POINT OF VIEW

# Diagnoses and descriptions in Plant Taxonomy: Are we making proper use of them?

**Gustavo Hassemer,[1*] Jefferson Prado[2] & Riccardo M. Baldini[3*]**

1 *Federal University of Mato Grosso do Sul, Três Lagoas Campus, CEP 79610-100, Três Lagoas, MS, Brazil*
2 *Institute of Botany, Herbarium SP, Av. Miguel Estéfano, 3687, CEP 04301-012, São Paulo, SP, Brazil*
3 *Department of Biology and Centro Studi Erbario Tropicale (Herbarium FT), University of Florence, Via Giorgio la Pira, 4, 50121, Florence, Italy*
* These authors contributed equally to this work.
Address for correspondence: *Gustavo Hassemer*, *g.hassemer@ufms.br*

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Plant taxonomists are responsible for, among many other tasks, the formalisation of new taxa, which require the publication of new names for them. According to the current version of *the International Code of Nomenclature for algae, fungi, and plants* (Turland & al., 2018—hereafter *ICN*), either a description or a diagnosis is enough for the valid publication of a name. In the cases that neither is provided, a name is not validly published (Art. 38 of the *ICN*), and is commonly referred to as a *nomen nudum* ("naked name").

In fact, Art. 38.2 of the *ICN* establishes that "A diagnosis of a taxon is a statement of that which in the opinion of its author distinguishes the taxon from other taxa", while in the *ICN* glossary, a description is defined as: "a published statement of a feature or features of an individual taxon; a description (or a diagnosis) is required for valid publication of a name of a new taxon (Art. 38.1(a) and 38.3); a validating description need not be diagnostic". The current version of the *ICN* is clear regarding the distinction between diagnosis and description, so that the definition of both terms does not currently seem to be a problem. The same approach is confirmed in Turland (2019: 18). It should be remarked that the *ICN* is focused on nomenclature and not on taxonomy, and does not aim to judge whether descriptions and diagnoses adequately represent the taxa (Nicolson, 1991). Furthermore, we highlight that the discussion presented here refers to Plant Taxonomy, not to other groups of organisms also covered by the *ICN*, i.e., algae and fungi.

From a historical point of view, Linnaeus (1751), in his *Philosophia botanica*, gave the definition of a *descriptio* in the Adumbratio 326 (p. 256) as follows: "Descriptio […] est totius plantae character naturalis, qui describat omnes ejusdem partes externas", and then he gave more details on how to set up and improve a description: for Linnaeus, a *descriptio* is an analytic statement clearly and conceptually distinct from a *diagnosis*, which is a synthetic statement. More recently, Ghiselin (1997), in the glossary at the end of his book, stated that a description "enumerates the properties of things, irrespective of whether or not the properties in question are defining" and a diagnosis "enumerates properties that are useful in identification", thus highlighting the descriptive aspect of a description, which aims at completeness, and the comparative aspect of a diagnosis, which aims at succinctness. Furthermore, a diagnosis reflects the "type method" that represents the epistemological point of contact between Taxonomy and Nomenclature (Candolle, 1867; Mayr, 1989; Witteveen, 2015, 2017, 2018). More reflections on this topic can be found in Simpson (1961), Wiley (1981) and Winston (1999).

Despite the explicit and satisfactory differentiation in the *ICN*, we argue that the distinction of a diagnosis and a description is not clear to many taxonomists these days, especially the younger ones. New taxa, especially new species, are often described supported only by descriptions, without a diagnosis (e.g., Berry & Galdames, 2013; Van der Maesen, 2013; Palchetti & al., 2018; Shui & al., 2019; Vaezi & al., 2019; Vladimirov & al., 2019), or other times diagnostic and descriptive information is joined under one or the other (e.g., Kuijt & Delprete, 2019). In some cases, a diagnosis is presented after a description (e.g., Arigela & al., 2019; Guzmán-Guzmán, 2019; Xiao & al., 2019), which we consider that further adds to the current state of confusion. Considering the fundamentally distinct purposes of diagnoses and descriptions (see above), we argue that it would be for the benefit of Plant Taxonomy, taxonomists and users of taxonomic classifications if both a diagnosis and a description were always provided to formalise new taxa and that, for consistency, diagnoses be presented before descriptions for each taxon.

Nevertheless, the importance of distinguishing diagnoses and descriptions goes much beyond the formalisation of new taxa. In fact, monographs and other taxonomic literature presenting morphological information should ideally present both diagnoses and descriptions for taxa. This would maximise the usefulness of those treatments, in allowing

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distinguishing a taxon from its relatives (e.g., a species from its congeners) in the most succinct manner, which is achieved by means of a diagnosis, and also in informing characters of the taxon in question as thoroughly as possible, which is achieved by means of a description. Synoptic works, which normally do not present descriptions of taxa, could nevertheless provide diagnoses for the taxa treated—those diagnoses, although succinct, would have enormous usefulness for the readership in order to comprehend the species concepts and delimitations adopted by the author. Currently, the vast majority of taxonomic works being published do not provide diagnoses for taxa that are not being newly described, a situation that we hope to change with the present letter.

Traditionally, the characters used for descriptions are morphologic, but with the development of new technologies, other types of information could be used, such as, e.g., chromosome number and morphology, physiological characters, biochemical characters, and DNA molecular data (e.g., Goldstein & DeSalle, 2011; Jörger & Schrödl, 2013; Renner, 2016; Bakker, 2017; Viruel & al., 2019). It is undeniable that non-morphological information can be very useful for supporting more stable and refined taxonomic classifications (Jörger & Schrödl, 2013), offering important support to morphology (although sometimes contradicting it), and most probably will see crescent use among systematists. The use of these extra types of information is undoubtedly improving the informational content for Taxonomy and Systematics as a whole. Such integrative approaches are critically important especially for the study of species complexes and cryptic species, and constitute further support for the integration (but not substitution!) of non-morphological information to the elaboration of descriptions (Tripp & Lendemer, 2014). We acknowledge that information on micro- or nanomorphological features such as chromosomic and molecular data is not always available, but its inclusion in a description is desirable and should be done when possible.

As an illustrative example, Li & al. (2012) recently published a new fern genus, *Gaga* Pryer & al., presenting a description and mentioning, regarding the etymology of the new taxon, that "At nucleotide positions 598–601 in the *matK* gene alignment, all *Gaga* species have 'GAGA' […], a sequence pattern not seen at this site in any other cheilanthoid fern sampled", from which the name of the genus was dedicated to a famous American pop star. Li & al. (2012) were the first to use a nucleotide sequence from which they justified the etymology of a new genus name, but they omitted this important molecular information from the description they provided for the new genus. This very relevant molecular information could have been included in the description of the new taxon, instead in the Etymology section. Furthermore, it should be noted that the first paragraph of the description they provided for *Gaga* is clearly a diagnosis, which is, however, not referred to as such; this fact corroborates the prevailing view, which we highlight here, that diagnoses and descriptions are nowadays being confused by many among the scientific community.

In the case of diagnoses, however, we argue that the use of non-morphological information would undo their very purpose, i.e., to provide the most succinct and accessible means for the identification of the taxon in question. Therefore, we argue that diagnoses should use only morphological characters. The use of morphological diagnoses advocated here does not preclude that non-morphological characters be used to elaborate non-morphological diagnoses, e.g., a molecular diagnosis presenting a string of nucleotides that is unique to the taxon in question. Thus, contrary to the description, the combination of different types of characters is counterproductive for diagnoses.

The abandonment of the use of morphology for the description of new taxa and for the taxonomic classification as a whole has been suggested in some recent works (e.g., Cook & al., 2010). We feel that this would have extremely negative consequences to Taxonomy and consequently to Systematics, because most of the taxonomic novelties (especially in Plant Taxonomy) are happening in contexts where molecular works are completely unavailable. Furthermore, people working with molecular phylogeny often lack experience and knowledge of taxonomic practices and nomenclature, and there is a well-known general trend of reduction (even extinction, in some environments) of taxonomists in research institutes, universities and even museums (Agnarsson & Kuntner, 2007; Ebach & al., 2011; Wägele & al., 2011; Sluys, 2013). The development of new techniques is increasing, not decreasing the demand for taxonomic expertise and correct specimen determinations (Will & Rubinoff, 2004; Packer & al., 2009; Taylor & Harris, 2012). In sum, abandoning morphology would bring no benefits to Plant Taxonomy and would effectively stall taxonomic advancement in the regions of the world precisely where most of the unknown biodiversity occurs. This would also have nefarious consequences for biodiversity conservation, not only because many narrowly endemic species would remain unknown to science, but also because without the use of morphology, it would become essentially impossible to recognise or determine rare and/or threatened species (Ely & al., 2017; Thomson & al., 2018).

To conclude, we think that a more disciplined use of diagnoses and descriptions should be adopted in Plant Taxonomy. We think that it is most beneficial for Systematics and its users that both a diagnosis *and* a description be informed in taxonomic works, both for the description of new species and for the treatment of already described taxa. We think that synoptic taxonomic works should inform the diagnostic characters for the taxa treated. Furthermore, we argue that diagnoses and descriptions should not be joined, or considered equivalent or interchangeable. In order for these changes to be made possible, it would be necessary that the editors of journals publishing taxonomic literature demand from authors the proper use of diagnoses and descriptions. To sum up, we present below the concepts we adopted for a diagnosis and a description.

A **diagnosis** is a synthetic statement of the morphological characters that allow the distinguishing of the taxon in question from its relatives (e.g., a species from its congeners). A diagnosis should ideally be as concise as possible.

A **description** is an analytic statement describing features that characterise the taxon in question, including macro-morphological to anatomical, biochemical, karyological and molecular aspects. A description should ideally be as thorough as possible.

## ■ AUTHOR CONTRIBUTIONS

RMB and GH idealised the work. GH and RMB wrote the text. JP revised the text and contributed with important criticism. — GH, http://orcid.org/0000-0003-4365-6934; JP, http://orcid.org/0000-0003-4783-3125; RMB, http://orcid.org/0000-0003-2181-3441

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