores smaller. . . . .	6
6	Sori in all ovaries of an inflorescence; spores 5–8 µm long, verrucose . . . . .	<i>Spor. zundelianum</i>
6*	Sori in some ovaries of an inflorescence; spores larger, echinulate . . . . .	7
7	Spores 7–16 µm long, with 1–3 µm high spines, often connected to irregular, incomplete meshes. . . . .	<i>Spor. trachypogonis</i>
7*	Spores 7–10 µm long, with 0.5–1.5 µm high, isolated tubercles or spines . . . . .	<i>Spor. trachypogonis-plumosi</i>

#### Key to the smut fungi of *Tricholaena*, see *Melinis*

#### Key to the smut fungi of *Trichopteryx*, see *Loudetia*

#### Key to the smut fungi of *Tripogon*, *Leptochloa* and *Oropetium*

1	Sori in the ovaries. . . . .	2
1*	Sori elsewhere. . . . .	6

2	Spores up to 25–28 $\mu\text{m}$ long . . . . .	3
2*	Spores less than 17 $\mu\text{m}$ long . . . . .	4
3	Spores 20–28 $\mu\text{m}$ long; spines coarse, 2.5–3.5 $\mu\text{m}$ high, 4–6 (–7) per spore diam. . . . .	<i>T. savilei</i>
3*	Spores 14.5–25.5 $\mu\text{m}$ long; spines finer, 0.5–2.5 $\mu\text{m}$ high . . . . .	<i>T. tripogonis</i>
4	Spores 13–17 $\mu\text{m}$ long, with blunt, triangular processes . . . . .	<i>T. leptochloae</i>
4*	Spores smaller, otherwise ornamented . . . . .	5
5	Spores 10–16 $\mu\text{m}$ long, prominently echinulate . . . . .	<i>U. ornata</i>
5*	Spores 8–13.5 $\mu\text{m}$ long, finely punctate-echinulate . . . . .	<i>Mac. tripogonis</i>
6	Sori in the spikelets, 1.5–2 mm long . . . . .	<i>U. curta</i>
6*	Sori elsewhere. . . . .	7
7	Sori as nodular galls on stems, leaves, inflorescence or flowers; spores finely echinulate, spines up to 0.5 $\mu\text{m}$ high . . . . .	<i>U. heterogena</i>
7*	Sori destroying the inflorescence; spores apparently smooth to finely punctate . . . . .	<i>U. thaxteri</i>

Key to the smut fungi of *Tristachya*, see *Loudetia*

Key to the smut fungi of *Uncinia*

1	Sori olive brown, dusty, mixed with sterile fungal filaments; spores 5–9.5 (–10) $\mu\text{m}$ long. . . . .	<i>Farysia unciniae</i>
1*	Sori black or blackish brown, agglutinated, no fungal filaments; spores larger. . . . .	2
2	Spores 11–17 (–20) $\mu\text{m}$ long, with 3–6 extremely well-developed internal swellings, light-refractive areas absent. . . . .	<i>Anthracoidea unciniae</i>
2*	Spores (14–) 16–22 (–24) $\mu\text{m}$ long, with 2–4 low internal swellings, light-refractive areas present . . . . .	<i>Anthracoidea sclerotiformis</i>

Key to the smut fungi of *Urochloa*, see *Brachiaria*

Key to the smut fungi of *Vetiveria*

1	Sori in the ovaries . . . . .	2
1*	Sori elsewhere. . . . .	3
2	Spores 15–25 $\mu\text{m}$ long, with coarse, 1.5 $\mu\text{m}$ high warts . . . . .	<i>T. vetiveriae</i>
2*	Spores 6.5–10.5 $\mu\text{m}$ long, with low tubercles . . . . .	<i>U. vetiveriae</i>
3	Sori in the racemes; columella present . . . . .	<i>Spor. chudaei</i>
3*	Sori elsewhere; columella absent . . . . .	4
4	Sori in the leaves; spore balls present; sterile cells absent . . . . .	<i>Tolyposporella linearis</i>
4*	Sori in the culms; spore balls absent; sterile cells present. . . . .	5
5	Spores 9–12 $\mu\text{m}$ long; sterile cells 8–12 $\mu\text{m}$ long . . . . .	<i>Mac. nigritanae</i>
5*	Spores 4–6.5 $\mu\text{m}$ long; sterile cells 5.5–8 $\mu\text{m}$ long . . . . .	<i>Mac. effusus</i>

Key to the smut fungi of *Yakirra*, see *Brachiaria*

Key to the smut fungi of *Zonotriche*, see *Loudetia*

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