



A modified digital formula as identification tool for thyriothecous foliicolous fungi and their anamorphs

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Abstract

A proposed new formula ‘Lini Neeta Jacob Swapna’ (LNJS digital formula) is well balanced and consists of four digits for the morphology and four for measurements of fungal characters. This formula, which is well suited for families Asterinaceae, Lembosiaceae, Microthyriaceae and Englerulaceae, is described in detail.

Key words – Asterinaceae – Englerulaceae – Lembosiaceae – Microthyriaceae – Schiffnerulaceae

Introduction

Beeli (1920) introduced an eight digit formula for summarizing key diagnostic characters in a numerical code that has proved a convenient and valuable tool in expediting the identification of fungi belonging to the pyrenomycete family Meliolaceae. The application and usefulness of this digital formula are: a) it presents, in brief, a fairly detailed picture of the external structure and appearance of the fungus; b) it provides the determinator with a shorthand system for grouping morphologically similar species within the larger genera for convenience of study, and for information storage; and c) from synoptic treatments of species arranged by host family the determinator can arrive rapidly at a preliminary placement of an unknown specimen, provided the host is known.

The Microthyriales, Asterinales and Englerulales families have received, on the whole, considerably less attention than the Meliolaceae, and have not been monographed on a worldwide basis. The most comprehensive treatments to date are those of Arnaud (1918), Doidge (1942), Stevens & Ryan (1939), Hansford (1946), Muller & Arx (1962) and Hosagoudar (1996, 2011, 2013).

Results

The proposed new formula (LNJS digital formula) is well balanced and consists of four digits for the morphology and four for the measurements and it is well suited for families Asterinaceae, Lembosiaceae, Microthyriaceae and Englerulaceae (Schiffnerulaceae).

The numbers to the left of the period characterize the principal organs used in generic and specific determination of thyriothecious leaf inhabiting fungi viz., morphological characters such as number of cells of appressoria (absent, unicellular, bicellular or multicellular), position of

appressoria (non-appressoriolate mycelium; intercalary; alternate or unilateral; opposite; alternate and opposite; whorled; appressoria formed only around the stomata; hypostroma or forming nutritive cells), presence or absence and dehiscence of thyriothecia and asexual fruiting bodies, pycnidia, conidia and septation and surface of ascospores (uniseptate or multiseptate, position of septa on spore). Those to the right cover measurements viz., length of appressoria, maximum length or diameter of mature thyriothecia, length and breadth of ascospores

Thus, a species with formula 1322.4232 has up to 40 µm long, unicellular, opposite appressoria, stellately dehiscing thyriothecia having a maximum diameter of 200 µm and uniseptate echinulate ascospores between 21 to 30 µm long and 6 to 10 µm wide. Likewise, a species with formula 1^{2/3}21.1221 has up to 10 µm long, unicellular unilateral to alternate and opposite appressoria, stellately dehiscing thyriothecia having a maximum diameter of 200 µm and smooth walled uniseptate ascospores between 11 to 20 µm long and up to 5 µm wide. The sign '/' means 'and' or 'both'. By supplementing this information with a few additional data, such as shape of colony, mycelium, and appressoria, it is possible to arrive at a nearly complete morphological picture of the fungus.

For the families Asterinaceae, Lembosiaceae, Microthyriaceae and Englerulaceae (Schiffnerulaceae) the following version is suggested:

LNJS digital formula

Morphology

I. Number of cells of appressoria

0. Absent
1. Unicellular
2. Bicellular
3. Multicellular

II. Position of appressoria

0. Absent
1. Intercalary
2. Alternate or unilateral
3. Opposite
4. Alternate and opposite
5. Whorled
6. Appressoria formed only around the stomata
7. Appressoria forming hypostroma
8. Appressoria forming nutritive cells

III. Sexual and asexual fruiting bodies

0. Absent
1. Thyriothecia dehisced by ostiole
2. Thyriothecia stellately dehiscing
3. Thyriothecia longitudinally dehiscing
4. Thyriothecia dehiscing by dissolving at the centre
5. Conidia present
6. Pycnidia present

IV. Septation and surface of ascospores

1. Uniseptate, septa at the middle, smooth-walled
2. Uniseptate, septa at the middle, echinulate
3. Uniseptate, septa at the middle, truncate
4. Uniseptate, septa at the middle, verrucose
5. Uniseptate, septa at the extreme end by forming one pinched-off cell
6. More than one septa

Measurements

V. Length of appressoria

1. Up to 10 µm long
2. Up to 20 µm long
3. Up to 30 µm long
4. Up to 40 µm long
5. More than 40 µm long

VI. Maximum length or diameter of mature thyriothecia

1. Up to 100 µm
2. 101–200 µm
3. 201–400 µm
4. 401–700 µm
5. 701–1000 µm
6. More than 1000 µm

VII. Length of ascospores

1. Up to 10 µm long
2. 11–20 µm long
3. 21–30 µm long
4. 31–40 µm long
5. More than 40 µm long

VIII Width of ascospores

1. Up to 5 µm wide
2. 6–10 µm wide
3. 11–15 µm wide
4. 16–20 µm wide
5. More than 20 µm wide

Application of the LNJS digital formula

The meliolaceous members are unique and all the genera can be classified with Beeli formula. However, the Asterinaceous, Schiffnerulaceous and Microthyriaceous members are heterogenous with large number of genera. Hence, the modified digital formula is applicable here in the identification of species. As an example, the description of a species of the genus *Asterina* is given along with its digital formula.

Asterina aporusae Hansf., Reinwardtia 3: 129, 1954; Hosag. & Abraham, J. Econ. Taxon. Bot. 4: 567, 2000.

Colonies amphigenous, thin, up to 2 mm in diameter, confluent. Hyphae straight, substraight to flexuous, branching alternate to irregular at acute to wide angles, loosely to closely reticulate, cells 9–12 × 3–6 µm. Appressoria unicellular, opposite, unilateral to rarely alternate, ovate, oblong, entire, 8–10 × 3–5 µm. Thyriothecia scattered, orbicular, up to 172 µm in diameter, margin crenate to slightly fimbriate, fringed hyphae flexuous and devoid of appressoria, stellately dehisced at the centre; asci globose to ovate, octosporous, up to 32 µm in diameter; ascospores brown, oblong, conglobate, uniseptate, constricted at the septum, 11–13 × 4–5 µm, wall smooth.

Digital formula is 1²/₃21.1221

This formula assembles the related or similar taxa in their morphology and measurements.

Discussion

Farr (1971) also provided a digital formula for Asterinaceae, but it was discarded or not used because the number of morphological digits were not equal to the number of digits for measurements. Hosagoudar et al. (2001) also proposed a modified digital formula for

Asterinaceae but it was inadequate to include all the genera in Asterinales. In both cases, digital formula were designed and used only for Asterinaceae.

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