

The quinquín sedges: Taxonomy of the *Carex phleoides* group (Cyperaceae)

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ABSTRACT

Carex phleoides is the largest species of the former genus *Uncinia*. It is widely distributed in the Neotropics, and is also known from the Juan Fernández archipelago off the coast of Chile. A second taxon, *U. trichocarpa*, is often considered a synonym of *C. phleoides*, but also sometimes a variety of that species or even a distinct species. We performed a morphometric study using representative material covering the entire distribution and morphological variation of *C. phleoides* s.l. to clarify its taxonomy. Our analyses revealed that *U. trichocarpa* is distinct from *C. phleoides*. Accordingly, we coined the name *C. quinquín* to accommodate this species under *Carex* because combinations of other available names are all blocked. *Carex phleoides* displayed two extremes of variation with geographical correspondence, a southern form in the Southern Cone north to Bolivia, and a northern one ranging from Bolivia to Mexico. We propose to recognize two subspecies within *C. phleoides*, the nominate subspecies being the southern one, and the northern one based on the epithet *koyamae*. Plants from the Juan Fernández archipelago were shown to be morphologically intermediate with the endemic *C. plurinervata*, a result that might point to introgression between these two species. We selected lectotypes for nine names, including two of the accepted ones, as well as their synonyms.

Keywords: Andes, *Carex*, cryptic species, Neotropics, *Uncinia*.

INTRODUCTION

The species of *Carex* L. formerly ascribed to the genus *Uncinia* Pers. (Global *Carex* Group 2015; henceforth simply ‘*Uncinia*’) have fascinated the cyperologist community because of their unique character of a hooked rachilla that protrudes from the utricle beak, the very reason why *Uncinia* was considered to be distinct from *Carex*. Such an adaptation clearly is related to epizoochorous dispersal (Villaverde et al., 2017).

The most recent accounts accept about 74 species in *Uncinia* (Global *Carex* Group, 2015). Most of these taxa are found in the Southern Hemisphere, either in the Neotropics or Australasia (Govaerts et al., 2017). There are a few species found in Pacific islands, and sub-Antarctic and also Antarctic archipelagos within the Antarctic Convergence zone (South Georgia archipelago; Wheeler, 1994). The northernmost limit of the group is the Philippines in the Old World, Hawai’i in the Pacific Ocean, and Mexico and Cuba in the Americas. There is a record of *C. hamata* Sw. in the continental U.S.A., but it is considered an introduction (USDA, NRCS, 2017). The taxonomy of *Uncinia* is particularly difficult. These plants present a fairly reduced morphology, with inflorescences consisting of a single, often ebracteate spike. Taxonomically useful characters mainly rely on utricle and glume morphology, and to a lesser extent, also on leaf morphology (Wheeler & Goetghebeur, 1997; Wheeler, 1994, 2007a, 2007b). *Uncinia* was traditionally arranged in two subgenera (Kükenthal 1909). The subg. *Pseudocarex* Kük. contained only *U. kingii* Boott (now *C. kingii* (Boott) Reznicek). On the other hand, subg. *Uncinia* was in turn divided in two sections, *Uncinia* (= *Stenandrae* C.B. Clarke) and *Platyandrae* C.B. Clarke, which differed in stamen morphology (filaments cylindrical, narrower than the anthers vs. filaments flat at least proximally, wider than the anthers, respectively). The phylogenetic information available revealed that while *C. kingii* is sister to the rest of *Uncinia*, the other two groups are not natural. The two sections are paraphyletic, and their species are arranged in two sister clades, each with representatives of both sections and from both sides of the Pacific (Starr et al., 2008; Global *Carex* Group, 2016).

Carex phleoides Cav. is probably the largest member of *Uncinia*, with spikes often wider than 6 mm, and stems that can be longer than one meter. It was ascribed to section *Platyandrae* because of the flattened stamen filaments. In its broadest interpretation, it is also one of the most widely distributed species of the genus, ranging from central Mexico to Patagonia (Govaerts et al., 2017). It is locally called *quinquín* in southern Chile (Fuentes, 1925), a name that comes from the Mapuche language and translates as ‘fishing device’ (Lenz, 1904), a clear reference to the hooked rachilla of this species. When the species is abundant these hooked rachilla are annoyingly difficult to ignore, because the ripe utricles attach everywhere to clothes and hair (pers. obs.). Two taxa, sometimes considered independent species, have been subsumed within a broader concept of *C. phleoides*: *U. trichocarpa* C.A. Mey. (lacking an available name in *Carex*) and *C. koyamae* (Gómez-Laur.) J.R. Starr. The former taxon was frequently treated as a variety under *C. phleoides* (*U. phleoides* var. *trichocarpa* (C.A. Mey.) C.B. Clarke), apparently distinct from the nominate variety by its variously scabrid rachilla (Fig. 1), a character unique among *Uncinia* species. Wheeler (2007a) proposed to recognize this taxon as a distinct species, endemic to the Chilean Coastal Range (Cordillera de la Costa). However, Starr (in Global *Carex* Group, 2015) later considered it merely a synonym of *C. phleoides*, and accordingly did not propose a name in *Carex* for it when transferring the rest of the species of *Uncinia* to *Carex*. *Carex koyamae* was initially described as a Costa Rican endemic (Gómez-Laurito 1980), different from *C. phleoides* in having a bract longer than the spike. *Carex phleoides* is typically bractless. Other bract-bearing plants from Chiapas were considered to belong to this species too (Chater, 1994). However, the discovery of typical *C. phleoides* further north in Mexico (González-Elizondo, 1983), as well as long-bracteate individuals in Argentina and Bolivia, led Jiménez-Mejías et al. (2016a) to subsume *C. koyamae* under *C. phleoides*. In addition, there is a fourth species, *C. plurinervata* J.R. Starr, an endemic from the Juan Fernández Islands (off the coast of Chile) that shows close similarities with *C. phleoides* (see Wheeler, 2007b). The two species co-occur in the archipelago in the remote island of Alejandro Selkirk, where Wheeler (2007b) reported each one from a single station. However, the discovery of herbarium material belonging to an additional locality revealed delimitation problems between these two taxa.

Morphometric analyses based on multivariate statistical methods have long been used as morphology-based predictors for species delimitation. These methods standardize the measure of morphological variability and objectively quantify the differences among groups (Valcárcel & Vargas, 2010), in contrast to treatments based on what is subjectively referred to as “taxonomic expertise”. Recent studies in *Carex* using these techniques have helped uncover cryptic variation and resurrected neglected taxa (Jiménez-Mejías et al., 2014; Benítez-Benítez et al., 2017; Míguez et al., under review).

The purpose of the present study is to clarify the taxonomy of the *Carex phleoides* group using a statistical approach. In particular, we aim to: 1) evaluate whether or not there is morphological structuring underlying the wide distribution range of *C. phleoides* s.l.; 2) assess if the different morphogroups detected deserve taxonomic recognition; 3) re-evaluate the morphological relationship between *C. plurinervata* and *C. phleoides* in the Juan Fernández archipelago; and 4) propose a revised taxonomic and nomenclatural treatment.

MATERIALS AND METHODS

Study group

The study group was defined as follows: 1) *Uncinia trichocarpa* was delimited following Wheeler (2007a); 2) for the Juan Fernández plants, the species *Carex plurinervata* and *C. phleoides* were delimited according to Wheeler (2007b); and 3) *C. phleoides* was divided according to our preliminary observations. We found that the populations of the Southern Cone have smaller utricles than those of the Northern Andes. Accordingly, we distinguished two large groups of populations within *C. phleoides*, those from the Southern Cone (southern *C. phleoides*; Chile and Argentina), and those from the Northern Andes (northern *C. phleoides*; Peru, Ecuador, Colombia, and Mexico). To avoid the a priori ascription of the Bolivian plants, they were considered separately (Bolivian *C. phleoides*). In total, we included 57 samples from four herbaria (MO, NY, UPOS, and US; abbreviations according to Thiers, 2017): 11 samples of *U. trichocarpa*, 20 of the northern *C. phleoides*, 13 of the southern *C. phleoides*, seven of Bolivian *C. phleoides*,

and six samples from the Juan Fernández archipelago. These last consisted of two samples of the type collection of *C. plurinervata* (Skottsberg 488), two of what Wheeler (2007b) considered to be *C. phleoides* (Skottsberg 370), and an undetermined problematic collection (Skottsberg 132). All the specimens studied are listed under ‘representative studied specimens’ in the taxonomic treatment, plus the two type collections of *C. plurinervata* at NY and US.

Morphometric analyses

We performed a morphometric study based on principal component analyses (PCA) and univariate comparisons as inspired by Valcárcel & Vargas (2010) and implemented in *Carex* by Jiménez-Mejías et al. (2014) and Míguez et al. (under review). Sampling adequacy of the dataset was evaluated using the Kaiser-Meyer-Olkin (KMO) factor. From a preliminary study including 20 characters and 27 samples (results not shown), we selected ten characters (Table 1) as those that potentially distinguished better between *Uncinia trichocarpa*, northern *Carex phleoides*, and southern *C. phleoides*. All the variables were quantitative and continuous. We measured the characters using a micrometer up to 0.1 mm. Given the scarcity of the available material in each herbarium voucher, and to minimize the damage to the specimens, only one glume and utricle were extracted from one spike. We selected glumes and utricles from the middle portion of the spike, which help the measurements to be comparable between specimens. Though taking just a single measurement per specimen affects the representativeness of our study at the population level, our aim is to identify differences among taxa. We expect that the bias in intrapopulational sampling is compensated by the inclusion of multiple samples per taxon. Mean and standard deviation were calculated for each variable within groups, and visually displayed using box-plots. PCA was performed to explore the overall structure of the dataset. All variables were standardized between 0 and 1 to avoid the overweighting of scale. In order to test statistically for morphological discontinuities in variables between species, we used the Kruskal-Wallis test. We selected this non-parametric approach since a number of the selected variables did not meet a normal distribution nor demonstrate homoscedasticity. Pairwise Mann-Whitney U-test was used as a post-hoc approach to find differences among the groups.

All analyses were performed in R, using the package FSA for the Kruskal-Wallis test and Mann-Whitney U-test, and the package ggbiplot to plot the PCA.

Nomenclatural study

We performed a nomenclatural study to elucidate the identity of *Carex phleoides*, *C. plurinervata*, and *Uncinia trichocarpa*, as well as of the synonyms listed by Govaerts et al. (2017) under *C. phleoides*. We studied high-resolution digital images of 19 vouchers belonging to twelve additional herbaria (BISH, BM, C, CORD, CR, E, GB, HAL, P, S, SGO, and SI) available via the Internet. In addition, we studied the actual lectotype of *C. phleoides* at MA. Protologues and available lectotypifications were consulted. Specimens studied and literature used are within the nomenclatural parts of the Taxonomic Treatment at the end of this paper.

RESULTS

The average values of the KMO factor varied between 0.52 and 0.78, with an average value of 0.65, which is considered suitable for the search of structure within our dataset. The three first components (PC1-3) displayed eigenvalues greater than 1, accounting for 35%, 26% and 15% of the variation respectively (total cumulative variation = 76%). The contributions of the variables to each component are shown in Table 2. The scatter plot of the two first components (Fig. 2) revealed that the samples of *Uncinia trichocarpa* were placed toward the lowest scores of PC1 and the highest ones of PC2, relatively distant from the rest of the samples. Similarly, *C. plurinervata* was displaced toward the highest scores of PC1 and PC2, also separated from the rest of the samples. The samples of *C. phleoides* formed a continuum placed toward the lowest scores of PC1 and PC2, with the southern populations showing mostly higher scores in PC1 than the northern ones, and both sets of populations overlapping. The Bolivian populations of *C. phleoides* formed two well-differentiated groups, one placed towards the samples of northern *C. phleoides*, and the other closer to the samples of southern *C. phleoides*. The Juan Fernández collection of *C. phleoides* (i.e., *Skottsberg 370*) was displaced at one of the edges of the southern *C. phleoides* group, at the highest PC1 and PC2 scores for the species. Eventually, the undetermined problematic collection from the

Juan Fernández archipelago (i.e., *Skottsberg 132*) closely approached *C. plurinervata* samples.

Results of the univariate statistics are shown in Table 1 and box-plots in Fig. 3. The Kruskal-Wallis test revealed significant differences in all the characters except spike maximum width that was marginally significant with $p=0.08$. Differences in mean values according to pairwise Mann-Whitney U-test are depicted in Fig. 3. The taxon that differed in most characters from all the others taxa together was *C. plurinervata*, which was retrieved as distinct in five characters. *Uncinia trichocarpa* was distinguished from the other two groups of *C. phleoides* together by another five characters. When accounting for each group within *C. phleoides*, *U. trichocarpa* significantly differed by seven characters from the northern *C. phleoides*, and by six from the southern one. Southern and northern groups within *C. phleoides* significantly differed only in five characters.

DISCUSSION

Our results support the recognition of at least three different taxonomic units at the species level: *Carex plurinervata*, *C. phleoides*, and *Uncinia trichocarpa*. Despite *U. trichocarpa* and the two groups within *C. phleoides* differing significantly one from each other by a similar number of characters, the fact that the southern and northern samples within *C. phleoides* show a morphological continuum seems to suggest it is best to treat them at subspecific rank within a broadly delimited *C. phleoides*. It must be noted that these two groups within *C. phleoides* do not constitute a cline of variation, since within each group the placement of the different samples is independent of their origin, with samples from disparate localities approaching, and others from neighboring localities not placed close one to each other. Accordingly, we propose to treat them as two subspecies, a southern taxon (subsp. *phleoides*) and a northern one (subsp. *koyamae*). Remarkably, the Bolivian samples occupy an intermediate position between the two subspecies, and the ascription of the different samples to one of each group must be considered with caution. This morphological intermediacy might point to introgression in a contact zone between the two subspecies. However, additional genetic studies would be needed to

provide further support to that hypothesis. Even though we were unable to include the type of *C. koyamae* in our morphometric study, the image we studied of one of the types, as well as the utricle length measurements provided by Gómez-Laurito (1980) showed that this material falls within the variation of our northern *C. phleoides*. We therefore combine its epithet at subspecies rank. Following our analyses, the Juan Fernández plants seem to conform to a morphological transition between *C. phleoides* subsp. *phleoides* and *C. plurinervata*. The collection *Skottsberg 132* grouped closely to the type collection of *C. plurinervata*, thus we consider it to be the second known record of that species. However, the ‘true’ *C. phleoides* from the Juan Fernández archipelago displayed a morphological extreme for subsp. *phleoides* and approached in some characters *C. plurinervata* (e.g., stem width 2.5-2.2 mm, rachilla length 3.5-2.5 mm). Wheeler (2007b) already noted the distinctiveness of these insular populations. Despite the low number of samples, our results might point to a hybrid origin of *C. phleoides* from the Juan Fernández archipelago, which could represent introgressive specimens between *C. phleoides* subsp. *phleoides* and *C. plurinervata*. Introgression in islands has been shown to be a conservation problem for rare plants in general and island endemics in particular (Rita et al., 2018). While *C. phleoides* is sometimes considered to be a weedy plant, we cannot disregard that the occurrence of the species in the Juan Fernández might be natural. The study of additional collections, as well as genetic studies would be desirable to elucidate the true nature of these abnormal plants.

TAXONOMIC TREATMENT

In the ensuing taxonomic treatment, we follow Jiménez-Mejías et al. (2016b) and call the closed perigynium a utricle.

1. *Carex phleoides* Cav., Icon. 5: 40 (1799).

Uncinia phleoides (Cav.) Pers., Syn. Pl. 2: 534 (1807).

Lectotype (as “tipo” designated by Garilleti (1993): CHILE [URUGUAY?]: Habitat in Talcahuano Concepción, Montevideo [sic], *L. Née* dedit (MA-475488!). *Second-step*

lectotypification (lectotype here designated): on the upper half of the herbarium sheet, the third flowering stem from the right.

Etymology: Resembling a *Phleum* (Poaceae).

Notes: Jiménez-Mejías et al. (2016a) attempted to typify this name, but their typification was superfluous because it was anticipated by Garilleti (1993), who designated MA-475488 as the type (“Material tipo”). However, on the sheet Garilleti designated as type there are six flowering stems that belong to four different taxa: *C. erinacea* Cav., *C. quinquin* Jim.-Mejías & Dorr, *C. multifaria* (Nees ex Bott) J.R. Starr, and *C. phleoides* Cav. subsp. *phleoides*. To preserve current usage of the name, we designate one of these six flowering stems as the lectotype.

1a. *Carex phleoides* subsp. *phleoides* (Figs. 4B, 5B)

= *Uncinia lasiocarpa* Steud. ex Boeckeler, *Linnaea* 41: 349 (1877).

TYPE: Chile. Col. Ariqueae [Aricua], Jan 1852, *W. Lechler* pl. Chilens. Ed. R.F. Hohenacker 567a (lectotype here designated, P-00277439 digital image!; isolectotypes, P-00277440 digital image!, P-00277438 digital image!).

= *Uncinia phleoides* f. *longispica* Franch., in P.A. Harriot, *Miss. Sci. Cap Horn, Bot.* 5: 378 (1889).

TYPE: Chile. Otway, Patagonie, 24 Jan 1879, *P. A. L. Savatier 1806* (lectotype here designated, P-00277435 digital image!; isolectotypes, P-00277436 digital image! P-00277437 digital image!).

= *Uncinia phleoides* var. *brachytricha* Speg., *Revista Fac. Agron. Univ. Nac. La Plata* 3: 626 (1897).

TYPE: Argentina. Chubut, Depart. Languiñeo/Futaleufú, in pratis dumetosis et sylvosis montanis secus Río Carrenleofú, *C. Spegazzini* (lectotype here designated, CORD-00002151 digital image!).

Plants perennial, cespitose from short rhizomes. Fertile culms ca. 30-150 cm long, 0.8-2.1(2.5) mm wide at the middle, usually shortly exceeding the leaves, trigonous, smooth. Leaves not rigid, herbaceous, widest ones 5.5-10 mm wide, flattish, the margins and tip antrorsely scabrous. Inflorescences a solitary, androgynous spike, 7-15 cm long, subclavate, rarely subclavate-cylindrical, (4)6-12(14) mm at its widest, densely flowered, with the utricles appressed, the staminate portion 0.6-1.6 cm, bractless or very rarely with an awn-shaped bract shorter or longer than the spike. Female glumes from the middle part of the spike 4.1-5.6 × 1.2-2 mm, shorter than the utricles, ovate to elliptical, rounded to acute, glabrous, coriaceous, stramineous, pale brown or dark brown, usually the body uniformly colored or with the upper margin reddish-brown tinged, often with a ciliolate hyaline margin, the sides faintly 3-9-veined, sometimes veinless. Utricles 5.5-7.3 × 0.8-1.5 mm, narrowly oblong, brown to reddish-brown, appressed-scabrid distally, smooth (or nearly so) proximally, margins ciliate with hairs in fascicles, with 2 prominent lateral costae and sides veinless or faintly veined, attenuated at the top into an indistinct to vaguely conic beak, the empty portion between the achene top and the utricle tip 1.8-1 mm long. Achenes 3.5-4.7 × 0.7-1.1 mm, narrowly oblong to nearly cylindrical, compressed-trigonous. Rachilla smooth, with the exerted portion 2.5-4.5 mm long.

Distribution: Patagonia, in Chile from Concepción to Aysén provinces (Wheeler 2007a), in Argentina from Río Negro north to Bolivia, disjunct in the mountains of Córdoba and Buenos Aires provinces (Flora del Cono Sur 2017), as well as on Alejandro Selkirk Island in the Juan Fernández Archipelago (Wheeler 2007b); doubtful in Uruguay (see notes).

Altitude: 120-3000 m.

Notes: The citation 'Montevideo' in the species protologue seems to be a mistake, as no *Uncinia* has ever been found in Uruguay. However, the presence of *Carex catharinensis* in the small mountains on both sides of the Rio de la Plata (Jiménez-Mejías et al. 2016a,

2018) leaves open the possibility of *C. phleoides* subsp. *phleoides*, the only *Uncinia* present in Buenos Aires province, being an extremely rare plant also in Uruguay. *Carex phleoides* subsp. *phleoides* seems to potentially hybridize with *C. plurinervata* on Alejandro Selkirk Island, as explained in the discussion.

Representative specimens examined. ARGENTINA. Buenos Aires, Tornquist, cerro de la Ventana, vertiente occidental, roquedal alto, 700 m, 30 Nov 1978, *Proyecto Ventana 445* (NY). Catamarca, Andalgalá, Estancia Grande, 16 Dec 1916, *Jorgensen 1444* (US); Neuquén, San Martín de los Andes, 12 Jan 2015, *Waterway & Lechowicz MW2015.005* (UPOS); Tucumán, Chicligasta, Estancia Las Pavas, 1750 m, 12 Dec 1925, *Venturi 4018* (US); Tucumán, Chicligasta, Estancia Las Pavas, 2650 m, 22 Nov 1926, *Venturi 4608* (US); Tucumán, Parque Los Alisos, 2160 m, 27 Jan 2015, *Rodríguez-Palacios & Jiménez-Mejías 3GERP15* (UPOS); Tucumán, Parque Los Alisos, 1920 m, 27 Jan 2015, *Rodríguez-Palacios & Jiménez-Mejías 1GERP15* (UPOS); Tucumán, La Banderita, 1925 m, 14 Feb 1971, *Ellenberg 4487* (NY). BOLIVIA. Cochabamba, Comarapa, road to Cochabamba, 5 Feb 1978, *King & Bishop 7659* (US); La Paz, Prov Sud Yungas, Calacoto 69 km hacia el Este, 31 Dec 1980, *Beck 3894* (NY); La Paz, Inquisivi, between Mina Chambillaya and Quime, 18 Feb 1989, *Lewis 35014* (NY); La Paz, Murillo, Valle del Rio Zongo, 3400 m, 8 Nov 1987, *Solomon 17260* (NY). CHILE: Valdivia, *Philippi 1162* (US); Temuco, Vielol, 120 m, 5 Dec 1934, *Montero 2022* (US); Valdivia, Ufer des Calle-Calle, 2 Dec 1897, *Buchtien* (US); Juan Fernández Islands, Masafuera, near Correspondencia Camp, 1130 m, 5 Mar 1917, *Skottsberg 370* (NY, US); Llanquihue, Peulla, 200-300 m, 14 Feb 1925, *Pennell 12652* (NY); Chiloe, Ancud, 6-7 Feb 1925, 10-50 m, *Pennell 12584* (NY)

1b. *Carex phleoides* subsp. *koyamae* (Gómez-Laur.) Jim.-Mejías, comb. et stat. nov. (Figs. 4A, 5A)

Uncinia koyamae Gómez-Laur., Brenesia 18: 92 (1980) [1981] [basionym].

Carex koyamae (Gómez-Laur.) J.R. Starr, Bot. J. Linn. Soc. 179: 33 (2015).

TYPE: Costa Rica. Limón, Región Atlántica del Macizo del Chiripó, ca. 150 m al norte del Lago Ditkebi, 3600 m, 18 Mar 1979, *J. Gómez-Laurito 4770* (holotype, CR digital image!).

= *Uncinia phleoides* var. *nux-nigra* C.B. Clarke, J. Linn. Soc., Bot. 20: 399 (1883).

TYPE: Ecuador, Pinchincha, *W. Jameson s.n.* (lectotype designated by Wheeler & Goetghebeur 1996, K-000501900 digital image!).

Plants perennial, cespitose from short rhizomes. Fertile culms ca. 15-100 cm long, 0.8-1.7 mm wide at the middle, shorter than or exceeding the leaves, trigonous, smooth. Leaves rigid, sometimes strongly coriaceous, widest ones 5.5-10.5 mm wide, flattish, the margins and tip antrorsely scabrous. Inflorescences a solitary, androgynous spike, 7-13 cm long, subclavate, rarely subclavate-cylindrical, 5.8-12(14) mm at its widest, densely flowered, with the utricles appressed, the staminate portion 0.7-1.1 cm, bractless or very rarely with an awn-shaped bract shorter or longer than the spike. Female glumes from the middle part of the spike $5-7 \times 0.8-2(2.2)$ mm, shorter than the utricles, ovate to elliptical, rounded to acute, glabrous, coriaceous, greenish, stramineous, pale brown or dark brown, usually the body uniformly colored or with the upper margin reddish-brown tinged, often with a ciliolate hyaline margin, the sides faintly 3-9-veined, sometimes veinless. Utricles $6.3-(8.3)8.5 \times 0.8-1.1(1.2)$ mm, narrowly oblong to narrowly elliptical, brown to reddish-brown, appressed-scabrid distally, smooth (or nearly so) proximally, margins ciliate with hairs in fascicles, with 2 prominent lateral costae and sides veinless or faintly veined, attenuated at the top into an indistinct or vaguely conic beak, the empty portion between the achene top and the utricle tip 1.5-2.3 mm long. Achenes $3.9-5 \times 0.6-1(1.1)$ mm, narrowly oblong, compressed-trigonous. Rachilla smooth, with the exerted portion 3.1-4.6 mm long.

Etymology: Commemorating Tetsuo M. Koyama (b. 1933), a Japanese botanist who specialized in Cyperaceae taxonomy.

Distribution: Central and northern Andes, from Bolivia to Venezuela; sporadically found to the north in Costa Rica and southern and central Mexico (Govaerts et al. 2017).

Altitude: 2500-3900 m.

Representative specimens examined. BOLIVIA. Cochabamba, Ayopaya, Sailapata, 3000 m, Nov 1935, *Cardenas 3201* (US); La Paz, Prov. Murillo, 13.1 km al E de la estación La Cumbre, 3850 m, 1 May 1988, *Solomon 18312* (NY); La Paz, Prov. Sud Yungas, Unduavi, 3300 m, 20 Feb 1986, *Solomon 14906* (NY). COLOMBIA. Cundinamarca, Quebrada Malagana, from Bogota to Fusagasuga, 8 Aug 1943, 2675 m, *Fosberg 21023* (US); Cundinamarca, Cordillera Oriental, Quebrada Malagana, from Bogotá to Fusagasuga, 15 km NE de Fusagasugá, 2675 m, 8 Aug 1943, *Fosberg 21023* (NY); Meta, Guamal, PN Sumapaz, 3 58 45 N 74 5 17 W, 3130-3210 m, 30 Jan 2002, *Betancur & Neira 9523* (NY); Nariño, Pasto, Volcán Galeras, La Concha Negra, 3200-3500 m, 16 May 1991, *Ramírez 3641* (NY); Nariño, Volcán Galeras, páramo de La Galera, 2490-3800 m, 22 Jul 1964, *Soejarto 1014* (NY); Nariño, Pasto, La Granja de Botana, 3000 m, 7 Mar 1991, *Ramírez 3191* (NY); [no locality] *Mutis 5330* (US). ECUADOR. Azuay, in vicinity of Toreador, between Molleturo and Quinoas, 3810-3930, 15 Jun 1943, *Steyermark 53231* (US); Mochpata, Tungurahua, 3000-2900 m, 23 Jul 1952, *Acosta Solis 21264* (US); in mte Pichincha, *Mille 330* (US); Carchi, Páramo El Ángel, 14 May 1973, *Holm-Nielsen et al. 5307* (NY); Ecuador, Chimborazo, Vicinity of Nevado El Altar, near Rio Blanco, 3370-3400 m, 31 Mar 1983, *Juncosa 876* (NY); Cotopaxi, Estación Boliche, 4200 m, 28 Nov 1987, *Freire et al. 909* (NY); Cotopaxi, Pisayambo, 3295 m, 21 Dec 1976, *Boeke 585* (NY); Cotopaxi National Park, 3200-3600 m, 27 May 1988, *Balslev & Paz y Miño 69278* (NY); Cotopaxi, Estación Cotopaxi, 3600 m, 6 Jul 1955, *Asplund 16808* (NY). MEXICO. Desierto de los Leones, Dec 1936, *Lyonnet 1504* (US). PERU. Mito, 9000 ft, 8-18 Apr 1923, *Macbride 3351* (NY, US). VENEZUELA. Táchira, Pata de Judío, 28 km al sur de San Vicente de la Revancha, 2900-3100 m, 20 Jan 1968, *Steyermark & Dunsterville 101190* (NY).

2. *Carex plurinervata* J.R. Starr, Bot. J. Linn. Soc. 139: 35 (2015) (Figs. 4C, 5C).

Uncinia costata Kük., Repert. Spec. Nov. Regni Veg. 16: 433 (1920) [nom. subs.]; non *Carex costata* J. Presl & C. Presl, Fl. Čech. 191 (1819).

TYPE: Chile. Masafuera, Quebrada de la Loberia, 280 m, 17 Feb 1917, C. J. F. Skottsberg 488 (lectotype designated by Wheeler 2007b, GB digital image!; isolectotypes, BISH digital image!, BM digital image!, C digital image!, NY!, S digital image!, US!).

Plants perennial, caespitose from short rhizomes. Fertile culms ca. 60-50 cm long, 1.3-2.3 mm wide at the middle, shorter than to exceeding the leaves, obscurely trigonous, smooth. Leaves more or less rigid, widest ones 5-6.5 mm, flattish, the margins and tip antrorsely scabrous. Inflorescences a solitary, androgynous spike, 10-14.5 cm long, cylindrical to subclavate-cylindrical, 3.5-9 mm at its widest, tightly flowered; staminate portion 1-1.5 cm long, bractless or sometimes with a scabridulous-ciliolate awn-shaped bract up shorter than or equaling the spike. Female glumes from the middle part of the spike 4.5-5 × 1.8-2.5 mm, slightly shorter than to sometimes longer than the utricles, broadly ovate, obtuse, glabrous, coriaceous, greenish brown to brown, with a pale reddish brown strip bordering the margins, apices narrowly white-hyaline and ciliolate, faintly several-veined. Utricles 3.8-5.2 × 1.2-1.4 mm, oblong-elliptic, pale brown to brown, minutely appressed-scabrid distally, smooth (or nearly so) proximally, margins ciliate with hairs in fascicles, with 2 prominent lateral costae and strongly 6-9-veined abaxially and 5-7-veined adaxially, the veins raised and running from the utricle base to the middle or beyond it, attenuated at the top into an indistinct beak, the empty portion between the achene top and the beak tip 1-1.1 mm long. Achenes 2.5-3.5 × 0.8-1 mm, oblong, compressed-trigonous. Rachilla smooth, with the exerted portion 1.5-2.7 mm long.

Etymology: *Pluri-* many, and *nervata*, nerved, in reference to the many-veined utricles.

Distribution: Endemic to Alejandro Selkirk Island in the Juan Fernández archipelago, where it is known from only two locations.

Altitude: 120-275 m.

Notes: The description we provide relies heavily on the one published by Wheeler (2007b), except expanded to include our measurements.

Representative specimens examined. CHILE. Juan Fernández, Alejandro Selkirk Island. Masafuera, Casao cangon, 120 m, 20 Jan 1955, *Skottsberg 132* (NY, US).

3. *Carex quinquin* Jim.-Mejías & Dorr, nom. nov. (Figs. 1, 4D, 5D)

Uncinia trichocarpa C.A. Mey., *Cyperac. Nov.*: 11, t. 4 (1831) [nom. subs.]; non *Carex trichocarpa* Muhl. ex Willd., *Sp. Pl.*, ed. 4, 4(1): 302 (1805).

Uncinia phleoides var. *trichocarpa* (C.A. Mey.) C.B. Clarke, *J. Linn. Soc., Bot.* 20: 399 (1883).

TYPE: Meyer (1831): Tab. IV, *Uncinia trichocarpa* (lectotype here designated).

= *Uncinia urvillei* Steud., *Syn. Pl. Glumac.* 2: 243 (1855).

TYPE: Chile. La Concepcion du Chili, Jan 1823, *J. S. C. Dumont d'Urville 1825* (lectotype here designated, P-00277449 digital image!).

= *Uncinia longispica* Boeckeler, *Flora* 41: 650 (1858).

Uncinia phleoides var. *longispica* (Boeckeler) C.B. Clarke, *J. Linn. Soc., Bot.* 20: 399 (1883).

Uncinia trichocarpa var. *longispica* (Boeckeler) Kük., *Bot. Centralbl.* 82: 131 (1900).

TYPE: Chile. Valparaíso, *H. Cuming 472* (lectotype here designated, E-00502227 digital image!; islectotype, E-00502228 digital image! SI-000390 digital image!).

= *Uncinia chlorostachya* Phil., *Linnaea* 33: 275 (1865).

TYPE: Chile. Corral, [*H. Krause s.n.* vel *R.A. Philippi s.n.*] (lectotype here designated, HAL-0109880 digital image!; islectotypes, SGO-000000964 digital image! SGO-000000963 digital image!).

= *Uncinia loliacea* Phil., Anales Univ. Chile 93: 503 (1896).

TYPE: Chile. Frai Jorge [Fray Jorge], 30 Jan 1883, R.A. *Philippi* s.n. (lectotype here designated, SGO-000000966 digital image!).

Plants perennial, caespitose from short rhizomes. Fertile culms ca. 20-80 cm long, 0.8-1.3 mm wide at the middle, usually shortly exceeding the leaves, trigonous, smooth. Leaves not rigid, herbaceous, widest ones 3.5-7 mm wide, flattish, the margins and tip antrorsely scabrous. Inflorescences a solitary, androgynous spike, 6-18 cm long, cylindrical to subclavate-cylindrical, 4.5-9 mm at its widest rather laxly flowered, with the utricles ascendant-spreading, the staminate portion 0.6-1.3 cm, bractless. Female glumes from the middle part of the spike 6-7.4(7.5) × 1.8-2.4 mm, shorter than the utricles, ovate to elliptical, obtuse to acute, glabrous, coriaceous, whitish-green, stramineous or pale brown, sometimes darker at center, often with the upper margin reddish-brown tinged, ciliolate, rarely the entire glume uniformly dark-brown, faintly 5-9-veined. Utricles (6.2)6.5-8.4(9) × 1.1-1.5(1.8) mm, oblong-elliptic, pale brown to brown, often reddish-brown streaked, appressed-scabrid distally, smooth (or nearly so) proximally, margins ciliate with hairs in fascicles, with 2 prominent lateral costae and sides veinless or faintly veined, attenuated at the top into a conic beak, the empty portion between the achene top and the utricle tip 1-1.7(1.8) mm long. Achenes 4-5.6 × 1-1.7 mm, oblong to oblong-elliptical, compressed-trigonous. Rachilla smooth or scabrid on the adaxial side of the hook, with the exerted portion 2.6-6 mm long.

Etymology: From *quinquín*, vernacular name of *Carex phleoides*-like plants in southern Chile (Fuentes 1925), derived from the Mapuche words *culin* or *culican*, which mean ‘fishing device’ (Lenz 1904), in clear reference to the hooked rachilla of *Uncinia* species.

Distribution: Endemic to the Chilean coastal range (Cordillera de la Costa) ranging between Coquimbo and Los Lagos regions (Wheeler 2007a).

Altitude: 0-500 m (Wheeler 2007a).

Notes: The description we provide relies heavily on the one published by Wheeler (2007a), but expanded to include our measurements.

The confusion regarding the identities of *Carex quinquin* and *C. phleoides* seems to rely, in part, on the overweighting of the character of the scabrid rachilla. Most previous treatments overemphasized the importance of this character. Even though Wheeler (2007a) had already stated that the rachilla of *C. quinquin* could sometimes be smooth, such an observation seems to have been overlooked by subsequent authors. We confirm that many of the specimens we studied of *C. quinquin* have entirely smooth rachillas, and that the character is even variable within the same individual.

Representative specimens examined. CHILE. Entre Valparaíso y Laguna Verde, 11 Dec 1931, *Looser 2064* (US); Valdivia, *Philippi 1164* (US); Temuco, Jan 1923, *Claude-Joseph 1958* (US); Temuco, cerro de la escuela agrícola, 25 Mar 1930, *Looser 1288* (US); Coquimbo, Ovalle, Fray Jorge, Nov 1925, *Werdermann 924* (US); Temuco, Oct 1927, *Claude-Joseph 4855* (US); Coquimbo, Parque Nacional Talinay, 18 Sep 1975, *Zollner 8254* (NY); Quillota, 10 Nov 1829, *Bertero 1574* (NY); Bío-Bío, Concepción, 100 m, 18 Nov 1990, *Taylor 10239* (MO); Concepción, desembocadura of Bío Bío, 30 m, 6 Nov 2001, *Landrum 10094* (MO); Concepción, Cerro Caracol, Mirador Alemán, 200 m, 21 Jan 1979, *Solomon & Solomon 4419* (MO).

Unplaced name

Uncinia phleoides var. *krausei* Kük., Bot. Centralbl. 76: 211 (1898).

Type: CHILE: Valdivia, *H. Krause* (at B, destroyed).

Identification key

The measurements utilized in this identification key are those of our own study with ranges expanded after the data provided by Wheeler (2007a, b).

1. Utricles 3.8-5.2 mm, with the veins raised and running from the base to the middle or beyond it; exerted portion of the rachilla 1.5-2.7 mm; stems (1.4)1.6-2.3 mm wide ... 2.

Carex plurinervata

1. Utricles 5.5-8.5(9) mm, veinless or faintly veined and then veins mostly conspicuous towards utricle base and not raised; exerted portion of the rachilla 2.5-4.9 mm; stems 0.7-1.7(2.5) mm wide.

2. Utricles (6.2)6.4-8.4(9) mm and female glumes 6-7.4(7.5) × 1.8-2.4 mm; achenes narrowly elliptic to oblong, 1-1.7 mm wide; rachilla scabrid on the hook adaxial side or entirely smooth; spike rather lax, 4.5-9 mm at its widest, with the utricles ascendant-spreading ... 3. *C. quinquin*

2. Utricles 5.5-7.3 mm and female glumes 4.1-5.6 × 1.2-2 mm, or utricles 6.3-8.3(8.5) mm and female glumes 5-7 × 1.3-2(2.2) mm; achenes narrowly oblong to cylindrical, 0.6-1.1 mm wide; rachilla entirely smooth; spike rather dense, (4)-5.8-11.9(14) mm at its widest, with the utricles appressed ... 3 (*Carex phleoides*)

3. Utricles 5.5-7.3 mm, the empty portion between the achene tip and the beak tip 1-1.8 mm; female glumes 4.1-5.6 mm ... 1a. *C. phleoides* subsp. *phleoides*

3. Utricles 6.3-8.3(8.5) mm, the empty portion between the achene tip and the beak tip (1.5)1.6-2.2(2.3) mm; female glumes 5-7 mm ... 1b. *C. phleoides* subsp. *koyamae*

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Table 1. Characters used in the morphometric study and univariate statistics per considered species and p-value obtained in the Kruskal-Wallis test. Measurements are given in mm. Data are presented as (maximum) mean \pm SD (minimum). Measured glumes and utricles were taken from the middle portion of the spikes. The southern and northern *Carex phleoides* are respectively named here as subsp. *phleoides* and subsp. *koyamae* according to our results. The Bolivian samples have already been included within the variation of each of the subspecies also after our findings. The *C. phleoides* collection from the Juan Fernández archipelago, *Skottsberg 370*, is here included within *C. phleoides* subsp. *phleoides*, while the collection *Skottsberg 132* is here considered to be *C. plurinervata*.

	<i>C. plurinervata</i> (n=4)	<i>C. phleoides</i> subsp. <i>koyamae</i> (n=23)	<i>C. phleoides</i> subsp. <i>phleoides</i> (n=19)	<i>U. trichocarpa</i> (\equiv <i>C.</i> <i>quinquin</i>) (n=11)	Kruskal- Wallis p- value
Stem middle width	(2.3)2.0 \pm 0.4(1.4)	(1.7)1.2 \pm 0.2(0.8)	(2.5)1.3 \pm 0.4(0.7)	(1.3)1.0 \pm 0.2(0.8)	<0.01
Spike maximum width	(9)6.1 \pm 2.4(3.5)	(14)7.9 \pm 1.9(5.8)	(14)7.8 \pm 2.0(4)	(9)6.5 \pm 1.5(4.5)	0.08
Female glume length	(5)4.8 \pm 0.3(4.5)	(7)5.9 \pm 0.6(5)	(5.6)4.9 \pm 0.4(4.1)	(7.5)6.4 \pm 0.5(6)	<0.01
Female glume maximum width	(2.4)2.2 \pm 0.3(1.8)	(2.2)1.6 \pm 0.2(1.3)	(2)1.5 \pm 0.3(1.2)	(2.4)2.1 \pm 0.2(1.8)	<0.01

Utricle length (including stipe)	(5.2)4.8±0.39(4.3)	(8.5)7.3±0.5(6.3)	(7.3)6.3±0.5(5.5)	(8.5)7.4±0.5(6.5)	<0.01
Utricle maximum width	(1.4)1.3±0.1(1.2)	(1.2)0.9±0.1(0.8)	(1.5)1.1±0.2(0.8)	(1.5)1.3±0.2(1.1)	<0.01
Utricle beak (empty portion between the achene tip and the beak tip)	(1.1)1.1±0.1(1)	(2.3)1.8±0.2(1.5)	(1.8)1.4±0.3(1.0)	(1.8)1.3±0.2(1)	<0.01
Rachilla exerted length	(2.7)2.2±0.5(1.5)	(4.6)3.9±0.4(3.1)	(4.5)3.6±0.6(2.5)	(4.9)3.8±0.6(3.2)	0.02
Achene length (excluding style base)	(3.5)2.9±0.5(2.5)	(5)4.4±0.3(3.9)	(4.7)4.1±0.3(3.5)	(5.5)4.8±0.5(4)	<0.01
Achene maximum width	(1)1.0±0.1(0.9)	(1.1)0.8±0.1(0.6)	(1.1)0.9±0.1(0.7)	(1.4)1.2±0.1(1)	<0.01

Table 2. Contribution of the variables to the first three components of the PCA.

	PC1	PC2	PC3
Stem middle width	0.247	0.129	-0.619
Spike maximum width	-0.119	-0.101	-0.652
Female glume length	-0.413	0.157	0.047
Female glume maximum width	-0.081	0.504	-0.123
Utricle length (including stipe)	-0.503	-0.045	-0.037
Utricle maximum width	-0.014	0.568	-0.141
Utricle beak (empty portion between the achene tip and the beak tip)	-0.269	-0.271	-0.365
Rachilla exerted length	-0.405	-0.148	-0.064
Achene length (excluding style base)	-0.491	0.031	0.103
Achene maximum width	-0.134	0.523	0.068

Fig. 1. Scabrid hooked rachilla of *Uncinia trichocarpa* (\equiv *Carex quinquin*) Note the prickles on the adaxial side of the hook (*Landrum 10094*, MO). Scale bar = 0.5 mm.

Fig. 2. Scatter plot of the two PCA first components of the morphometric study including specimens of *Carex plurinervata*, *C. phleoides*, and *Uncinia trichocarpa*.

Fig. 3. Box-plots of the variables included in the study. The x-axis represent the taxonomic groups considered (Pl, *Carex plurinervata*; NPh, Northern *Carex phleoides*; SPh, Southern *Carex phleoides*; Tr, *Uncinia trichocarpa*), the y-axis the measurements (mm). Small letters within, above or below boxes indicate groups with similar mean values according to pairwise Mann-Whitney U-test. The boxes cover 50% of the data values ranging between 25th and 75th percentiles, and the lines show 95% of the values between the 5th and 95th percentiles. The line within the box represents the median. Dots indicate outlying values.

Fig. 4. Utricles of the taxa studied. From left to right, A. *Carex phleoides* subsp. *koyamae* (*Fosberg 21023*, US); B. *Carex phleoides* subsp. *phleoides* (*Venturi 4018*, US); C. *Carex plurinervata* (isotype, *Skottsberg 488*, US); D. *Carex quinquin* (*Landrum 10094*, MO). Scale bar = 1 mm.

Fig. 5. Achenes of the taxa studied. From left to right, A. *Carex phleoides* subsp. *koyamae* (*Fosberg 21023*, US); B. *Carex phleoides* subsp. *phleoides* (*Venturi 4018*, US); C. *Carex plurinervata* (isotype, *Skottsberg 488*, US); D. *Carex quinquin* (*Landrum 10094*, MO). Scale bar = 1 mm.



FIGURE 1

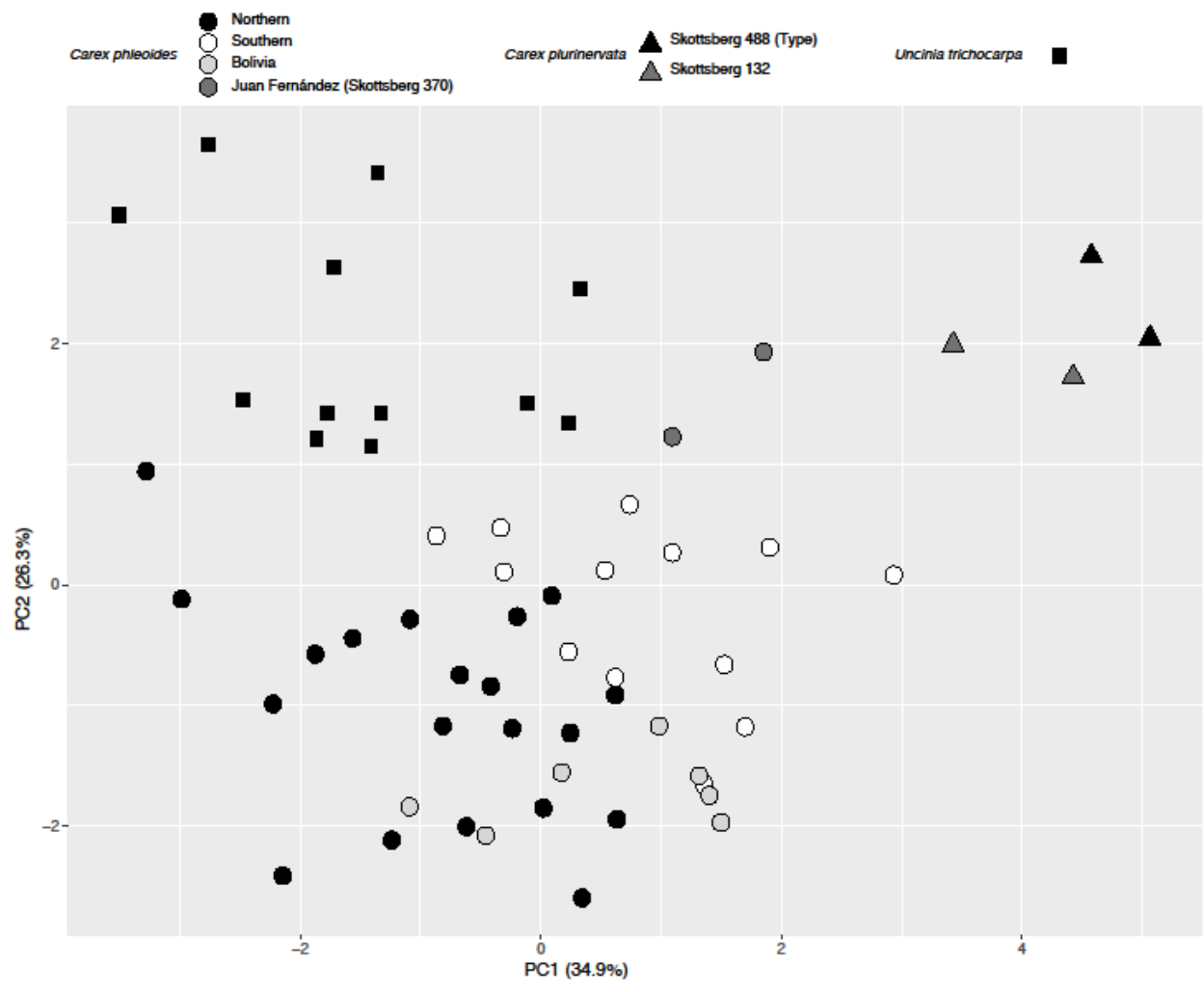


FIGURE 2

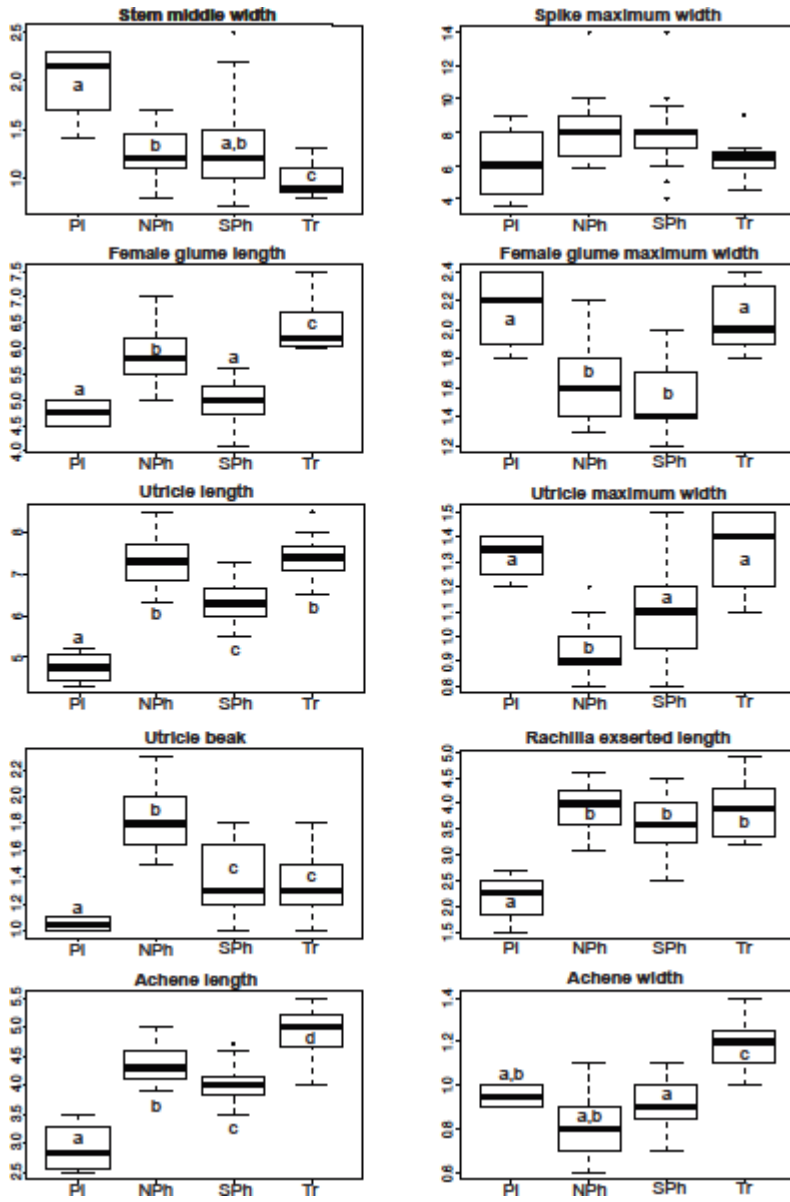


FIGURE 3



FIGURE 4

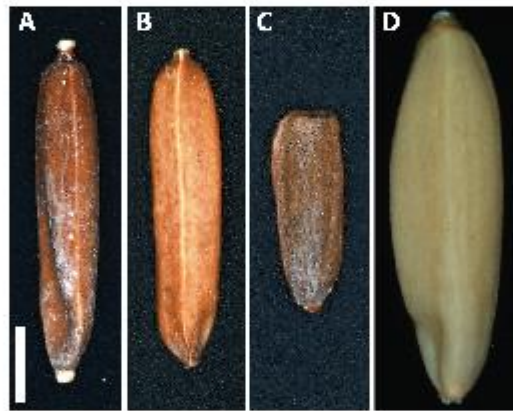


FIGURE 5