

# Misinterpretations and plagiarism in a publication about Himalayan *Impatiens*: polemics with the paper of Singh R.K. *et al.* 2021

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**Abstract.** In the publication “Typifications, new combinations and new synonyms in Indian *Impatiens* (Balsaminaceae)” by Singh, R. K. *et al.* (2021), the authors used pseudoscientific theoretical background, utilized material collected by other persons without citing the source of data in support of their claims, and made serious errors in the determination and delimitation of *Impatiens* taxa occurring in Himalayas and adjacent areas. They proposed new combinations and statuses without sufficient field and literature studies and failed to show convincing evidences in their treatments. Their documentation lacks important details, like authorship of the published pictures, locations and dates of pictures, or measurements of plant parts; the whole documentation has geographically biased gaps – in case of Western Himalayan or Sikkimese taxa, there is almost no original illustrative material. Finally, they falsely claimed extensive field studies in Western Himalaya. This paper reinstates 19 species and 1 variety synonymised by Singh *et al.* (2021) with scientific evidences based on illustrations from types and colour photographs from fresh collections.

**Key words:** Balsaminaceae, determination, ethics, Himalaya, *Impatiens*, lectotypification, reinstatement, taxonomy

## 1. Introduction

Taxonomically, the genus *Impatiens* Riv. ex L. is notoriously difficult to classify (Hooker 1908; Grey-Wilson 1980). Due to the semi-succulent stems and fleshy leaves, providing well-dried herbarium specimens is challenging. Flowers are extremely fragile and in dried specimens majority of them are folded and coalesced, making separating and reconstructing the different parts laborious. Conversely, due to the hypervariable flower morphology within the genus, determining the shapes and sizes of sepals and petals is crucial for identification (Chen 1978; Chen *et al.* 2007). In addition, capsules and seeds are quite diverse and often considered to be important morphological

characters for solving classification issues (Lu & Chen 1991; Utami & Shimizu 2005; Song *et al.* 2005; Yu *et al.* 2015; Ruchisansakun *et al.* 2018). Because of the explosive nature of mature seed pods, seeds or fruits are often missing on herbarium specimens. Descriptions of floral and fruit characters based only on herbarium specimens may therefore be incomplete or ambiguous. Thus, field investigations, specimens prepared with utmost care along with photographic documentation and thorough notes are essential for accurately describing the reproductive characters (Chen 1978; Shui *et al.* 2011; Yu 2012). Collecting good material is particularly difficult and time consuming in mountainous areas like Himalayas, where some taxa could occur above 4000 m elevation. Most species of *Impatiens* cannot

endure persistent drought or extended exposure to direct sunlight (Fischer 2004), as a result, *Impatiens* are typically confined to stream margins, waterside boulders, and wet montane forests.

During Pliocene and Pleistocene, rapid diversification of the genus *Impatiens* occurred and forms were separated from closely related lineages. This diversification led to high endemism in particular geographic areas, e.g., mountain ranges or valleys (Janssens *et al.* 2009). The knowledge on the distribution, altitudinal limits and ecology of many *Impatiens* is inherently limited and could be the reason why extensive publications on the genus were few and far between like “An Epitome of the British Indian species of *Impatiens*” by Hooker (1904-1906), “*Impatiens* of Africa” by Grey-Wilson (1980), or more recent studies of Chen *et al.* (2007), Bhaskar (2012), Yu (2012), Gogoi *et al.* (2018), Rahelivololona (2018), or Ruchisansakun *et al.* (2018).

Rajeev Kumar Singh, Dipankar Borah and Momang Taram published an article entitled “Typifications, new combinations and new synonyms in Indian *Impatiens* (Balsaminaceae)” (<http://brc.amu.edu.pl/Typifications-new-combinations-and-new-synonyms-in-Indian-Impatiens-Balsaminaceae,136272,0,2.html>) in a recent issue of *Biodiversity: Research and Conservation* journal. It is a lengthy paper, dealing with forty four plant names, proposing 39 new synonyms and six new combinations. Taxa included in this paper not only occur along the Himalayan countries of Afghanistan, Pakistan, Nepal, India, and Bhutan, but also in the adjacent countries of China, Myanmar and SE Asia. The thorough study of this publication (including the illustrations) revealed fundamental errors in species identification and treatment at basic level, a significant decline in scientific standards, and the unethical practices employed in fabricating a publication with falsification and plagiarism. The aim of our paper is to identify these fundamental errors and provide reliable knowledge about the Himalayan *Impatiens*.

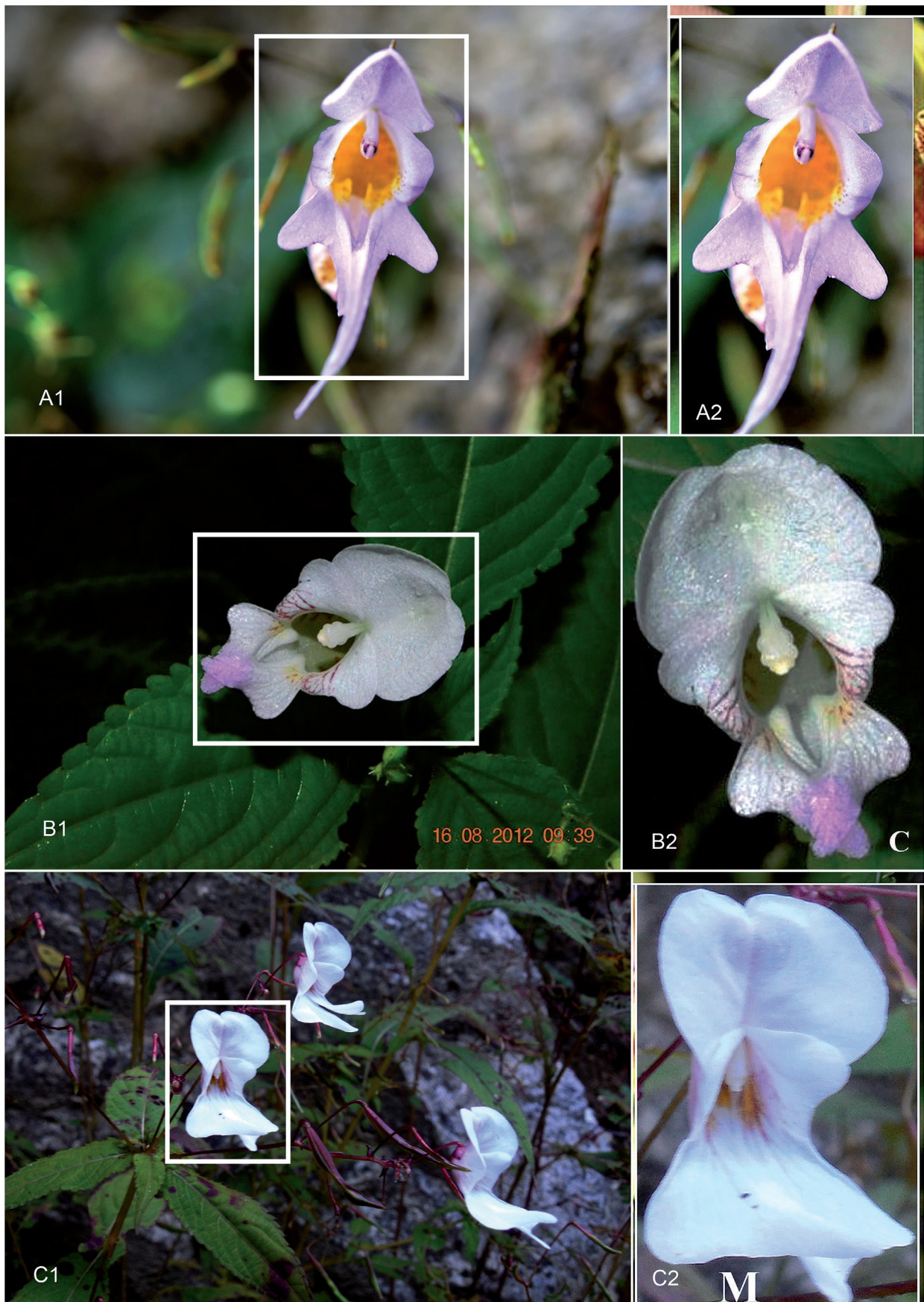
## 2. General remarks

The premise under which the authors place their argument in their Introduction is itself based on a shaky theoretical ground of ‘inheritance of acquired characteristics’ of Jean Baptiste de Lamarck and Trofim Lysenko (for more discussion on lysenkoism see: Lerner *et al.* 2001; Kolchinsky *et al.* 2017). The authors wrote: “It is observed that abiotic ecological factors (climatic, edaphic and physiographic) play a major role (up to 95%) in the morphological variation of some taxa, while biotic factors play a minor role (up to 5%)”. Environmental factors do modify some plant features, for example plant height, branching and leaf area [see studies of Lall *et al.* (1997) on *I. flanaganae*,

and Schmitt (1993) on *I. capensis*], like, e.g., smaller plants of *I. racemosa* could have much smaller flowers with short spurs (Akiyama *et al.* 1991), while late season specimens of *I. cymbifera* often produce sterile, thread-like inflorescences (Grey-Wilson 1989b). Though sweeping, as it is, their statement on abiotic factors playing up to 95% in morphological variations, is not backed by any scientific data and does not even drop a hint whether the changes were stable over many generations and if they have long lasting impact on evolution. Molecular studies using genes as a tool, address evolutionary trends much more credibly with reproducible evidences for phylogeny and make sense for speciation (e.g., Janssens *et al.* 2009; Utami & Ardiyani 2015; Yu *et al.* 2015; Shajita *et al.* 2016).

The publication of this magnitude, deeming to typify forty four plant names and proposing 39 new synonyms and six new combinations, should ideally be done with thorough literature survey of the taxa in question as a minimum criterion and a proven expertise in the taxa. The frivolousness displayed by Singh *et al.* (2021) could be assessed by the fact that while discussing the countries particularly rich in *Impatiens*, the authors have completely missed out on China, which has 274 species (Wang *et al.* 2015). Since 2015, more than twenty new *Impatiens* species were described from China (see [https://www.researchgate.net/publication/348884116\\_Balsams\\_of\\_XXI\\_century\\_2020](https://www.researchgate.net/publication/348884116_Balsams_of_XXI_century_2020)); several taxa known earlier from neighbouring areas (Guo *et al.* 2016; Peng *et al.* 2019; Zhang *et al.* 2020a, 2020b) were also reported in this country. Therefore, China with c. 300 *Impatiens* species probably has the richest Balsaminaceae flora in the world. The frivolity extends nearer home as the number of Indian species is taken as 240. If the baseline data of 203 taxa reported by Vivekanathan *et al.* in *Flora of India* (1997) are accepted, then more than 80 taxa have since been described. This was reflected in the recent publication ‘*Flowering Plants of India*’, in which Gogoi *et al.* (2020b) reported 279 species for the country. The lack of thorough study of literature for a thing as basic as the number of taxa undermines the publication of Singh *et al.* (2021).

The poor quality of documentation is striking in the publication as the minimum requisite of using scale bars in pictures to enable estimation of dimensions of particular organs, or flower dissections, studies of flower details, etc., is disregarded except for few (see Shui *et al.* 2011 for the description of methods of specimen preparations). More importantly, not a single picture is accompanied by information on a place of observation, date, elevation, or authorship mentioned, giving the impression that all pictures were taken by the authors, i.e., by Singh *et al.* (2021). However, plagiarism is evident in the publication as 21 of 105 illustrative



**Fig. 1.** Examples of pictures used without citing the source and without consent of author or licensor. White frame shows part of picture used in the paper of Singh *et al.* (2021)

Explanations: (A) *Impatiens bicornuta*, A1 – original picture, posted by Saroj Kumar Kasaju on efloraofindia portal <https://groups.google.com/g/indiantreepix/c/UgbLVzLWHW4> (file name DSC\_0708), A2 – cropped version, used as Fig. 6, bottom row, fourth from the left in the discussed paper; (B) *Impatiens devendrae*, B1 – original picture, posted by Balkar Singh in efloraofindia portal <https://groups.google.com/g/indiantreepix/c/Jbb-fATSMFc> (file name Impatiens devendrae (8)), B2 – cropped version, used as Fig. 5C in the discussed paper; (C) *Impatiens violoides*, C1 – original picture, posted by Krishan Lal on efloraofindia portal <https://efloraofindia.com/2014/10/30/impatiens-violoides/>, C2 – cropped version, used as Fig. 12M in the discussed paper. Pictures used with permission of authors (Saroj K. Kasaju, Balkar Singh) and licensor (J. M. Garg) in the case of pictures authored by Late Krishan Lal

**Table 1.** List of pictures in the publication of R. K. Singh *et al.* (2021) used without citing the source and without permission of legal owners. In cases where we were unable to contact authors/owners of pictures, author and status is marked ‘?’

Lp	Name in paper	Place in paper	Manipulation	Author	Source
1	<i>Impatiens balfourii</i>	Fig. 4, upper left	cropped	?	<a href="https://www.hardy-plant.org.uk/hortlib?ref=mimg-2015-09">https://www.hardy-plant.org.uk/hortlib?ref=mimg-2015-09</a>
2	<i>Impatiens balfourii</i>	Fig. 4, upper right	cropped	?	<a href="http://1234juin.over-blog.com/2015/09/impatiente-de-belfour.html">http://1234juin.over-blog.com/2015/09/impatiente-de-belfour.html</a>
3	<i>Impatiens balfourii</i>	Fig. 4, middle left	cropped	Senki Tufako	<a href="https://www.fotocommunity.com/photo/impatiens-balfourii-senki-tufako/44368163">https://www.fotocommunity.com/photo/impatiens-balfourii-senki-tufako/44368163</a>
4	<i>Impatiens balfourii</i>	Fig. 4, middle right	cropped	Giuliano Da Zanche	<a href="https://www.flickr.com/photos/99230652@N04/41893178875/">https://www.flickr.com/photos/99230652@N04/41893178875/</a>
5	<i>Impatiens balfourii</i>	Fig. 4, bottom left	cropped	?	<a href="https://biodiversidade.eu/especie/impatiens-balfourii-hook-f/?lang=en">https://biodiversidade.eu/especie/impatiens-balfourii-hook-f/?lang=en</a>
6	<i>Impatiens balfourii</i>	Fig. 4, bottom right	cropped	?	The Flora of Pakistan, <a href="https://pakflora.com/pkflora/pakflora/findspp.php?spp=Impatiens%20balfourii">https://pakflora.com/pkflora/pakflora/findspp.php?spp=Impatiens%20balfourii</a>
7	<i>Impatiens bicolor</i> var. <i>bicolor</i>	Fig. 5A	cropped	?	Denver Botanic Garden, <a href="http://navigate.botanicgardens.org/webui/oecgi2.exe/INET_ECM_Displ?NAMENUM=34010&amp;startpage=1">http://navigate.botanicgardens.org/webui/oecgi2.exe/INET_ECM_Displ?NAMENUM=34010&amp;startpage=1</a>
8	<i>Impatiens bicolor</i> var. <i>bicolor</i>	Fig. 5B	cropped	?	<a href="http://empreintes-terre-et-jardins.over-blog.com/2020/07/220-un-impatiens-de-l-himalaya-impatiens-bicolor.html">http://empreintes-terre-et-jardins.over-blog.com/2020/07/220-un-impatiens-de-l-himalaya-impatiens-bicolor.html</a>
9	<i>Impatiens bicolor</i> var. <i>devendrae</i>	Fig. 5C	cropped, rotated 90 degrees	Balkar Singh	<a href="https://groups.google.com/g/indiantreepix/c/Jbb-fATSMFc">https://groups.google.com/g/indiantreepix/c/Jbb-fATSMFc</a>
10	<i>Impatiens bicolor</i> var. <i>devendrae</i>	Fig. 5D	cropped	Nidhan Singh	<a href="https://groups.google.com/g/indiantreepix/c/bv1svtps4Ec">https://groups.google.com/g/indiantreepix/c/bv1svtps4Ec</a>
11	<i>Impatiens bicornuta</i>	Fig. 6, bottom row, fourth from the left	cropped	Saroj Kumar Kasaju	<a href="https://groups.google.com/g/indiantreepix/c/UgbLVzLWHW4">https://groups.google.com/g/indiantreepix/c/UgbLVzLWHW4</a>
12	<i>Impatiens bicornuta</i>	Fig. 6, bottom row, first from the left	cropped	Saroj Kumar Kasaju	<a href="https://groups.google.com/g/indiantreepix/c/0A236YXN1Mo">https://groups.google.com/g/indiantreepix/c/0A236YXN1Mo</a>
13	<i>Impatiens bicornuta</i>	Fig. 6, bottom row, fifth from the left	cropped	?	Le Jardin Tropical, <a href="https://plantensexotiquesetropicales.com/produit/impatiens-pradhanii/">https://plantensexotiquesetropicales.com/produit/impatiens-pradhanii/</a>
14	<i>Impatiens leptoceras</i>	Fig. 9G	cropped, middle right part of original picture	Peter Zale	<a href="https://plinthetal.files.wordpress.com/2015/03/impatiens.jpg">https://plinthetal.files.wordpress.com/2015/03/impatiens.jpg</a>
15	<i>Impatiens leptoceras</i>	Fig. 9H	cropped, upper left corner of original picture	Peter Zale	<a href="https://plinthetal.files.wordpress.com/2015/03/impatiens.jpg">https://plinthetal.files.wordpress.com/2015/03/impatiens.jpg</a>
16	<i>Impatiens porrecta</i>	Fig. 10, second row from bottom, third from the left	cropped	M. Sawmliana	<a href="https://efloraofindia.com/2017/09/20/hmuifang/">https://efloraofindia.com/2017/09/20/hmuifang/</a>
17	<i>Impatiens pulchra</i>	Fig. 12C	cropped	M. Sawmliana	<a href="https://efloraofindia.com/wp-content/uploads/2020/10/Impatiens%20sp.-Ramnuaihang-%20-2-.JPG">https://efloraofindia.com/wp-content/uploads/2020/10/Impatiens%20sp.-Ramnuaihang-%20-2-.JPG</a>
18	<i>Impatiens pulchra</i>	Fig. 12D	cropped	Alchemist@zz	<a href="https://naturelib.net/plantae/impatiens-monticola/#">https://naturelib.net/plantae/impatiens-monticola/#</a>

File name or other identification details	Status
sole picture of <i>I. balfourii</i>	?
first picture in top of the page	?
sole picture of <i>I. balfourii</i>	copyrighted
sole picture of <i>I. balfourii</i>	copyrighted
eighth picture of the species	CC BY-NC
sole picture of <i>I. balfourii</i>	copyrighted
picture of <i>I. bicolor</i> in upper right corner	?
fourth picture of <i>I. bicolor</i>	?
<i>Impatiens devendrae</i> (8)	CC BY
<i>I. devendrae</i> (2)	CC BY
DSC_0708	CC BY
_DSC0063	CC BY
sole picture of <i>I. pradhanii</i>	?
sole picture of <i>I. drepanophora</i>	copyrighted
sole picture of <i>I. drepanophora</i>	copyrighted
<i>Impatiens</i> sp.-8	CC BY
<i>Impatiens</i> sp.-Ramnuaitang- -2-. JPG	CC BY
upper picture, plant named <i>I. monticola</i>	copyrighted

materials provided are taken from different web pages, without citing sources (Table 1, Fig. 1). These pictures were cropped and in two cases manipulated (rotated). The use of pictures from Europe or North America to support the authors' claim seems unethical. The majority of these pictures are licensed as CC BY. Such license requires giving the author or licensor the credits in the manner specified by this license. In five cases, the pictures used in Singh *et al.*'s (2021) publication are without any citation of the source and copyright information (Table 1). More important is fact that five pictures used are fully copyrighted, as indicated by their owners.

The whole paper is very unevenly illustrated – species common in Eastern Himalaya, apparently observed and photographed by the co-authors, have many pictures (*I. porrecta* has 26 pictures, *I. arguta* 18, *I. zironiana* (distinctly seen as having a long linear capsule and wrongly identified as *I. citrina* in the paper) 14, *I. pulchra* 7, *I. khasiana* and *I. latifolia* 6). But even there, some strange gaps occur, for example *I. tripetala*, commonly found in lower altitudes of NE India (Vivekananthan *et al.* 1997; Gogoi *et al.* 2018), does not have a single picture. Among seven pictures claimed to be of *I. pulchra*, only three look like this species (Fig. 12C, D, E in the discussed paper), the others are claimed wrongly, and three of these were taken from internet (Table 1). Many species from Western Himalaya or Sikkim have no illustration at all (Table 2). Only 14 of 33 names recognized by Singh *et al.* (2021) have any picture or illustrations.

The authors claimed that they made extensive field studies in Western Himalaya: “Many variable forms of *I. balfourii* were seen in the field”; “These forms are found within the populations of *I. bicolor* at many localities in Himachal Pradesh, Jammu & Kashmir and Uttarakhand”; “Therefore, these taxa are synonymized under *I. bicornuta* after the detailed study of type specimens, other herbarium specimens, and live plants in different types of habitat”. *Impatiens balfourii* is known from Western Himalaya – from Pakistan (Nasir 1980) to Uttarakhand (Pusalkar & Srivastava 2018); *I. bicolor* grows from Pakistan (Nasir 1980) to Nepal ([http://www.efloras.org/florataxon.aspx?flora\\_id=110&taxon\\_id=242423060](http://www.efloras.org/florataxon.aspx?flora_id=110&taxon_id=242423060)) and finally, *I. bicornuta* aggregate sensu Akiyama (1987) and Grey-Wilson (1989a) is distributed from Sikkim in the east through Nepal ([http://www.efloras.org/florataxon.aspx?flora\\_id=110&taxon\\_id=242423061](http://www.efloras.org/florataxon.aspx?flora_id=110&taxon_id=242423061)) to Western Himalaya (Pusalkar & Srivastava 2018), as well as in southern Tibet (Chen *et al.* 2007). In reality, all six pictures of *I. balfourii*, all four pictures of *I. bicolor* s.l. and three of four pictures of the true *I. bicornuta* aggregate shown in the discussed paper were taken from internet (Table 1). Falsification is more apparent when

Lp	Name in paper	Place in paper	Manipulation	Author	Source
19	<i>Impatiens pulchra</i>	Fig. 12E	cropped	M. Sawmliana	<a href="https://08511630493324166816.googlegroups.com/attach/1fe9f32e50915/Impatiens%20sp%20(1).JPG?part=0.1&amp;view=1&amp;vt=ANaJVrFHU6_40YofSrFXz5HOMkzC7x4yWg_DgPiW-BIp0H7vbhcA3dOExD_M_rDMQdgDGSXqJiGchK7KYJxyLo1WHvboVfx4QOxRlflhXNoF8ejHE_3ndR0">https://08511630493324166816.googlegroups.com/attach/1fe9f32e50915/Impatiens%20sp%20(1).JPG?part=0.1&amp;view=1&amp;vt=ANaJVrFHU6_40YofSrFXz5HOMkzC7x4yWg_DgPiW-BIp0H7vbhcA3dOExD_M_rDMQdgDGSXqJiGchK7KYJxyLo1WHvboVfx4QOxRlflhXNoF8ejHE_3ndR0</a>
20	<i>Impatiens violoides</i>	Fig. 12M	cropped	Krishan Lal	<a href="https://efloraofindia.com/2014/10/30/impatiens-violoides/">https://efloraofindia.com/2014/10/30/impatiens-violoides/</a>
21	<i>Impatiens violoides</i>	Fig. 12N	cropped, rotated 90 degrees	Krishan Lal	<a href="https://efloraofindia.com/2014/10/30/impatiens-violoides/">https://efloraofindia.com/2014/10/30/impatiens-violoides/</a>

even after “detailed studies in the field” the authors lack enough original materials, but have to rely on pictures downloaded from other sources, particularly, without quoting them.

The authors of this response limit themselves to taxa growing in Himalaya and adjacent part of NE India. The authors wonder, however, how Singh *et al.* (2021) were able to deal with taxa growing out of Himalayan range (*I. kamtilongensis* and *I. tongbiguanensis*), as well as with taxa known only from old and incomplete herbarium material (*I. duthiei* or *I. inayatii*)?

There is no valid scientific argument or justification provided by Singh *et al.* (2021) for reducing the taxa from the species level to intraspecific combinations or synonyms, except hollow statements that authors feel the respective taxa are the same or similar. This is unjustifiable from the standpoint of scientific principles. Examples with our substantiations are provided below that reflect Singh *et al.*'s (2021) poor understanding of the discussed taxa, dearth of taxonomic effort and expertise and perfunctory opinions based on the shallow superficial study.

### 3. Examples

*Impatiens arguta* Hook.f. & Thomson is a variable taxon (Fig. 3A-3H), characterized by 1-3 flowers borne in fascicles in leaf axils, the lower sepal abruptly constricted into a hooked spur, four lateral sepals and serrate leaf margin (Hooker & Thomson 1859). Despite clear morphological differences (single flowered axillary inflorescence, lower sepal gradually constricted into coiled spur, two lateral sepals and leaf margin crenate, setose between teeth; Fig. 2B1-2B6), Singh *et al.* (2021) synonymised *I. spirifera* Hook.f. & Thomson with *I. arguta*. Hooker (1904-906) described *I. spirifera* on the basis of collection from Sikkim and lectotype (*Impatiens*

no. 99, *J.D. Hooker s. n.* K000694933!). Hooker clearly indicated that this species has 1 pair of lateral sepals and coiled spur (Fig. 2B1-2B6, Fig. 11C1 & 11C2) and for *I. arguta*, he clearly annotated 2 pairs of lateral sepals and the specimen itself contains the pasted 2 pairs of lateral sepals and a hooked spur in a lower sepal (*J.D. Hooker s.n.*, K000694618!; Fig. 2A1-2A6). The recently described *I. tatoensis* Gogoi & W.Adamowski shares some features (coiled spur, 1 pair of lateral sepals and subfusiform capsule) with *I. spirifera*, however it differs by its perennial habit, bullate glabrous leaves, the two-flowered inflorescences, violet flowers and lateral sepals with dentate margins (Fig. 2C1-2C5; Gogoi *et al.* 2017).

At least one more taxon, synonymised by Singh *et al.* (2021) with *I. arguta* is also a separate species: *I. arunachalensis* Hareesh, A. Joe, M. Sabu & Gogoi, characterized by pedunculate flowers, a pouch-shaped lower sepal, abruptly constricted into a straight spur with a coiled or annular tip and notched apex, and recurved basal lobes of lateral united petals with reddish-brown blotches (Hareesh *et al.* 2017).

Features of all these taxa are in opposition to the original description of *I. arguta* (Hooker & Thomson 1859). Such overly wide circumscription of *I. arguta* (plants glabrous or puberulent; with two or four lateral sepals; flowers ependuculate or pedunculate, spur hooked or coiled, etc.) will make determination of many Himalayan balsams practically impossible.

*Impatiens balfourii* Hook.f. is a balsam with bicolored, white and rose or white and lavender flowers, found in Western Himalaya from Pakistan (Nasir 1980) to Uttarakhand (Pusalkar & Srivastava 2018). Singh *et al.* (2021) claimed that “*I. flemingii* comes within the variability range of *I. balfourii*”. Contrastingly, Nasir (1980) describes *I. flemingii* as having smaller flowers, 10-20 mm long and the capsule up to 12 mm long,

File name or other identification details	Status
Ife9f32e50915/Impatiens sp (1).JPG?part=0.1&view=1&vt=ANaJVrHoNJJp7LvPFV6TjyuCsyOJgthSBetGXLYnJoQdWMCi3WHq205MRdeXQOpD1eqmfuKu66S3ndgw-s0AHKyxbCB7oxVj20tWC2Yq_UCFQrGyE2zSmZQ	CC BY
Impatiens_serrata__belowChansil_Pass_3000m__6_	CC BY
Impatiens_serrata__belowChansil_Pass_3000m__7_	CC BY

whereas *I. balfourii* has flowers 18-27 mm long and capsules up to 20-24 mm long. Hooker (1903; 1904-1906) gives even higher values for length of flowers and capsules of *I. balfourii* (Fig. 4A1, 4A2 and 4B1, 4B2). Additionally, Rahman *et al.* (2016) found differences in morphology of epidermal cells and presence of stomata: *I. balfourii* lacks stomata on adaxial side of leaf blade and has simply undulating cell wall pattern on both sides, while *I. flemingii* has stomata on both sides and deeply undulating cell wall pattern on abaxial side of leaf blade.

Another species reduced to a variety of *I. balfourii* by Singh *et al.* (2021), i.e., *Impatiens meeboldii* Hook.f., is a species found in the Western Himalayas from Kashmir region to parts of Pakistan (Nasir 1980; Basu & Uniyal 2002). Hooker described this species on the basis of the collections made by A. K. Meebold *s. n.* & 2467 (K000694790! & K000694791!). This is a much smaller plant, not exceeding 30 cm (Hooker 1910; Nasir 1980; Basu & Uniyal 2002; [http://www.efloras.org/florataxon.aspx?flora\\_id=5&taxon\\_id=250071529](http://www.efloras.org/florataxon.aspx?flora_id=5&taxon_id=250071529)), having flowers with distinctly infundibuliform lower sepal and straight spur as well as a distal lobe of lateral united petals distinctly bilobed, which can easily be seen in the pasted paper on the type specimen (Fig. 4C1, 4C2, & 4D2a).

On the other hand, *I. dorjeekhandui* Chowlu, S.S. Dash & Gogoi is a species only found in western Arunachal Pradesh, almost 2000 km away from the native range of *Impatiens meeboldii* Hook.f. and c. 1000 km from easternmost localities of *I. balfourii*. Habit-wise, *I. dorjeekhandui* is a species more than double in height than *I. meeboldii* (Chowlu *et al.* 2017). Even while considering the height of the plant as a variable feature influenced by biotic and abiotic factors, *I. dorjeekhandui* is clearly different from *I. meeboldii* due to its hairiness, the hooked spur (vs.

straight spur in *I. meeboldii*), a distal lobe of lateral united petals evenly dolabriform, distinctly unlobed (Chowlu *et al.* 2017; Fig. 4D1, 4D2b, 4D2c). Usually characters like these are sufficient to separate these two species taxonomically. In turn *I. balfourii* Hook.f. is three to five times taller than *I. meeboldii*, and has much longer leaves, inflorescence and capsule (Nasir 1980; Fig. 4A1 & 4A2). Finally, in *I. meeboldii*, capsules are short, fusiform and nodding (Fig. 5C1 & GC2), whereas in *I. balfourii*, they are broadly linear and erect (Fig. 4A1)

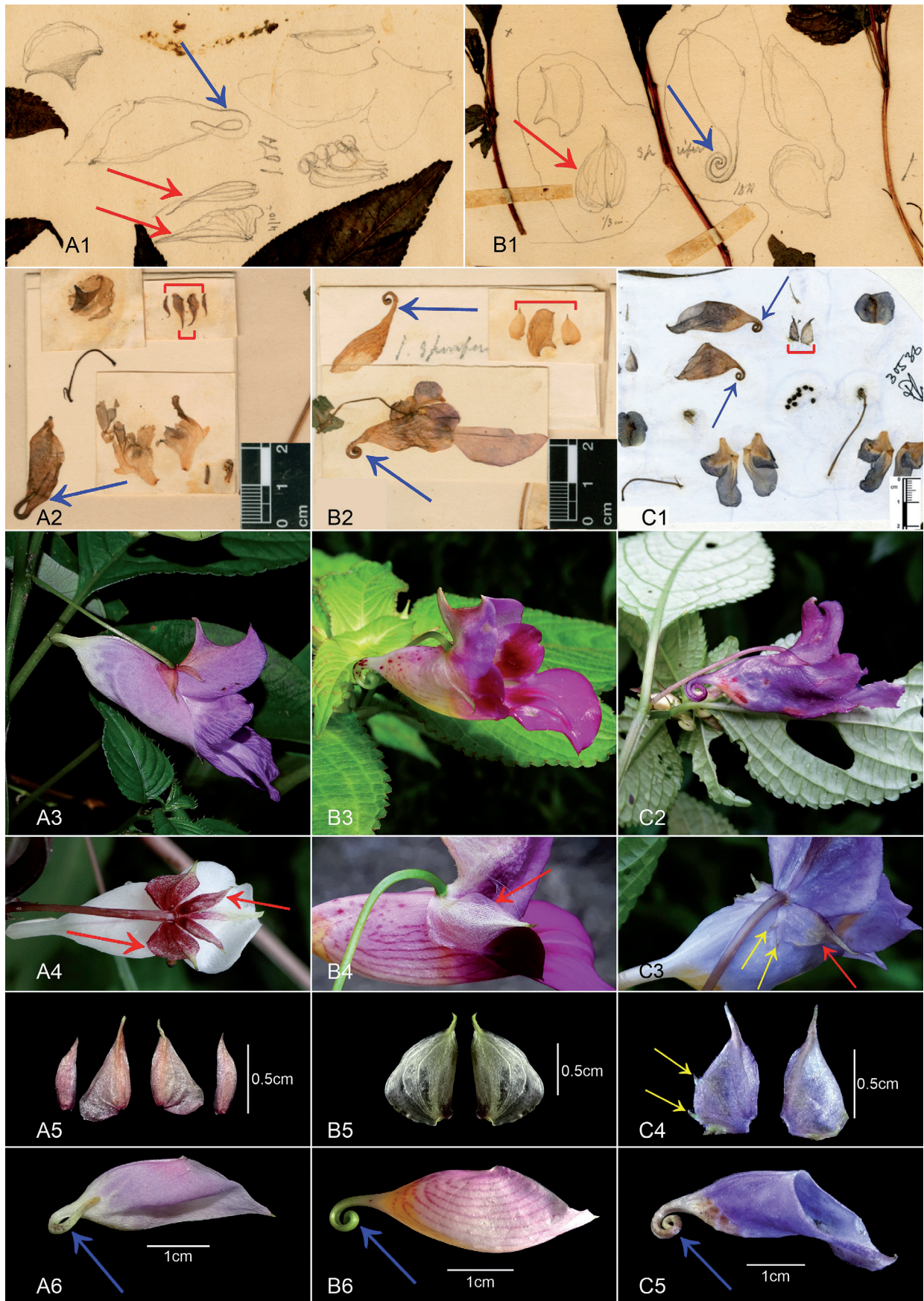
The recently described *Impatiens pyrorrhiza* Lidén & Bharali, regarded as the easternmost relative of *I. urticifolia* Wall. (Lidén & Bharali 2017), was synonymised with *I. bicornuta* Wall. by Singh *et al.* (2021), a completely different species due to its multiflowered, radiate inflorescence, having shrimp-like lower sepals, and an S-shaped spur (Akiyama 1987; Grey-Wilson 1989a; Fig. 5A1, 6A2). *I. urticifolia* and its relatives have short racemose inflorescence and a different shape of lower sepal (Akiyama & Ohba 2015b; compare Fig. 5C1, 5C2, 5D1 & 5D2 in this text). The separation of *I. urticifolia* group from the *I. bicornuta* group is confirmed by molecular studies (Yu *et al.* 2015). The haste and arbitrarily arranged photographs in Fig. 6 in page no. 11 are evident as four pictures in upper and middle parts and one in bottom (second from left) show different species, apparently related to *I. urticifolia*. Only four pictures in bottom row (first, third, fourth and fifth from the left) are of *I. bicornuta* aggregate sensu Akiyama (1987) and Grey-Wilson (1989a). Fifth from the left is a picture of *I. pradhanii* H.Hara, a distinct form with yellow, red streaked flowers (see also Fig. 5B1 & 5B2 in this text), known from Nepal and Sikkim; the others seem to be *I. bicornuta* due to more or less purplish and spotted flowers. Plants with purplish (*I. bicornuta*) and yellow (*I. pradhanii*) flowers were never seen growing in the same place, thus, the approach of Akiyama (1987) and Grey-Wilson (1989a) to treat these taxa as separate species is followed here.

The authors of discussed paper wrote: "After the detailed study of *Impatiens citrina* Hook. f. in Arunachal Pradesh, we found that *I. idumishmiensis*, *I. lohitisensis*, *I. pseudocitrina* and *I. zironiana* are variable forms of *I. citrina*. These forms were seen within the populations of *I. citrina* in some areas of the districts: Anjaw, Changlang, Lohit, Lower Dibang valley, Lower Subansiri, Tirap and West Kameng of Arunachal Pradesh state (Fig. 7)." In fact, Singh *et al.* (2021) have overlooked many of the basic characters that are used to delimit the species or for infrageneric delimitations of the taxa, the most important one being the capsule. Hooker (1904-1906) described *I. citrina* Hook.f. on the basis of *W. Griffith 1235* (K000694584!) from the

**Table 2.** List of pictures in the publication of R.K. Singh *et al.* (2021). There is a noticeable scarcity of original material from Western Himalaya and Sikkim

Sl. No.	Name in Singh <i>et al.</i> (2021)	No. of pictures	Distribution	Remarks
1	<i>Impatiens arguta</i>	18	Bhutan, China, Nepal, Myanmar; common in NE India	two pictures of <i>I. spirifera</i>
2	<i>Impatiens arguta</i> var. <i>walongensis</i>	0	Arunachal Pradesh	
3	<i>Impatiens arguta</i> var. <i>wattii</i>	0	Manipur	
4	<i>Impatiens balfourii</i>	6	Western Himalaya	all six pictures from the internet
5	<i>Impatiens balfourii</i> var. <i>meeboldii</i>	0	Western Himalaya	
6	<i>Impatiens bicolor</i>	2	Western Himalaya	both pictures from the internet
7	<i>Impatiens bicolor</i> var. <i>devendrae</i>	2	Western Himalaya	both pictures from the internet
8	<i>Impatiens bicornuta</i>	9	Western Himalaya, Nepal, Sikkim	partial misidentification; only four pictures are of <i>I. bicornuta</i> agg., three of these four are taken from the internet; see the text
9	<i>Impatiens citrina</i>	14	Arunachal Pradesh	misidentification, pictures show <i>I. zironiana</i> ; see the text
10	<i>Impatiens cyclosepala</i>	0	Arunachal Pradesh, China	
11	<i>Impatiens decipiens</i>	0	Sikkim, West Bengal	
12	<i>Impatiens exilis</i>	0	Nepal, West Bengal, Sikkim, Bhutan	
13	<i>Impatiens falcifera</i>	0	Nepal, Sikkim, West Bengal, Bhutan, China	
14	<i>Impatiens gammiei</i>	0	Sikkim, West Bengal, Arunachal Pradesh	
15	<i>Impatiens hobsonii</i>	0	Nepal, Sikkim	
16	<i>Impatiens infundibularis</i>	0	Sikkim, West Bengal	
17	<i>Impatiens khasiana</i>	6	Meghalaya, Arunachal Pradesh, Myanmar	one picture shows <i>I. arguta</i> - see the text
18	<i>Impatiens kingii</i>	0	Sikkim, Bhutan	
19	<i>Impatiens latiflora</i>	6	Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland	
20	<i>Impatiens leptoceras</i>	3	Nepal	misidentification, pictures show <i>I. drepanophora</i>
21	<i>Impatiens occultans</i>	0	Nepal, Sikkim, West Bengal	recently found in Tibet (Guo <i>et al.</i> 2016)
22	<i>Impatiens porrecta</i>	26	Myanmar, China, India, Arunachal Pradesh, Manipur, Nagaland, Meghalaya, Laos	very broad circumscription - see the text
23	<i>Impatiens pulchra</i>	7	Myanmar, China, India - Mizoram, Nagaland, Sikkim, E Nepal, Thailand	only three true <i>I. pulchra</i> , of these three are from the internet
24	<i>Impatiens scitula</i>	3	Sikkim, West Bengal, Bhutan, Tibet, Arunachal Pradesh	
25	<i>Impatiens serrata</i>	0	Western Himalaya, Nepal	
26	<i>Impatiens stenantha</i>	2	Nepal, China, Bhutan, Myanmar; common in NE India	one misidentification, picture shows <i>I. drepanophora</i> (Fig. 12K)
27	<i>Impatiens sulcata</i>	0	Western Himalaya, Nepal, Sikkim, Bhutan, Arunachal Pradesh, China	
28	<i>Impatiens sulcata</i> var. <i>amplexicaulis</i>	0	Western Himalaya	
29	<i>Impatiens sulcata</i> var. <i>glandulifera</i>	0	Western Himalaya, Nepal	
30	<i>Impatiens thomsonii</i>	0	Western Himalaya, Sikkim	
31	<i>Impatiens tripetala</i>	0	Bangladesh, Bhutan, Myanmar, Nepal; common in lower elevations in NE India	recently reported from Yunnan (Zhang <i>et al.</i> 2020b)
32	<i>Impatiens tuberculata</i>	0	Sikkim, Bhutan, S Tibet	
33	<i>Impatiens violoides</i>	2	Western Himalaya	both pictures from the internet





**Fig. 2.** Morphological distinction between *Impatiens arguta* Hook.f. & Thomson (A), *I. spirifera* Hook.f. (B), and *I. tatoensis* Gogoi & W. Adamowski (C)

Explanations: A1 & B1 – Hooker’s sketch of floral parts showing lower sepal and lateral sepals; A2, B2 & C1 – dissected floral parts from type specimens showing pairs of lateral sepals, and lower sepal with incurved and coiled spur; A3, B3 & C2 – lateral view of flowers; A4, B4 & C3 – dorso-lateral view of flowers showing lateral sepals; A5, B5 & C4 – pairs of lateral sepals; A6, B6 & C5 – close view of lower sepals showing incurved and coiled spur (A1 & A2 from *J. D. Hooker s.n.*, lectotype K000694618!, and B1 & B2 from *J. D. Hooker s.n.*, lectotype K000694933! © Board of Trustees of the Royal Botanic Gardens, Kew, <http://specimens.kew.org/herbarium/K000694618> & <http://specimens.kew.org/herbarium/K000694933>, and C1 from *R. Gogoi 30536*, holotype CAL0000024913!)



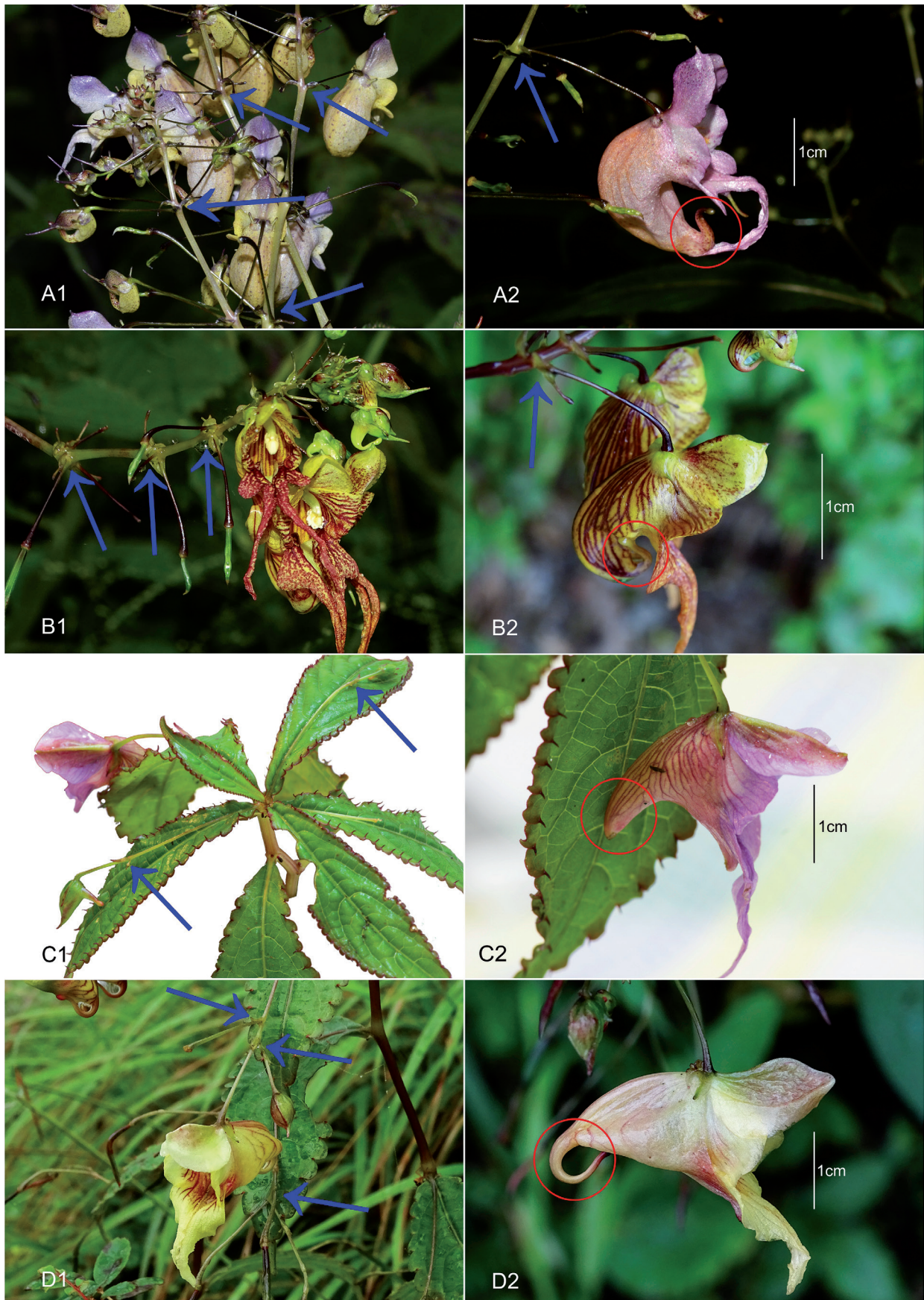
**Fig. 3.** Range of flower color variation in *Impatiens arguta* Hook.f. & Thomson

Explanations: A – dark hue purple colored flower, B – flower with dark hue of purple mixed with white, C – purple colored flower, D – flower with purple hues mixed with white and orange, E & G – white flower with lighter hues of maroon on dorsal petal and lateral united petals, F – yellowish-green flower with purplish-blue lateral united petals, H – yellow colored flower. Notice also differences in shape of appendix on dorsal petal, A-C – sharp, horn-like, D-H – cristate. Photo credit: Dr. Santanu Dey (D, F & H)



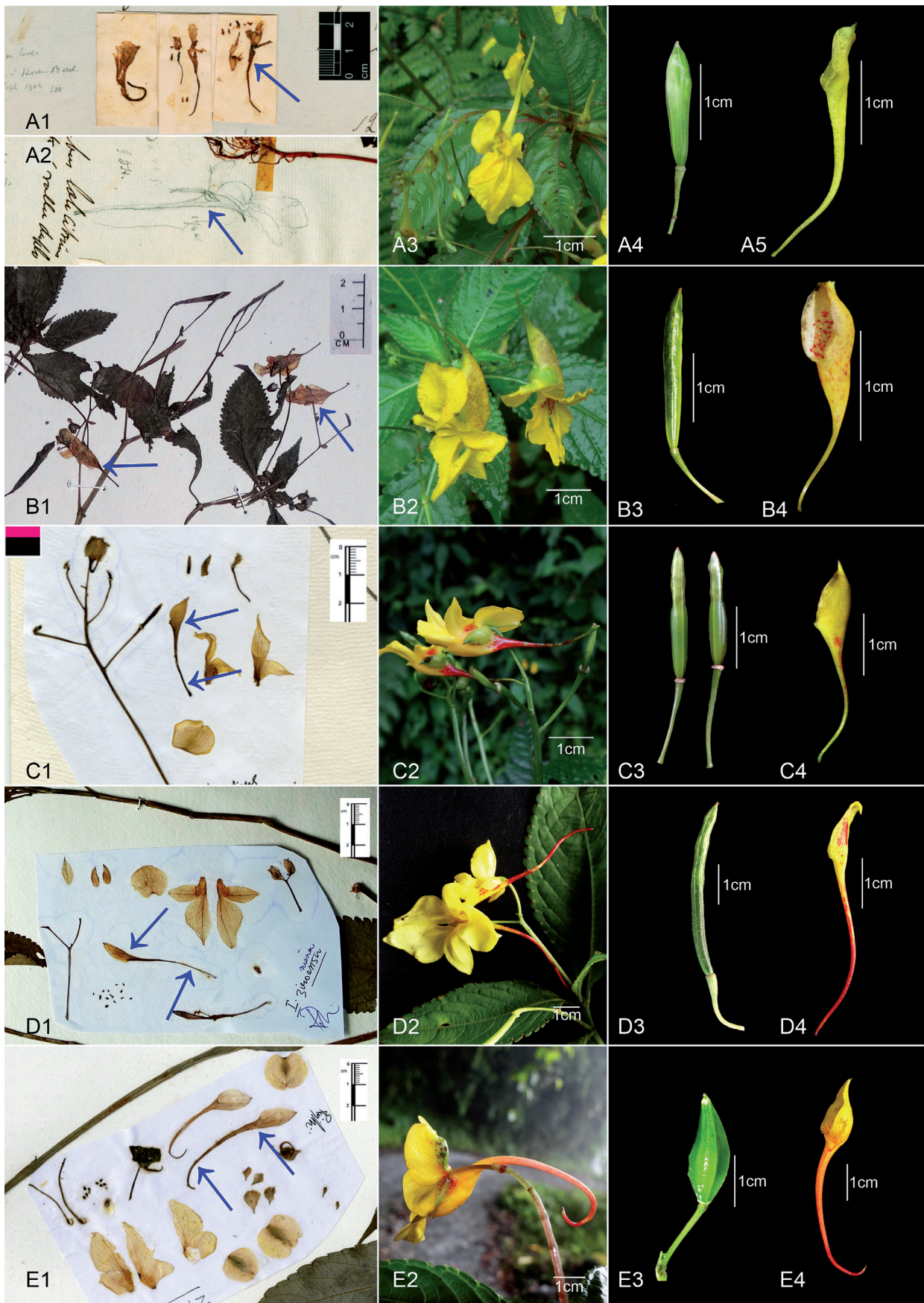
**Fig. 4.** Type specimen images comparing *I. balfourii* Hook.f. (A), *I. flemingii* Hook.f. (B), *I. meeboldii* Hook.f. (C including D2a), and *I. dorjeekhandui* Chowlu, S.S.Dash & Gogoi [D excluding D2a (*I. meeboldii*)]

Explanations: A1, B1 & C1 – portions of type specimens showing inflorescences, flowers and capsules, D1 – holotype image of *I. dorjeekhandui*; A2, B2 & C2 – Hooker's sketch of floral parts; D2 – dissected floral parts of *I. dorjeekhandui* showing lower sepal with distinctly curved spur (b), and unlobed distal lobe of lateral united petals (c); D2a – dissected floral part of *I. meeboldii* showing lower sepal with straight spur, and bilobulate distal lobe of lateral united petals. (A1 & A2 from *s.coll. s.n.*, lectotype K000694736!; B1 & B2 from *s.coll. s.n.*, lectotype K000694674!; C1, C2 & D2a from A. K. Meebold *s.n.*, isolectotype K000694790! © Board of Trustees of the Royal Botanic Gardens, Kew, <http://specimens.kew.org/herbarium/K000694736>, <http://specimens.kew.org/herbarium/K000694674> & <http://specimens.kew.org/herbarium/K000694790>, and D1 from K. Chowlu & S. S. Dash 40952, holotype CAL0000033832!)



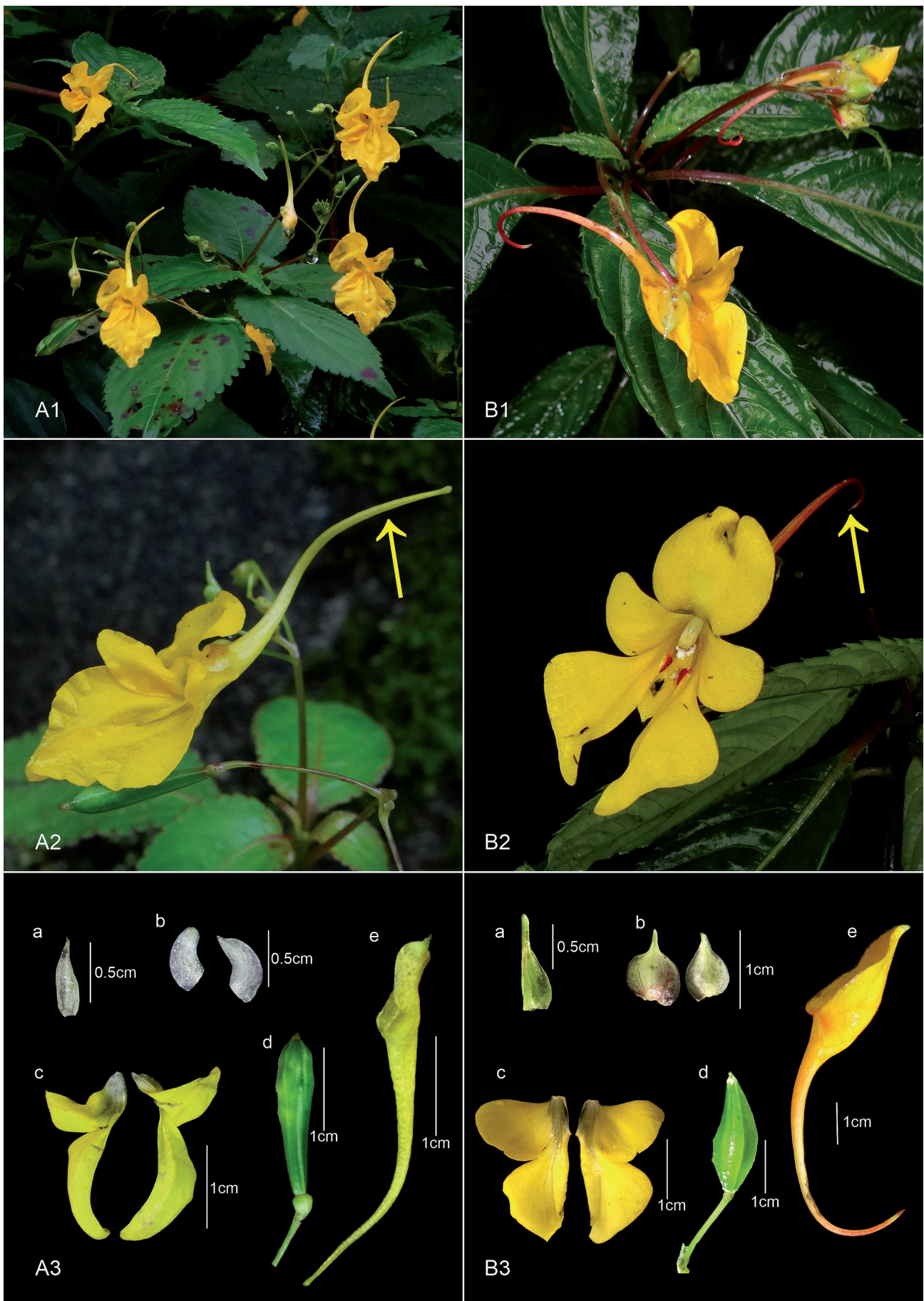
**Fig. 5.** Comparison of inflorescences and flower morphology of *Impatiens bicornuta* Wall. (A), *I. pradhanii* H.Hara (B), *I. pyrrohiza* Lidén & Bharali (C), and *I. urticifolia* Wall. (D)

Explanations: A1 & B1 – radiate inflorescence with flowers in whorls, C1 & D1 – 1-6-flowered racemose inflorescence, A2 & B2 – flowers showing saccate lower sepal with abruptly narrowed, short spur, C2 & D2 – flowers showing sub-bucciniform to bucciniform lower sepals with gradually constricted blunt or curved spur. Photo credit: Saroj Kumar Kasaju (A1 & A2) and Magnus Lidén (C1 & C2)



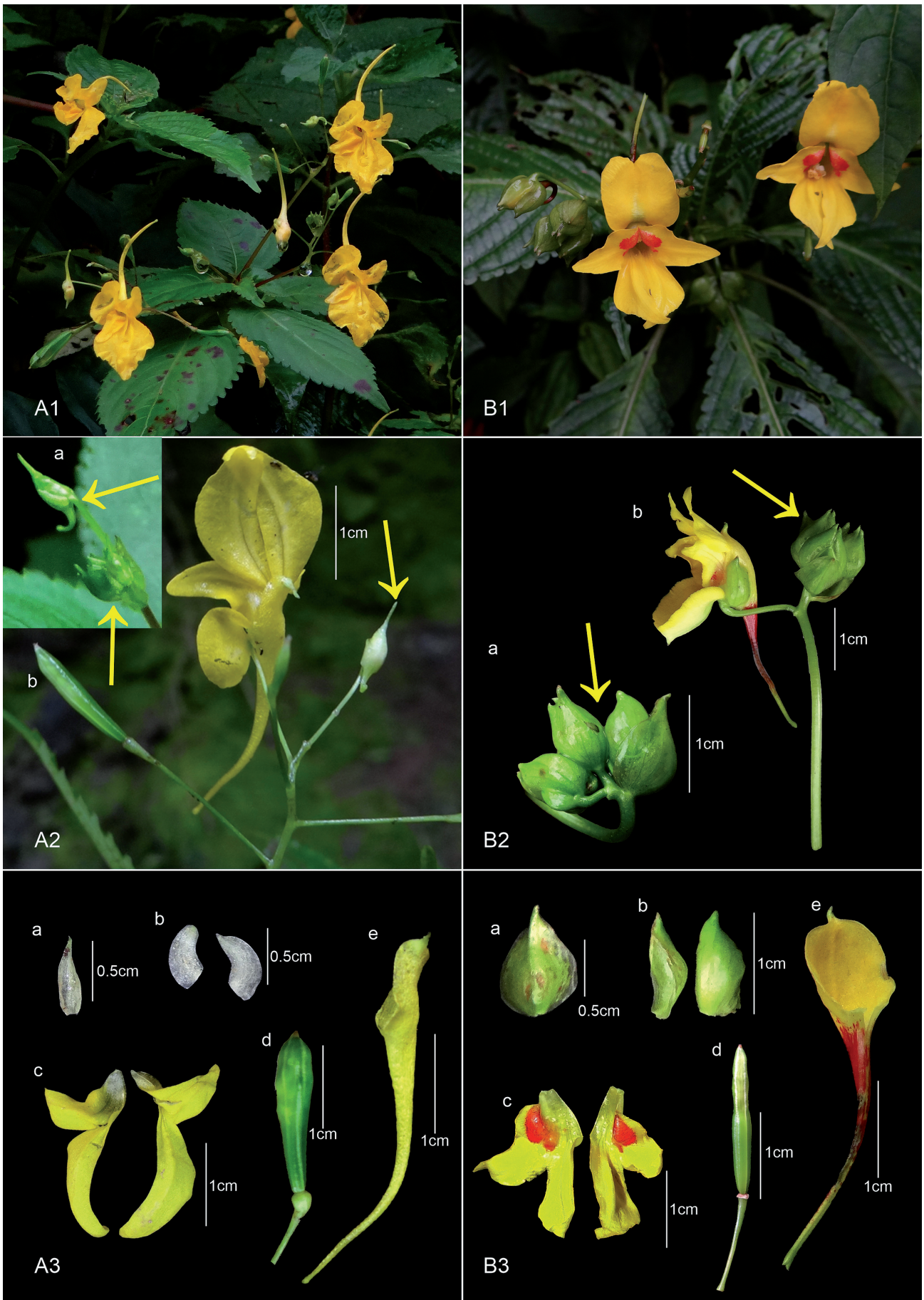
**Fig. 6.** Morphological distinction between *Impatiens citrina* Hook.f. (A), *I. pseudocitrina* Hareesh, M.Sabu & Gogoi (B), *I. lohitisensis* Gogoi & Borah (C), *I. zironiana* Gogoi, Hareesh & W.Adamowski (D) and *I. idumishmiensis* Gogoi, W.Adamowski, Borah & Chhetri (E)

Explanations: A1, C1, D1 & E1 – dissected floral parts from type specimens showing lower sepals and spur characters, A2 – Hooker’s sketch of *I. citrina* flower showing navicular/narrow lower sepal, B1 – a part of *I. pseudocitrina* specimen with flowers showing bucciniform lower sepal; A3, B2, C2, D2 & E2 – fronto-lateral and lateral view of flowers; A4, B3, C3, D3 & E3 – capsules; A5, B4, C4, D4 & E4 – lower sepals. (A1 & A2 from W. Griffith 1235, lectotype K000694584! © Board of Trustees of the Royal Botanic Gardens, Kew, <http://specimens.kew.org/herbarium/K000694584>; B1 from R. Gogoi 24344, paratype CAL!; C1 from R. Gogoi 24533, isotype ASSAM0000000152!; D1 from R. Gogoi 30539, holotype CAL0000024906!; E1 from R. Gogoi & S. Borah 21861, holotype CAL0000024956!). Photo credit: Vadakkoot S. Hareesh (B3 & B4)



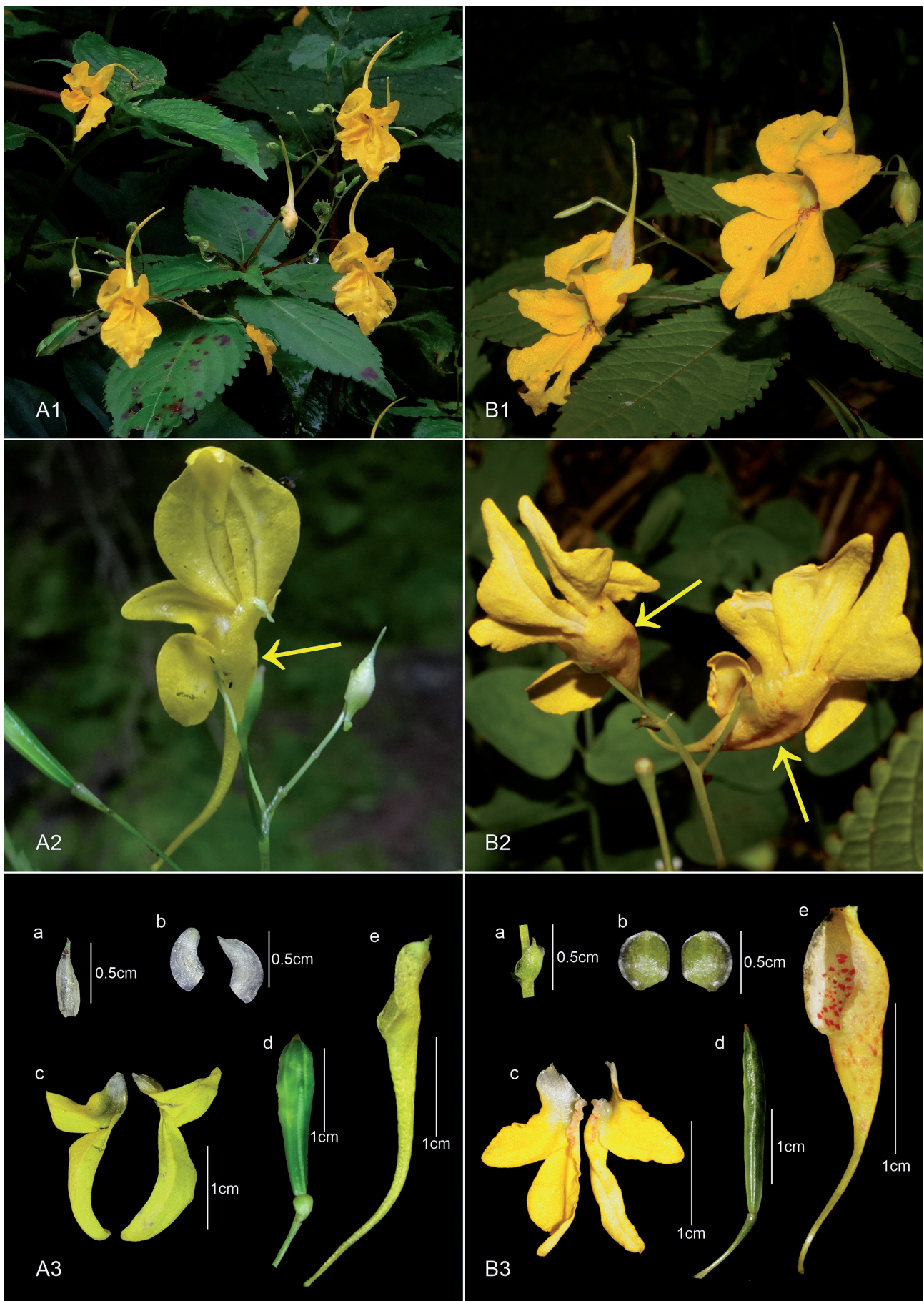
**Fig. 7.** Comparison of *Impatiens citrina* Hook.f. (A) and *I. idumishmiensis* Gogoi, W.Adamowski, Borah & Chhetri (B)

Explanations: A1 & B1 – plants in habitats with flowers, A2 & B2 – close fronto-lateral and lateral view of flowers, A3 & B3 – dissected floral parts, bract (a), lateral sepals (b), lateral united petals (c), capsule (d), and lower sepal (e)



**Fig. 8.** Comparison of *Impatiens citrina* Hook.f. (A) and *I. lohitis* Gogoi & Borah (B)

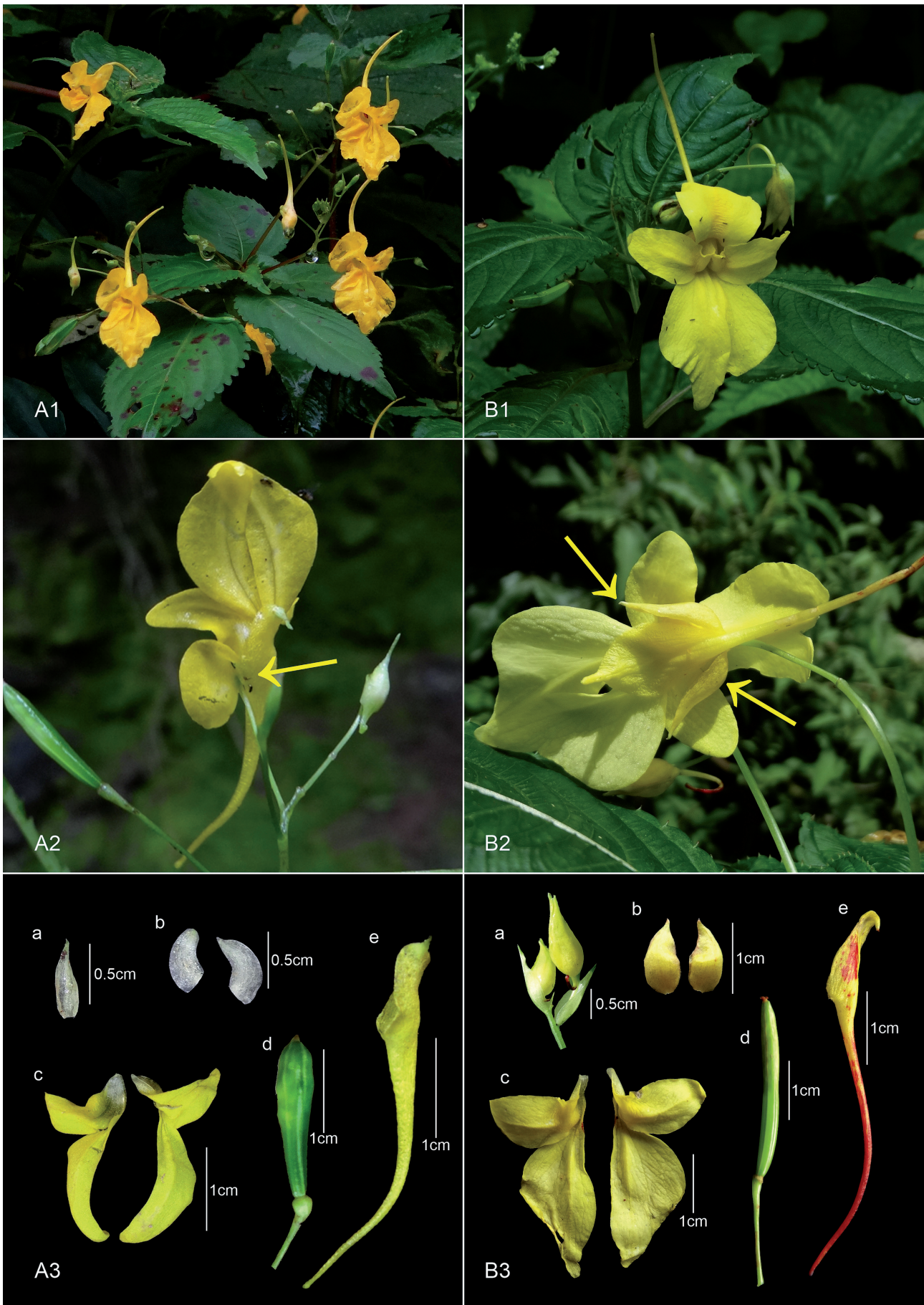
Explanations: A1 & B1 – plants in habitats with flower buds, and flowers (front view), A2 & B2 – inflorescence with lateral view of flowers (b) and young flower buds (a), A3 & B3 – dissected floral parts, bract (a), lateral sepals (b), lateral united petals (c), capsule (d), and lower sepal (e)



**Fig. 9.** Comparison of *Impatiens citrina* Hook.f. (A) and *I. pseudocitrina* Hareesh, M.Sabu & Gogoi (B)

Explanations: A1 & B1 – plants in habitats with flowers (fronto-lateral and front view), A2 & B2 – ventral view of flowers showing lower sepals, A3 & B3 – dissected floral parts, bract (a), lateral sepals (b), lateral united petals (c), capsule (d), and lower sepal (e). Photo credit: Vadakkoot S. Hareesh (B1, B2 & B3)





**Fig. 10.** Comparison of *Impatiens citrina* Hook.f. (A) and *I. zironiana* Gogoi, Hareesh & W.Adamowski (B)

Explanations: A1 & B1 – plants in habitats with flowers (front view), A2 & B2 – ventral view of flowers showing lower sepals and lateral sepals, A3 & B3 – dissected floral parts, bract (a), lateral sepals (b), lateral united petals (c), capsule (d), and lower sepal (e)



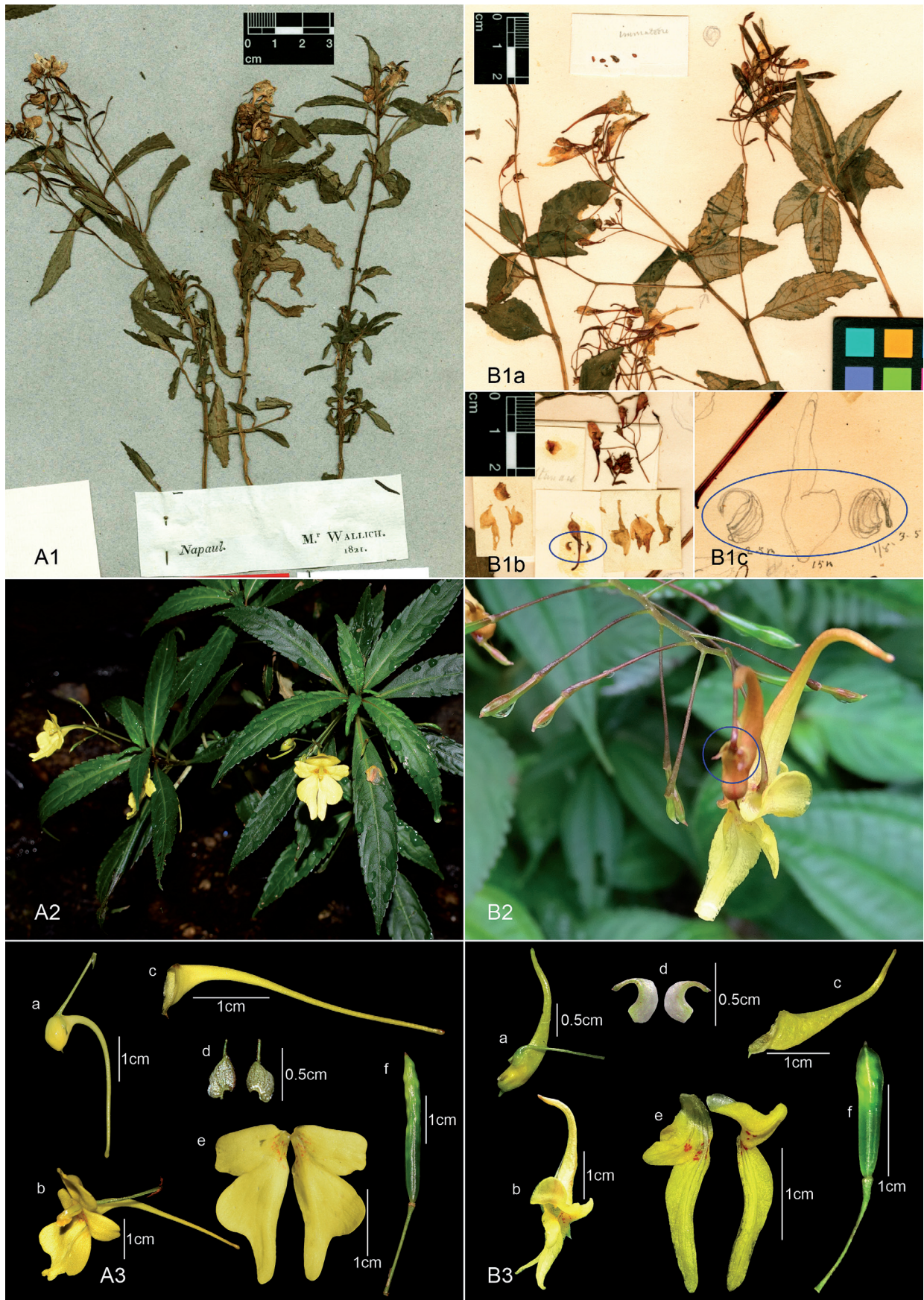
**Fig. 11.** Variation in flower color and spur of lower sepal

Explanations: A – *I. citrina* Hook.f., yellow colored flowers (A1), mature clavate capsule (A2), white colored flowers (A3); B – *I. zironiana* Gogoi, Hareesh & W.Adamowski, linear capsules (B1), flower having dark hue of yellow (B2), lime yellow colored flower (B3); C – *I. spirifera* Hook.f., flower with gradually elongated lower sepal and upward pointing keel on dorsal petal (C1), flower with shortened lower sepal and forward pointing keel on dorsal petal (C2); D – *I. stanantha* Hook.f., light yellow colored flower with rusty red markings and hooked incurved spur (D1), bright yellow colored flower without markings and completely inflexed spur (D2), bright yellow colored flower with rusty red markings on throat and slightly inflexed spur (D3)



**Fig. 12.** Morphological distinction between: *Impatiens angustiflora* Hook.f. (A) and *I. leptoceras* DC. (B)

Explanations: A1 – portion of type specimen showing inflorescence and a flower with upcurved spur, A2 – dissected floral parts from type and original materials showing lateral united petals and lower sepal, A3 – lower sepal (ax & ay), and lateral united petals (b), B1 – portion of type specimen showing inflorescence and flowers with downcurved spur, B2 – dissected flower parts showing lower sepal and flower buds, B3 – lower sepal (a), and lateral united petals (b). (A1 & A2 from *T. Lobb s.n.*, lectotype K000694623!, B2 from original material *Wallich 4770*, K001039862! © Board of Trustees of the Royal Botanic Gardens, Kew <http://specimens.kew.org/herbarium/K000694623> & <http://specimens.kew.org/herbarium/K001039862>; and B1 from *Wallich s.n.*, syntype G00218029!, © Catalogue des herbiers de Genève (CHG), Conservatoire & Jardin botaniques de la Ville de Genève <https://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=216209&base=img&lang=en>. Photo credit: B. B. T. Tham (A3ax), Chaya Deori (A3ay & A3b), and La Dorchee Sherpa (B3)



**Fig. 13.** Comparison of *Impatiens leptoceras* DC. (A) and *I. drepanophora* Hook. f. (B)

Explanations: A1 & B1a – portions of type specimens showing inflorescences, B1b – dissected floral parts, B1c – Hooker’s sketch of lateral sepals depicting drepanate awns, A2 & B2 – plants in habitats showing flower buds and flowers, A3 & B3 – dissected floral parts, flower bud (a), flower (b), lower sepal (c), lateral sepals (d), lateral united petals (e), and capsule (f). (A1 from *Wallich s.n.*, syntype G00218029!, © Catalogue des herbiers de Genève, CHG, Conservatoire & Jardin botaniques de la Ville de Genève <https://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=216209&base=img&lang=en>, and B2 from *J. D. Hooker & T. Thomson 56*, lectotype K000694682!, © Board of Trustees of the Royal Botanic Gardens, Kew <http://specimens.kew.org/herbarium/K000694682>). Photo credit: La Dorchee Sherpa (A2 & A3)

present day Arunachal Pradesh, as a plant with yellow coloured flowers (sometimes white, see Fig. 11A3), which superficially resembles *I. lohitisensis* Gogoi & Borah, *I. pseudocitrina* Hareesh *et al.*, and *I. zironiana* Gogoi *et al.* However, *I. citrina* bears clavate capsules (see Fig. 6A4), whereas the other three discussed species have linear elongated capsules (Fig. 6B3, 6C3 & 6D3). We found only *I. zironiana* illustrated in Fig. 7 in Singh *et al.* (2021), where it is identified erroneously as *I. citrina* – the linear elongated capsules are visible in several pictures in the photoplate. There is no proof that authors have ever seen *I. citrina*, *I. lohitisensis*, or *I. pseudocitrina* in the field.

Moreover, Singh *et al.* (2021) synonymised *I. idumishimiensis* Gogoi *et al.* with all four species (*I. citrina*, *I. lohitisensis*, *I. pseudocitrina*, and *I. zironiana*) completely ignoring several important features of the last species (*I. idumishimiensis*), a decumbent species, having a short fusiform capsule, much bigger flowers and a different shape of lower sepal and downcurved spur (Fig. 6E1-6E4). For more detailed comparisons of *I. citrina* with *I. idumishimiensis*, *I. lohitisensis*, *I. pseudocitrina* or *I. zironiana*, see Fig. 7, 8, 9 & 10. Incidentally, *I. citrina* was lectotypified first by Gogoi & Borah (2018) in the paper published on 31.07.2018. The paper by Ruchisansakun *et al.* (2018), cited by Singh *et al.* (2021), was published almost four months later.

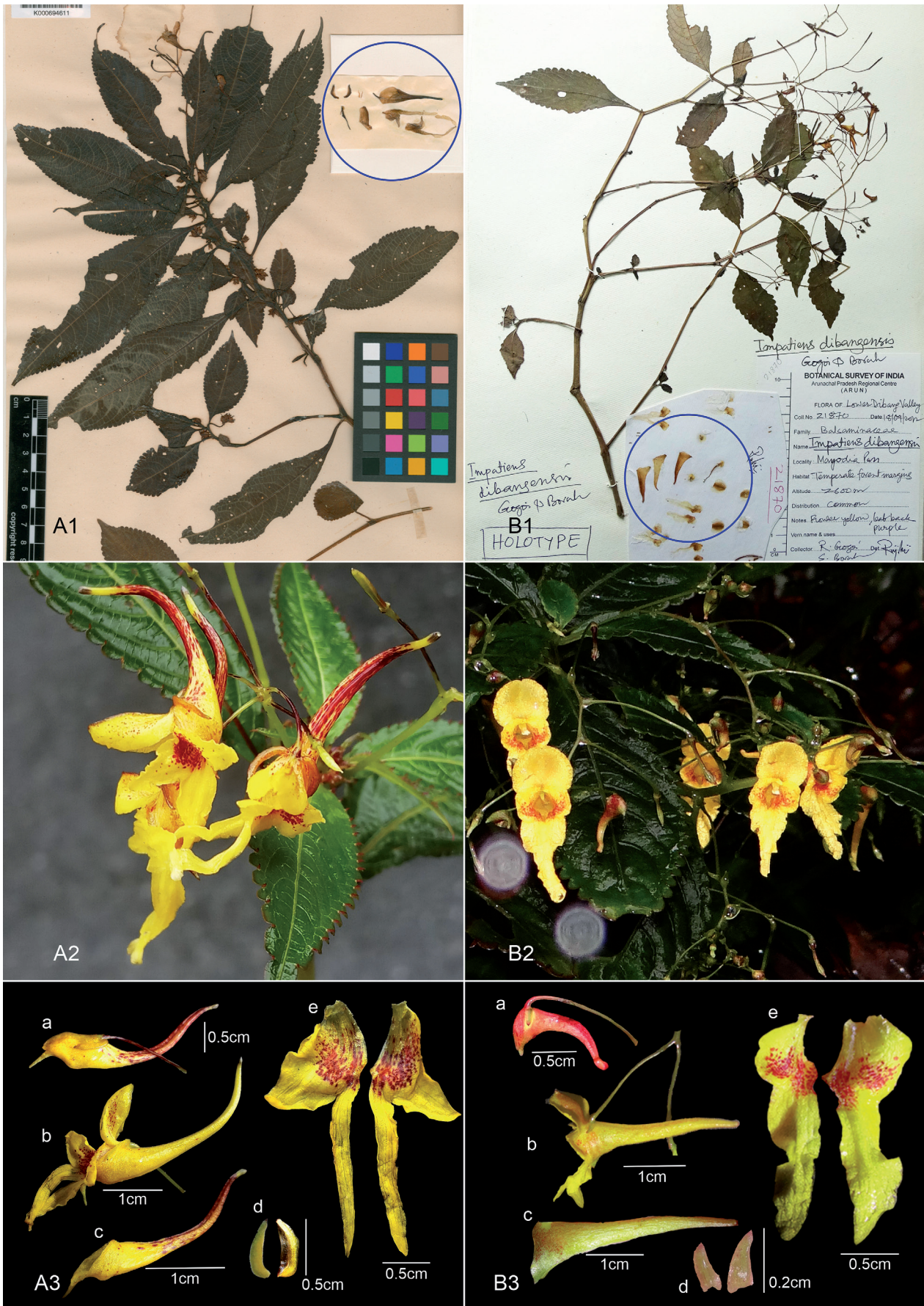
In Fig. 8, Singh *et al.* (2021) showed the variation of *Impatiens khasiana* Hook.f. (a species with two ovate strongly hairy lateral sepals) on six images. However, the picture at the right side of bottom row, despite showing balsam flower far past its prime, is identifiable as *I. arguta* due to glabrous nature of the plant and four elongated, glabrous lateral sepals (Fig. 2A1-2A6 and Fig. 3), a serrate leaf margin and distinct extrafloral nectaries visible as black dots in the base of the petiole which are never present in *I. khasiana*. There is no variation in other 5 photos and they all seem to come from the same population. *I. khasiana* var. *toppinii* (Dunn) Ruchis. & Suksathan. is a truly glabrous and decumbent taxon (treated as a separate species, *I. toppinii* in Gogoi *et al.* 2018), although its general morphology is similar to *I. khasiana* Hook.f. that has, however, a much more erect stature and hairy stems and leaves. Ruchisansakun *et al.* (2018) treated them as two varieties during their revision of Balsaminaceae in Myanmar, which seems quite appropriate.

Singh *et al.* (2021) synonymised *I. angustiflora* Hook.f. with *I. leptoceras* DC., an endemic species of Nepal. de Candolle (1824) described *I. leptoceras* based on the collection by N. Wallich from Nepal (G00218028 !) in 1819. The downcurved linear long tubular lower sepal with long, downcurved spur, and broad dolabriform distal lobes of the lateral united

petals (Fig. 12B1-12B3 and Fig. 13A1-13A3) are sufficient to distinguish this species from any other Himalyan species. On the other hand, *I. angustiflora* (K000694623!) is a species endemic to Meghalaya; it was described by Hooker in 1875 in “*Flora of British India*” (Hooker 1875) based on a collection by T. Lobb and Hooker & Thomson’s own collection from Khasi Hills of present day Meghalaya, India. Before erecting it as an independent species, Hooker & Thomson reported this species as *Impatiens leptoceras* DC. and its varieties (variety  $\eta$  &  $\theta$ ) (Hooker & Thomson 1859). In 1875, Hooker realised it to be a distinct species and described *I. angustiflora* Hook.f. with two varieties. The var. *1* included W. Griffith’s collection from Bhutan and the var. *2* was based on T. Lobb’s and Hooker & Thomson’s own collections. Later, Hooker again realised that the Bhutan plant (var. *1*) was not related to this species and excluded it from *I. angustiflora* Hook.f. (Hooker 1904-1906; Gogoi *et al.* 2020a). *Impatiens angustiflora* is morphologically different from *I. leptoceras*, because of its narrowly funnellform lower sepal with slightly upcurved spur and the narrow distal lobe of lateral united petals (Fig. 12A1-12A3). Singh *et al.* (2021) have not dwelled into details of the historical basis of splitting these two so different taxa by Hooker (1905). Additionally, they erroneously claimed it (see Fig. 9, G & H in the discussed paper) as *I. leptoceras* DC., of what is actually *I. drepanophora* Hook.f., due to the narrow tubular lower sepal with upcurved spur and the distinctly awned lateral sepals (compare Fig. 13B1-13B3 in this text).

*Impatiens dibangensis* Gogoi & Borah is a species endemic to the Lower Dibang Valley district of Arunachal Pradesh (Gogoi & Borah 2017). Singh *et al.* (2021) based on superficial observation treated it under the synonymy of *I. stenantha* Hook.f., which however is rather different and a distinct species (Fig. 14A1-14A3 and Fig. 11D1-11D3). These two species clearly differ in their inflorescence pattern, the shape of the lower sepal, the lateral sepals, and the lateral united petals. *I. dibangensis* Gogoi & Borah can easily be differentiated from *I. stenantha* Hook.f. by the straight lower sepal and slightly downcurved spur, and much different lateral united petals (Fig. 14A1-14A3). In *I. stenantha*, a distal lobe of lateral united petals is narrowly ribbon shaped and gradually tapering towards apex (Fig. 14A3e) vs. much wider, uniform and oblong-elongate in *I. dibangensis* (Fig. 14B3e) makes both the species easily separable.

Hooker and Thomson (1859) described *Impatiens porrecta* as a plant with pale yellow or straw-colored flowers, streaked with red. Ruchisansakun *et al.* (2018) in their revision of Balsaminaceae of Myanmar follow the original description of Hooker and Thomson (1859) and describe *I. porrecta* as having yellow flowers with



**Fig. 14.** Comparison of *I. stenantha* Hook.f. (A) and *I. dibangensis* Gogoi & Borah (B)

Explanations: A1 & B1 – type specimen images with dissected floral parts, A2 & B2 – inflorescences and front view of flowers, A3 & B3 – flowers and dissected floral parts, flower bud (a), lateral view of flower (b), lower sepal (c), lateral sepals (d) and lateral united petals (e). (A1 from *J.D. Hooker s.n.*, lectotype K000694611! © Board of Trustees of the Royal Botanic Gardens, Kew, <http://specimens.kew.org/herbarium/K000694611>, and B1 from Gogoi & Borah 21870, holotype CAL0000024924!)



**Fig. 15.** Comparison of *Impatiens marianae* Rchb.f. ex Hook.f. (A), *I. porrecta* Wall. ex Hook.f. & Thomson (B), and *I. nicolsoniana* Gogoi & Arisdason (C)

Explanations: A1 – front view of flower, B1 – fronto- lateral view of flower, A2 & B2 – close lateral view of flowers showing lateral sepals and lower sepal, A3 & B3 – plants in natural habitats showing variegated leaves of *I. marianae*, and leaves of *I. porrecta*, A4 & B4 – lower sepal (a) and lateral sepals (b), C1 & C2 – dissected floral parts and Hooker’s pencil sketch from type specimen showing distinctly navicular lower sepal with gradually constricted spur. (C1 & C2 from type specimen *Gustav Mann s.n.*, K000694773! © Board of Trustees of the Royal Botanic Gardens, Kew, <http://specimens.kew.org/herbarium/K000694773>)



**Fig. 16.** Comparison of *Impatiens sulcata* Wall. (A), *I. amplexicaulis* Edgew. (B), and *I. glandulifera* Royle (C)

Explanations: A1 & B1 – portions of type specimens showing phyllotaxy and leaf base (xa & xb), inflorescence, and capsule (yb), C1 – portion of *I. glandulifera* specimen showing phyllotaxy (xc) and capsule (yc); A2, B2 & C2 – arrangement of leaves (alt=alternate, opp=opposite, whl=whorled) and leaf base (amp=amplexicaul); A3, B3 & C3 – capsules; A4, B4 & C4 – flowering twigs showing leaf arrangement, leaf base, inflorescence, and capsules.

(A1 from *N. Wallich s.n.*, lectotype K001039846!; B1 from *M. P. Edgeworth 333*, lectotype K000694628, and C1 from *M. P. Edgeworth 1068*, K000481167! © Board of Trustees of the Royal Botanic Gardens, Kew, <http://specimens.kew.org/herbarium/K001039846>, <http://specimens.kew.org/herbarium/K000694628>, & <http://specimens.kew.org/herbarium/K000481167>)



some red reticulate markings. Also, Zhang *et al.* (2020a), while describing a new species, *I. quintadecimacopii*, and reporting the first finding of *I. porrecta* in China, shows a plant with yellow, red streaked flowers as this species. On the other hand in Gogoi *et al.* (2018), a plant named *I. porrecta* has flowers white, tinged with pink (Fig. 15B1-15B4), similar to the majority of pictures of this plant treated under the same name by Singh *et al.* (2021). Another similar species is *Impatiens marianae* Rchb.f. ex Hook.f., cultivated because of its beautiful purple flowers and variegated foliage. The species is based on a collection by G. Mann 488 (K000694794 !) collected in July 1879. The variegated nature of the leaves is still prominently visible in the leaves of the specimens collected some 140 years ago. Leaf variegation of the species seems to be genetically fixed. Wild forms of *I. marianae* were observed in two localities in different parts of Arunachal Pradesh by one of the authors (RG) of this reply (Fig. 15A1-15A4; see also Gogoi *et al.* 2018). A third similar species, recently renamed as *Impatiens nicolsoniana* Gogoi & Arisdason (replacement name for *Impatiens mannii* C.B. Clarke ex Hook.f.; for discussion see Gogoi & Arisdason 2016, the type specimen is wrongly placed under *I. cuspidifera* Hook.f. at K) was based on the collection *Gustav Mann s.n.*, K000694773! Hooker erected this species on the basis of brick red to red flowers and a lower sepal navicular with gradually constricted, almost straight spur (Fig. 15C1 & 15C2). This species is almost in oblivion after its first description, hence, lumping it with *I. porrecta* without trying to collect and study fresh material seems premature. While these observations raise doubts towards the true identity of white to pink flowered forms, called *I. porrecta* by Gogoi *et al.* (2018) and their relations with the above mentioned taxa, we do not accept the concept of *I. porrecta s.l.* proposed by Singh *et al.* (2021), due to superficial character of their observations. They claim: “In some places we found variegated and non-variegated leaves within the same population (Fig. 10)”. However, in Fig. 10 in the discussed paper, we see only separate pictures of variegated and non-variegated forms of *I. marianae* and similar taxa. There is only one picture somewhat supporting these claims (Fig. 10, middle in the second row from top in the discussed paper), showing a plant with purple flower, typical for *I. marianae* and non-variegated leaves. A revision of this group of balsams requires much more thorough studies.

The authors of the discussed paper reduced the well known and identifiable taxa, *I. glandulifera* (Fig. 16C1-16C4) and *I. amplexicaulis* (Fig. 16B1-16B4), to varieties of another species, *I. sulcata* (Fig. 16A1-16A4), completely disregarding the work of generations of taxonomists (Hooker 1904-1906; Nasir 1980; Akiyama & Ohba 2015a), simply stating:

“*I. glandulifera* Royle is similar to *I. sulcata* Wall. in all respects, except the shape of capsule, therefore treated here as variety of *I. sulcata*. In *I. sulcata* var. *sulcata*, capsule is linear and cylindrical and in *I. sulcata* var. *glandulifera*, capsule is fusiform and broadly clavate.” They did not notice that leaves of *I. glandulifera* are opposite or in whorls of three (sometimes even five) and leaf margins serrate, as well as the petioles densely glandular (Fig. 16C1 & 16C2, whereas in *I. sulcata*, at least the middle leaves are alternate and the leaf margins crenate (Fig. 16A1 & 16A2), as well as the petioles without glands or sparsely glandular (compare Hooker 1904-1906; Nasir 1980; Pusalkar & Srivastava 2018). There are also differences between these taxa in seedcoat microstructure and morphology of epidermal cells. The seedcoat of *I. glandulifera* is rugosely areolate, and egranulate (Abid *et al.* 2011) or rugosely ruminant (Maciejewska-Rutkowska & Janczak 2017), whereas the seedcoat of *I. sulcata* is foveate areolate, granulate (Abid *et al.* 2011) or reticulate type, fine reticulate subtype (Rewicz *et al.* 2020). Rahman *et al.* (2016) found abaxial epidermal cells very irregular, up to 18 lobed, the stomatal pore elliptic in *Impatiens sulcata* and the abaxial cells more or less rectangular (4-5 lobed), while the stomatal pore spindle shaped in *I. glandulifera*. “*Impatiens amplexicaulis* Edgew. is similar to *I. sulcata* Wall. in all respects, except the leaves characters, therefore treated here as variety of *I. sulcata*”, whereas Singh *et al.* (2021) do not even mention another taxon with amplexicaul leaves, i.e., *I. chungtienensis* (= *I. badrinathii*; for discussion see Akiyama & Ohba 2015a), growing from Western Himalaya to China. Contrary to the statement of Singh *et al.* (2021), *I. amplexicaulis* has not only amplexicaul leaves (Fig. 16 B2), but also smaller flowers 18-28 mm long, 15-24 mm deep, and a lower sepal 10-16 mm long, 8-11 mm deep (Akiyama & Ohba 2015a); in *I. sulcata* the leaves are petiolate (Fig. 16 A2), the flowers are 25-35 mm long (Pusalkar & Srivastava 2018), and lower sepal is 14-25 mm long, 10-17 mm deep (Grey-Wilson 1991); in *I. glandulifera* leaves are petiolate (Fig. 16 C2), flowers can be 25-40 mm long (Nasir 1980; Beerling & Perrins 1993; Pusalkar & Srivastava 2018). *I. amplexicaulis* has also a shorter inflorescence with 3-6(7) flowers (Akiyama & Ohba 2015a); in *I. sulcata*, there are four to many flowered inflorescences (Grey-Wilson 1991); in *I. glandulifera* three to twelve flowered inflorescence (Beerling & Perrins 1993). Along with these characters the capsule shape itself is enough to separate these 3 species (Fig. 16A3, B3, C3 & C4).

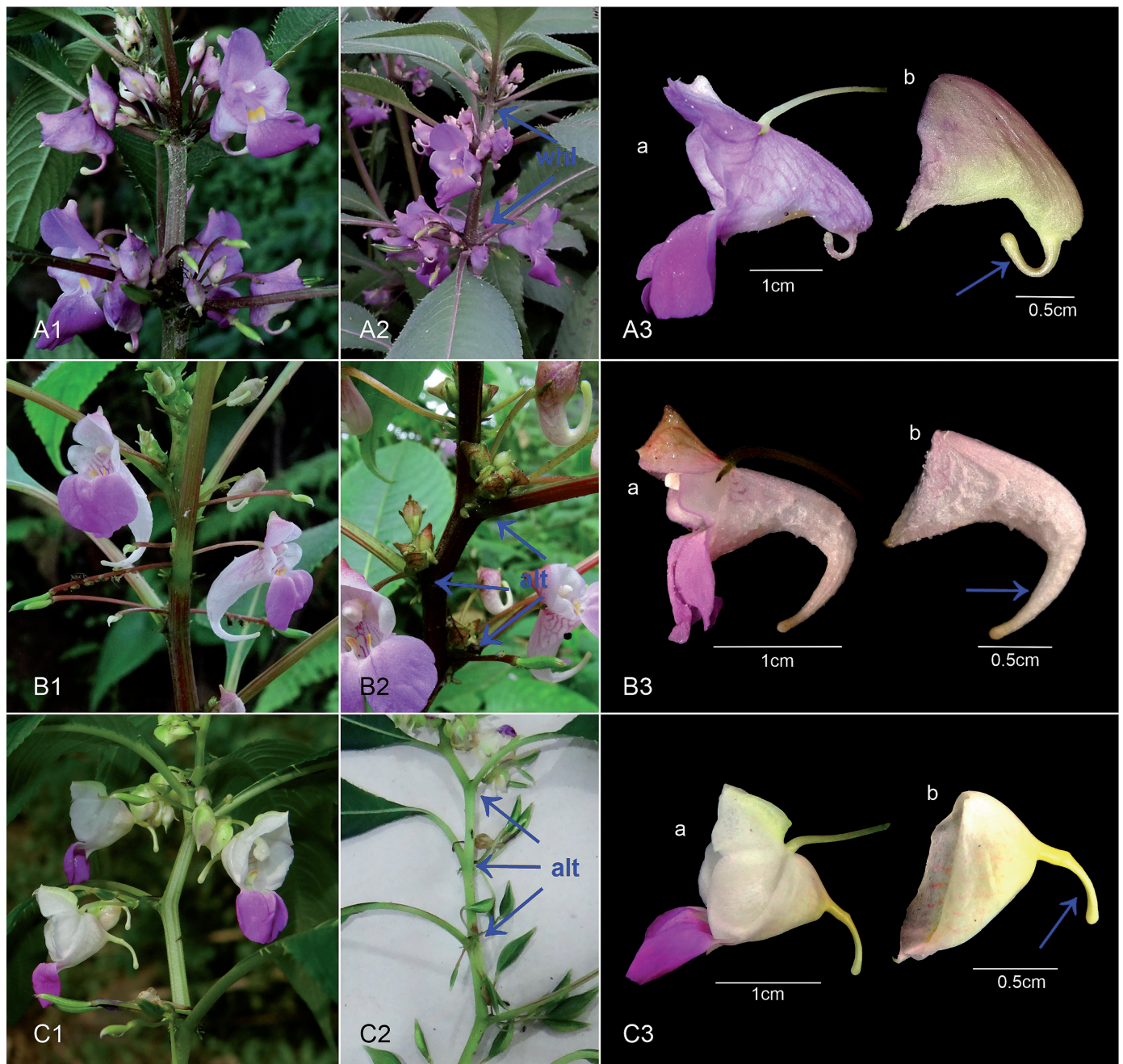
*Impatiens tripetala* Roxb. ex DC., *I. florigera* C.B. Clarke ex Hook.f. and *I. kamrupana* Gogoi, J. Sarma & Borah are species with fascicled inflorescence, more or less pink flowers and short, fusiform capsule, which may lead to confusion in terms of their identity, if

they are considered superficially. Although these three species seem close, there are enough differences to identify them correctly. *I. florigera* (Fig. 17B1-17B3) belongs to the same section as *I. tripetala*, however, it clearly differs due to its elongated bucciniform lower sepal (vs. saccate in *I. tripetala*; Fig. 17A1-17A3), the elongated-curved spur (vs. shortly hooked in *I. tripetala*) and alternate leaves (vs. opposite in *I. tripetala*). At the same time, *I. kamrupana* is a species with alternate leaves, like in *I. florigera*, however, it has a subbucciniform lower sepal and an abruptly constricted straight spur (Fig. 17C1-17C3). These three

species can be easily separated due to differences in leaf arrangement, shape of the lower sepal and shape of spur, which is sufficient to be treated as distinct species (Fig. 17). Hence, we reject the synonymisation of *I. florigera* and *I. kamrupana* under *I. tripetala* proposed by Singh *et al.* (2021) as unjustified.

#### 4. Conclusion

The paper by Singh *et al.* (2021) consistently disparages the ethics of scientific rigour, scholarly conduct and decorum by use of unproven theoretical



**Fig. 17.** Comparison of closely allied species: *Impatiens tripetala* Roxb. ex DC. (A), *I. florigera* C.B. Clarke ex Hook.f. (B), and *I. kamrupana* Gogoi, J. Sarma & Borah (C)

Explanations: A1, B1 & C1 – flowers in axillary fascicles; A2, B2 & C2 – part of stem showing arrangement of leaves (whl=whorled, alt=alternate); A3, B3 & C3 – side view of flowers (a), and side view of lower sepal showing the spur character (b)

background of ‘inheritance of acquired characteristics’ (see General remarks); the blatant harvesting and misuse of materials collected by other persons without acknowledgements (Table 1); the false claims of extensive field studies in Western Himalaya (Table 2 and General remarks); serious taxonomic errors in determining and delimiting *Impatiens* species native of the Himalayan range and adjacent areas (Table 2 and Examples); proposals of new combinations and statuses without enough field and literature studies and failure to provide convincing evidences to validate the treatments; the evident geographically biased gaps as in case of Western Himalayan or Sikkimese taxa, there were almost no original illustrative material (Tables 1-2); the overall documentation lacks important details, like authorship of pictures, locations and dates of pictures, or measurements of plant parts.

In this paper, the true taxonomic statuses of the species, viz.: *Impatiens amplexicaulis* Edgew. [= *I. sulcata* var. *amplexicaulis* (Edgew.) R.Kr. Singh & D.Borah, Biodiv. Res. Conserv. 61: 25, 2021 *syn. nov.*], *I. angustiflora* Hook.f., *I. arunachalensis* Hareesh, A.Joe, M.Sabu & Gogoi, *I. dibangensis* Gogoi & Borah, *I. dorjeekhandui* Chowlu, S.S.Dash & Gogoi, *I. flemingii* Hook.f., *I. florigera* C.B.Clarke ex Hook.f., *I. glandulifera* Royle [= *Impatiens sulcata* var. *glandulifera* (Royle.) R.Kr. Singh & D.Borah, Biodiv. Res. Conserv. 61: 25, 2021 *syn. nov.*], *I. idumishmiensis* Gogoi, W.Adamowski, Borah & Chhetri, *I. kamrupana* Gogoi, J.Sarma & Borah, *I. khasiana* var. *toppinii* (Dunn) Ruchis. & Suksathan, *I. leptoceras* DC., *I. lohitisensis* Gogoi & Borah, *I. marianae* Rechb.f. ex Hook.f., *I. meeboldi* [= *I. balfourii* var. *meeboldii* (Hook.f.) R.Kr.Singh & D.Borah, Biodiv. Res. Conserv. 61: 8, 2021 *syn. nov.*], *I. nicolsoniana* Gogoi & Arisdason, *I. pradhanii* H.Hara, *I. pseudocitrina* Hareesh, M.Sabu & Gogoi, *I. pyrorhiza* Lidén & Bharali, *I. spirifera* Hook.f., *I. tatoensis* Gogoi & W.Adamowski, and *I. zironiana* Gogoi, Hareesh &

W.Adamowski, have been reinstated and categorically justified based on scientific documentary evidences with facts and figures.

Notwithstanding the above discussed species, the majority of the other species treated by Singh *et al.* (2021) are not based on actual taxonomic principles and will be reinstated in subsequent papers. The publication by Singh *et al.* (2021) is conducted without due taxonomic enquiry and deliberation, contributing nothing but taxonomic name noise. Scientific community perusing the work of Singh *et al.* (2021) must be careful in judging the status of the species of *Impatiens*, and must examine the established facts around.

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#### Comments from the BRC Editorial Office:

At the beginning of 2021, we published an article entitled “Typifications, new combinations and new synonyms in Indian *Impatiens* (Balsaminaceae)” submitted by the team of authors: Singh R.K., Borah D. & Taram M. (BRC, 2021, 61: 1-27), which caused a great resonance in a group of specialists.

We would like to assure readers that this article has been published in accordance with the rigors of editorial art, incl. based on positive reviews. In this issue, we publish a critical article by Gogoi R., Adamowski W., Sherpa N., Sharma A. & Borah S., presenting strictly scientific arguments and, at the same time, raising allegations of a formal and legal nature. As before, this publication was preceded by reviews. We are convinced that presenting opposing viewpoints and scientific polemics is the optimal solution in the situation that has arisen. As editors, we do not undertake an assessment of the formal and legal allegations formulated in this publication.