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First contribution to the taxonomic and cytotaxonomic study of *Parapholis* and *Hainardia* (*Poaceae*) in Albania

Abstract

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This is the first contribution to the study of *Parapholis* and *Hainardia* (*Poaceae*) in Albania. New taxa for the Albanian flora are reported for *Parapholis* (*P. marginata* and *P. strigosa*), together with the results of a comprehensive cytotaxonomic study of this genus, and a general taxonomic arrangement for *Hainardia* and *Parapholis* is provided, comparing the results with the corresponding data from adjacent Adriatic areas.

Key words: *Hainardiaceae*, kariotype, taxonomy.

Introduction

The genus *Parapholis* was created by Hubbard (1946) to include four species previously described under different genera: *P. incurva* (L.) C.E. Hubb. (≡ *Aegilops incurva* L.), *P. filiformis* (Roth) C.E. Hubb. (≡ *Rottboella filiformis* Roth), *P. pycnantha* (Hack.) C.E. Hubb. (≡ *Lepturus filiformis* var. *pycnanthus* Hack.) and *P. strigosa* (Dumort.) C.E. Hubb. (≡ *Lepturus strigosus* Dumort.), sharing spikelets sunk in rachis's cavity, 1 floret, glumes 2, inserted side by side, at maturity the rhachis disarticulating with complete internode.

Through a general revision of the genus, Runemark (1962) followed Hubbard's treatment and described a fifth species, *P. marginata* Runemark, distributed in the Eastern Mediterranean. Up to now, two further taxa have been either indicated from Iraq (*P. gracilis* Bor; Bor 1963) and SSSR (Georgia) (*P. incurva* var. *longiflora* (Grossh.) Tzvelev; Tzvelev 1976) as new species and new combination respectively. Together with *Pholiurus* Trin. and the monotypic *Hainardia* Greuter (only including *H. cylindrica* (Willd.) Greuter), it has been included by Greuter (1967) in the tribe *Hainardiaceae* Greuter, characterized by spikelets fast compressed and sunk in the rachis's cavity, alternate or at times opposite, 1 floret, 1 glume in the lateral spikelets and 2 in the apical. The rhachis may disarticulate with complete internode (Cuccuini 2002; Cuccuini & Fiorini 2004).

Based on later studies (Soreng & al. 2015, 2017), the tribe has been either neglected or splitted between *Poeae* subtribes *Parapholiinae* Caro (*Parapholis* and *Hainardia*) and *Beckmanniinae* Nevski (*Pholiurus*).

No specific study has been published on this group in Albania. Main information can be retrieved from both international, national, regional or local floristic treatments and specific scientific reports (Janchen 1920; Ubrizsy & Péntzes 1960; Papparisto & al. 1962; Tutin & al. 1980; Mersinllari & Hoda 1985; Mullaj 1987; Hoda & Mersinllari 2000; Tan & Mullaj 2000; Vangjeli 2003; Shehu & al. 2010; Meyer 2011; Ball 2011). In his *Prodromus Florae peninsulae Balcanicae* Hayek (1933) mentioned only *Hainardia cylindrica* (sub *Lepturus cylindricus* Trin.), Demiri (1983) added *Parapholis incurva* (sub *Lepturus incurvatus*) Trin. Based on the most recent floristic overviews published by Vangjeli & al. (2000), Vangjeli (2015), Pils (2016) and Barina & al. (2018), the former *Hainardiae* are represented in the Albanian flora by three species: *H. cylindrica*, *P. filiformis* and *P. incurva*. In addition, *Pholiurus pannonicus* (Host) Trin. was reported from a single gathering (or probably from an observation) in the Vlore district, from Sazan island (Baldacci 1894d; Fiori 1927, cited also by Barina & al. 2018; Demiri 1983), where it could have formed an adventitious, maybe ephemeral population. Nevertheless, its actual occurrence in Albania cannot be confirmed, since no specimen could be traced either in Baldacci's or Fiori's herbaria (in PAD and FI) and no new observation is reported in the recent floristic survey of Sazan (Hoda & Mersinllari 2000).

This is the first contribution devoted to this topic and represents a base for additional investigations, both from the morphological and cytological point of view.

Materials & methods

All the above mentioned publications dealing with the flora of Albania or some specific areas or environments within this country provided the background of the study. For the identification of the specimens we referred mainly to Tutin & al. (1980), Cuccuini (2002), and Vangjeli (2015); for the micro-characters (e.g. lemma and pollen) we referred only to data in Cuccuini (2002), Cuccuini & Fiorini (2004) (concerning materials also from Adriatic region). In addition, a critical analysis was carried out on herbarium specimens from some herbaria hosting Albanian specimens (FI, FR, JE and the herbarium of Natural Science Museum of Tirana). A detailed list of revised specimen is provided. On the whole we checked 20 specimens and many duplicates belonging to the new collections in FI, that enabled cytological analysis, for about 120 individuals. Unfortunately, the physical witness of former *Hainardiae* from Albania are still poor or difficult to check, other herbaria with important Albanian collections don't have *Hainardiae* materials or didn't send anything even after many remainders.

Many botanists who worked on Albanian territory (such as Baldacci 1894a, 1894b, 1894c, 1894d, 1895, 1896, 1897, 1899a, 1899b, 1899c, 1901; Baldacci & Béguinot 1918; Degen 1895, 1897a, 1897b, 1901, 1922; Halácsy 1892) didn't mention at all any member of *Hainardia* or *Parapholis*. Even Antonio Baldacci – the outstanding Italian botanist who has been travelled in Albania between 1885 and 1897 and whose herbarium (ca. 100.000 specimens spread among different herbaria) probably represents the larger botanical collection from that country – only once collected *H. cylindrica* (sub *Monerma*) in 1888 in the Albanian Epirus.

Karyological analyses, when possible, were performed on root-tips of germinated seeds collected from exsiccata, which after 4 months of chilling (-15°C), were put in seed-beds in standard condition of 100% moisture at room temperature. After a pre-treatment of about 3 hours in 8-hydroxichinoline saturated solution at room temperature, the root tips were fixed for many hours in Carnoy's Fluid solution (Ethanol and Acetic Acid - 3:1) (Johansen 1940), also used as a preservative solution of root tips in the test tubes stocked at 5°C temperature. Afterwards, the material was washed in distilled water and stained with 40% water solution of lacto-propionic orcein (Dyer 1979) for 18–48 hours at room temperature, without hydrolyze. Observations were made on temporary preparations: a tip was dissected and squashed on clean glass slide with one drop of 45% acetic acid under a coverslip, before examination with a Zeiss Axiophot light photomicroscope. The somatic mitosis plates were captured with a digital photcamera Canon G5 mounted on the photomicroscope, in a personal computer by soft Canon Remote Capture, then resized to 600dpi and 1000 enlargements. Measurements were taken on digital photos with “rule tool” of Photoshop and values were processed with Excel in order to obtain chromosome ordering and homologue recognition, and karyotype formula according to chromosome nomenclature proposed by Levan & al. (1964). Karyological parameters (Table 1) have been also calculated as Ask%, CVCL, MCA, A1 and A2 to compare data with previous analyses (Fiorini & Cuccuini 2002).

Diagnostic characters

In addition to those traditionally provided in European and Albanian Floras (Tutin & al. 1980; Vangjeli & al. 2000; Cuccuini 2002; Vangjeli 2003, 2015), we provided some additional, key morphological diagnostic characters, as retrieved from the analysis of herbarium specimens and described in more detailed and/or recent taxonomic studies on this group (Runemark 1962; Paunero 1964; Cuccuini 2002; Fiorini & Cuccuini 2002; Cuccuini & Fiorini 2004). Moreover, a short list of micro-characters (e.g. lemma and pollen) even if usually not diagnostic, is provided in order to make easier the identification of both taxa and morphotypes, following only

Table. 1. Applied karyological parameters: **S**=short arm, **L**= long arm, (**totS**) or (**totL**) = sum of short (or long) arms in chromosome set, (**i...n**) describe a chromosome set from the first to the last one “**n**”.

Index	Formula	Term	References
M, m.st, t, T	$L/S \ 1=M; \ 1 < m < 1.7; \ 1.7 < sm < 3; \ 3 < st < 7; \ 7 < t < \infty$	Arm/ratio = r	Levan & al. (1964)
CL	L+S	Chromosom lengt	
	L-S	Arm gap	
Ask %	$\frac{totL}{tot(L+S)} \times 100$ $50 < < 100$	Centromeric index %	Arano & Saito (1980)
A1	$1 - \frac{Mean(S/L)}{0 < < 1}$	Intrachromosomal asymmetry	Romero Zarco (1986)
A2	$\frac{Dev.St.CL}{Mean \ CL}$ $0 < < \infty$	Interchromosomal asymmetry	Romero Zarco (1986)
CV CL	$\frac{Dev.St.CL}{Mean \ CL} \times 100$ $0 < < 100$	Coefficient of Variation CL	Paszko (2006)
MCA	$\frac{Mean(L-S)}{(L+S)} \times 100$ $0 < < 100$	Mean Centromeric Asymmetry %	Peruzzi & Eroğlu (2013)

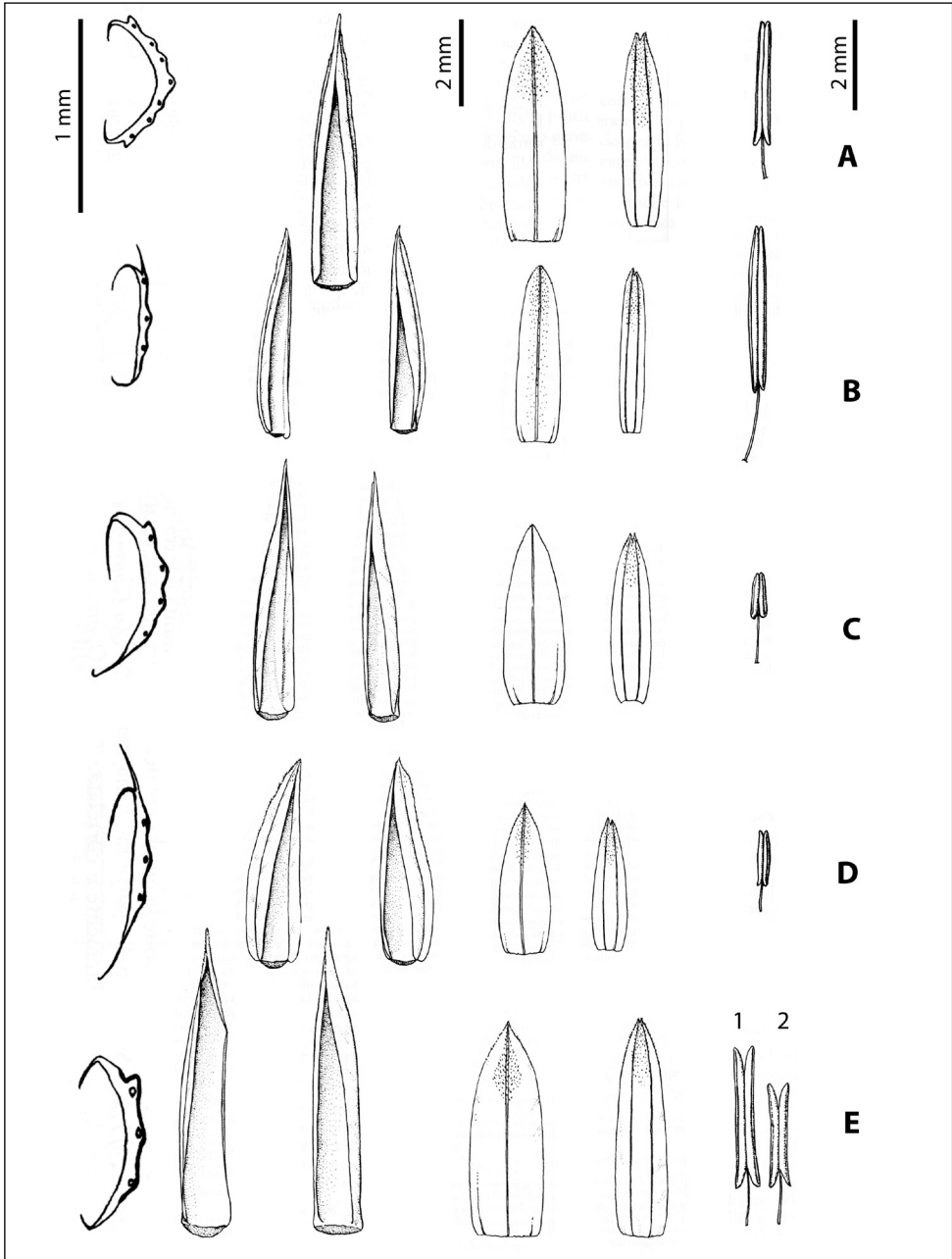


Fig. 1. A) *Hainardia cylindrica*; B) *Parapholis filiformis*; C) *P. incurva*; D) *P. marginata*; E) *P. strigosa*. From the left: upper glume section (from middle part), upper and lower glume/s, lemma and palea, anther/s (morphotype 1 and 2 in E), from Cuccuini, 2002 (B, C, D, E) and Cuccuini & Fiorini 2004 (A) modified. Scalebar: on the left for upper glume section; in the middle for the glumes, lemma and palea; on the right for anthers.

data, concerning also Adriatic region, in Cuccuini (2002), Cuccuini in Guarino & La Rosa (2019) and Cuccuini & Fiorini (2004).

Figure 1 points out, by an analytical drawing, the macrocharacters to favour an esyer identification.

In Table 2 a list of micro-morphological characters is provided to ensure the correct identification of the species when the most important diagnostic traits are absent or lead to doubtful outputs. Thickness epidermal cell wall in *Hainardia* lemma is usually 1.5-2 times higher than in *Parapholis incurva* and *P. marginata*, and up to 4 times higher than in *P. filiformis* and *P. strigosa*). In the morphologically more similar species “complexes” (*P. filiformis* vs. *P. strigosa* and *P. incurva* vs. *P. marginata*), useful information can also be retrieved from the absence/presence of esodermic cells, the length and the distribution pattern of the stomata.

***Parapholis* taxonomic framework**

Parapholis C.E. Hubb., Blumea, suppl. 3: 10-21. 1946.

Lepidurus Janchen, Wiener Bot. Zeitschr. 93: 85. 1944, nom. prov.

Typus: *Parapholis incurva* (L.) C.E. Hubb., Blumea, suppl. 3: 85. 1944.

Parapholis filiformis (Roth) C.E. Hubb., Blumea, suppl. 3: 14. 1946.

Bas.: *Rottboella filiformis* Roth, Usteri. Ann. Bot. X. 38. 1794.

Table 2. Main micro-characters of the 5 taxa of *Parapholis* and *Hainardia* genera present in Albania.

Taxa	Lemma					Pollen
	thickness epidermal cell wall (µm)	ripple depth/cell width	esodermic cell	stomata length (µm)	stomata quantity and position	annulus thickness (µm)
<i>Parapholis filiformis</i>	thin, 1-2	1/4 - 1/5	widespread presence	21.5	a few number in apical part	1
<i>P. incurva</i>	medium, ≤ 3	1/3	absent	30	double row in apical central nervature	1
<i>P. marginata</i>	medium, ≈ 3	≥1/3	variables (from diffuse to present in small areas)	26	in several rows, up to the middle central nervature	1
<i>P. strigosa</i>	thin, 2	1/4 - 1/5	absent	26.5-31	in several rows on 2/3 of the length of the central nervature from the apex	2.5
<i>Hainardia cylindrica</i>	large, 3-4	1/2	presence in about 1/3 from the apex with increasing frequency	27-32	double row in apical central nervature	1.5

Typus: Lectotypus (designated by Cuccuini 2002: 33) “*Rottboella filiformis* Roth, nov. Plant. Spec. Ex munif. Cel. Rhbt med. Doctoris ac phisici Vegesack. 1796”, (Ex Herb. G. Mayer, GOET).

More frequent Syn.: *Lepturus filiformis* (Roth) Trin.; *Lepturus incurvus* var. *filiformis* Fiori; *Pholiurus filiformis* (Roth) Schinz & Thell.; *Pholiurus incurvus* ssp. *filiformis* (Roth) Camus.

Parapholis marginata Runemark, Bot. Notiser: 115: 8-9. 1962.

Typus: Holotypus, “*Grece Kiklades. Sirina. Dio Adelfi the W-islands, 14-4-1960, Runemark & Nordenstam*” (LD).

Parapholis incurva (L.) C.E. Hubb., Blumea, suppl. 3: 14. 1946.

Bas.: *Aegilops incurva* L. Sp. Pl., 2: 1051. 1753.

Typus: Neotypus LINN 1281.11 (designated by Cuccuini 2002: 18-19). The same specimen was previously considered a lectotype by Cuccuini in Cafferty & al. (2000: 242-243).

More frequent Syn.: *Agrostis incurva* (L.) Scop. (“*incurvata*”); *Rottboellia incurvae* (L.) L. f. (“*incurvata*”); *Ophiurus incurvus* (L.) P. Beauv. (“*incurvatus*”); *Lepturus incurvus* (L.) Trin. (“*incurvatus*”); *Pholiurus incurvus* (L.) Hitchcock (“*incurvatus*”)

Parapholis strigosa (Dumort.) C.E. Hubb., Blumea, suppl. 3: 14. 1946

Bas.: *Lepturus strigosus* Dumort., Obs. Gram. Belg. 146-147. 1823, “*Lepiurus*”

Typus: Lectotypus “*Lepiurus, Ostenda s.d.*” campione posizionato sulla sinistra del foglio n° [specimen on the left of the sheet no.] 1088499 (Herb Dumortier, BR) (designated by Cuccuini 2002: 23).

***Hainardia* taxonomic framework**

Hainardia Greuter, Boissiera 13: 178. 1967

Typus: *Rottboellia cylindrica* Will., Sp. Pl. 1: 464. 1797

Hainardia cilindrica (Willd) Gruter, Boissiera 13: 117.1967

Bas.: *Rottboellia cylindrica* Willd. Sp. Pl. 1: 464. 1797

Typus: Lectotypus: [icon in] “*Gramen loliaceum majus*” Barrelier P.J., Gallia; Hispaniae et Italiam Obs. Tav. 5. 1714 (designated by Cuccuini & Fiorini 2004: 154).

More frequent Syn.: *Lepturus cylindricus* (Willd.) Trin; *Ophiurus cylindricus* (Willd.) Link, *Monerma cylindrica* (Willd.) Coss. & Dur.

Analytic key of Parapholis – Hainardia in Albania

- | | |
|---|--|
| 1 Spikelets with 1 glume and 1 floret | <i>Hainardia cylindrica</i> ^a |
| 1 Spikelets with 2 glumes and 1 floret | 2 |
| 2 Keel of glumes winged | 3 |
| 2 Keel of glumes not winged or ±plicate | 4 |
| 3 Anthers at least 2 mm long | <i>Parapholis filiformis</i> |
| 3 Anthers at least 1 mm long | <i>Parapholis marginata</i> |
| 4 Anthers at least 1 (–1.1) mm long | <i>Parapholis incurva</i> ^b |
| 4 Anthers at least 2–3.2 mm long | <i>Parapholis strigosa</i> ^c |

Notes

- ^aSometimes, in *H. cylindrica* plants with two-glumes-spikelets have been observed. Even if often interpreted as teratosis with no systematic significance, Castroviejo & al. (1979) interpreted them as the result of an inter-generic hybridization of *Hainardia cylindrica* with *Parapholis incurva*, namely *Hainardiopolis* × *pauneroi* Castroviejo, with the unbalanced abundance of the two parental species turning out in different introgressive morphotypes. On the contrary, we think that such individuals derive from an anomalous embryological development of *H. cylindrica* in extreme environments (Cuccuini & Fiorini 2004). Further studies are needed to solve this enigma.
- ^bIn *P. incurva* two morphotypes – both found in Albania – are known for this species which are associated to a different ecological context. Morphotype 1 is characterized by both erect or decumbent, vigorous shoots, up to 35 cm long, usually much branched at base, with strongly incurved spikes; it is the most widespread along coasts and lagoon shores and endowed with the higher chromosome numbers [$2n=28, 30 (32) + (4-5) B$], a record which is here confirmed also for the Albanian populations. On the contrary, the plants of morphotype 2 are erect, much less branched, 5–30 cm tall, with straight or only slightly curved spikes; they are more abundant in non-coastal habitats, from behind the coastal dunes to inner stands on both argillaceous outcrops, ruderal environments and salt-steppic depressions, and have less chromosome numbers [$2n=24 + (0-2) B$]. Our knowledge of such a variability and its relatedness with the growing conditions, both in Albanian territory and elsewhere, is still poor and inadequate to support the taxonomic value of several infra-specific taxa described until now.
- ^cCurrent occurrence of *Parapholis strigosa* mainly include North-European populations, while its Mediterranean distribution is confined in the Adriatic basin. Along the seashores of central and northern Adriatic, i.e. from Abruzzi seashores in Italy until (at least) the Kvarner islands in Croatia, this species was found with a morphotype 1 with long anthers (2.7–3.2 mm). They are shorter (2–2.5 mm) morphotype 2 in both the populations of Northern Europe and in the southernmost populations of W Adriatic, on Gargano lagoon, where the species starts to be progressively replaced by the vicariant *P. filiformis*. Since Albanian populations grows at the same latitudes of Gargano, further analysis would be interesting to check whether they also belong to morphotype (2).

Iconography

Parapholis incurva: Paunero (1964), fig 3-4. - Runemark (1962), fig. 3C. - Cuccuini (2002), fig. 3.

P. strigosa: Paunero (1964), fig. 7, sub *P. pycnantha*. - Runemark (1962), fig. 3E. - Cuccuini (2002), fig. 5.

P. filiformis: Runemark (1962), fig. 3F. - Paunero (1964), fig. 5. - Cuccuini (2002), fig. 11.

P. marginata: Runemark (1962), fig. 3D. - Paunero (1964), fig. 1. - Cuccuini (2002), fig. 9

Phenology

(April), May – June, (July) for all species.

Citotaxonomic Investigation

Chromosome counts resulted $2n=32=2M+14m+12sm+4st+(1-2)B$ in *Parapholis incurva* (Vlor, FI051505), $2n=14=4m+2m-sat+8sm+4B$ in *Parapholis filiformis* (Laguna Karavasta, FI051562), and probably $2n \leq 28$ in *Parapholis strigosa* (FI051563) (Fig. 2).

Chromosome studies are summarized in Tab. 3, in which are compared previous investigated Italian data (Fiorini & Cuccuini 2002; Cuccuini & Fiorini 2004) about Adriatic area, with new Albanian data. Some karyological parameters recently introduced (Paszko 2006; Peruzzi & Eroğlu 2013) are upload for previous Italian data.

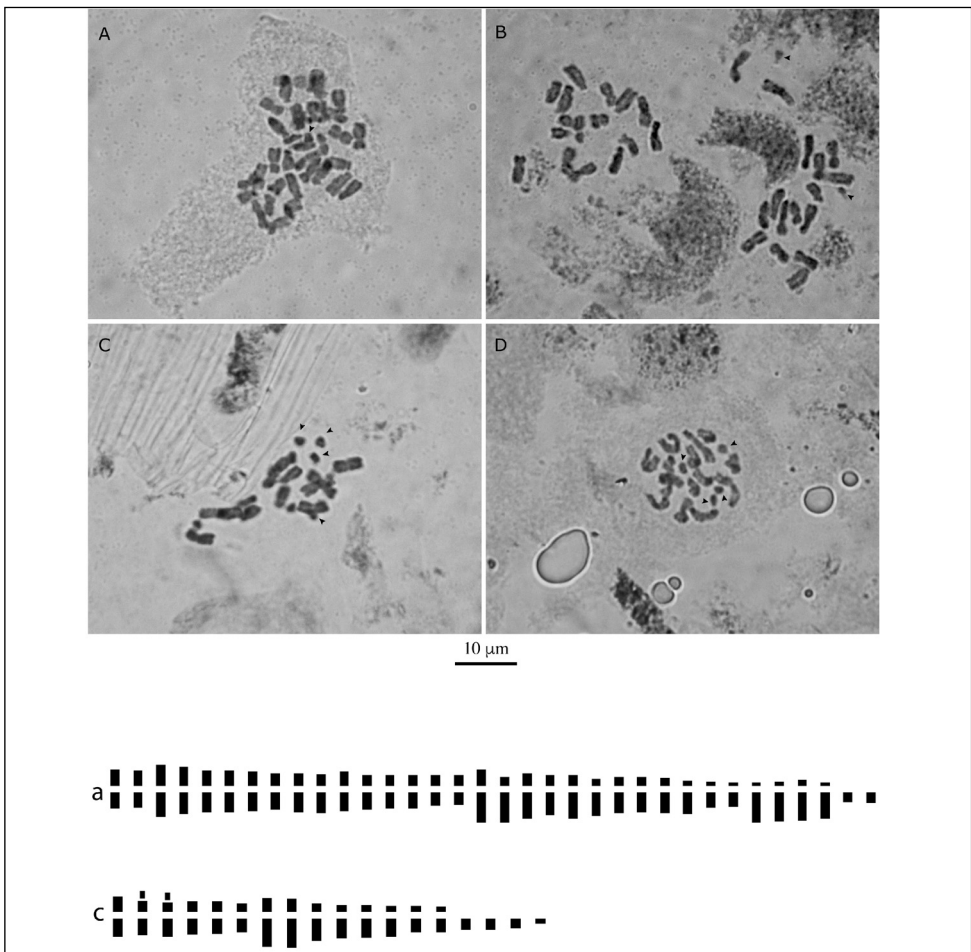


Fig. 2. Metaphase plates: (A, B) *Parapholis incurva* (Valona, FI051505), (a) karyogram $2n=32=2M+14m+12sm+4st+2B$; (C) *Parapholis filiformis* (Laguna Karavasta, FI051562), (c) karyogram, $2n=14=4m+2m-sat+8sm+4B$ and (D) *P. filiformis* (Laguna Karavasta, FI055530) Arrows B-chromosomes. Scale bar 10 µm.

Table 3. **2n**, chromosome number; **nX**, ploidy level; **formula**, karyotype; **µm** average chromosome length; **AsK**, centromeric index; **A1**, intrachromosomal asymmetry; **A2**, interchromosomal asymmetry; **CvCL**, coefficient of variation in chromosome length; **Mca**, mean centromeric asymmetry.

Specimen	localities	2n	nB	nX	base	Kariotype	µm	AsK	A1	A2	CvCL	Mca
<i>P. incurva</i>	ITALIA-Friuli VG-Marano Lagunare	28	4-5	4x	7	2M + 10m + 8sm + 8st	5,305	0,60	0,49	0,17	16,87	35,2
	ITALIA -Emilia Romagna - Goro	38	1-2	6x?	6	4M + 14m + 9sm + 11 st	5,88	0,66	0,44	0,16	15,75	32,55
	ALBANIA-Valona (033) Isolotti Ksanil (Isola SE) FI051505	32	1	4x	?	2M + 14m + 12sm + 4st+ 1B	3,95	0,64	0,39	0,24	24,56	26,92
	ALBANIA-Valona (026) Isolotti Ksanil (Isola SE) FI051505	32	2	4x	?	2M + 14m + 12sm + 4st+2B	4,5	0,64	0,39	0,22	22,43	31,32
<i>P. filiformis</i>	ITALIA-Campania-Lago di Fusaro	14	0-2	2x	7	8m + 6sm	5,6	0,61	0,36	0,15	14,92	23,23
	ALBANIA - laguna di Karavastase (staz.B-015) FI051562	14	4	2x	7	4m +2m sat + 8sm+4B	4,1	0,56	0,37	0,2	20,03	24,53
	ALBANIA - laguna di Karavastase (073) FI055530	14	4	2x	7	4m + 2m sat + 8sm+4B	4,5	0,5897	0,42	0,27	26,66	28
	<i>P. strigosa</i> ITALIA-FriuliVG-Grado ALBANIA - laguna di Karavastase-Istmo FI051563	28 ~28	1-2	4x	7	24m + 4sm ---	4,7 ---	0,54 ---	0,27 ---	0,16 ---	15,71 ---	16,24 ---

General Conclusions

Based on our taxonomic analysis, Albania hosts *H. cylindrica* plus four species of *Parapholis*: *P. filiformis*, *P. incurva*, *P. marginata* and *P. strigosa*.

To put in evidence their diagnostic characters (macro as number of flowers, size of mature anthers, winged or not-winged glumes keel and general habit of the plant) allow an easier identification of herbarium specimens, an analytical iconography (Fig. 1) and a synoptic table listing the most important micro-morphological characters (lemma: epidermal and exodermic cells, stomata and pollen: annulus) traits are provided (Tab. 2). Two species were found to be new for Albania: *P. marginata* and *P. strigosa*. Both grow in Karavasta lagoon, where their habitat for saltmarsh and seashore habitats of recent origin is confirmed. Regarding *P. strigosa*, some plants belonging to specimen FI051563 differ from the typical ones for their lanceolate-acuminate, sharply winged (vs. mostly ovate, unwinged or slightly plicate) and slender habit. Even if they could be interpreted as a still undocumented result of hybridization between *P. strigosa* and *P. filiformis*, we think they are most probably anomalous individual of *P. strigosa*, since their chromosome number ($2n = 24-28$) is much higher than the only one known ($2n = 14$) for *P. filiformis*.

However, our data are not sufficient to a comprehensive, ecological revision of the genera. Several areas and environmental contexts potentially suitable for former *Hainardieae* (including inner clay outcrops, ruderal sites and secondary volcanic habitats) still need to be explored. Due to this incomplete geographic and ecologic sampling, an overall taxonomic vision of the variation of this group in Albania cannot be provided yet and further investigations are strongly encouraged.

Karyological analyses partially agree with those made on Italian populations of *Parapholis* by Fiorini & Cuccuini (2002). All reports here introduced are new data. A synoptic Table of all karyological data of Albania together with Italian reports is made to simplify reading.

P. filiformis: metaphasic plates show chromosome number $2n=14$ and some B chromosomes as in Italian populations. Average chromosome size are a little smaller. Karyotype formula is similar, but more asymmetric, because of 8sm instead of 6sm and confirmed by indices $A1=0,42$, $A2=0,27$ and $MCA=28$ are little bigger than in Italian populations.

P. incurva: metaphasic plates show chromosome number $2n=32$ and some B chromosome. This number has never been counted in Italian populations, but only in southern Portugal (Castro & Fontes, 1946). The two metaphase plates show little differences because of smaller degree of contraction of chromosomes in the second photo (Fig. 2, B). Average chromosome sizes are smaller, than in Italian populations. Karyotype formula has different chromosome number, but shows similar proportional arrangement (M,m,sm,st). Indices of asymmetry show larger intrachromosome value and smaller interchromosome value than in Italian populations of Northern Adriatic area.

The karyological differences found in all investigated populations of *P. incurva*, in Mediterranean area (Fiorini & Cuccuini 2002), Albania enclosed, could be explained as a reaction to the strong selection of habitats and substratum (see above) in a fragmented and very large geographical area, that could induce different chromosome numbers, dysploid complements and B chromosomes.

About ***P. strigosa***, we can only say that probably $2n \leq 28$. The number of seeds was insufficient for adequate investigation, therefore a scarce number of bad metaphasic plates were seen.

Specimina visa

Parapholis filiformis (Roth) C.E. Hubb.

Durrës, shkozet ligatina, 10/07/1964, *M. Zemuri & E. Palisergi* (Tirana); Durrës: Golem, në vende mogalore ligatina, 28/06/1986, *A. Mullay & V. Tartari* (Tirana); Prefettura di Fier, distretto di Lushnië, laguna di Karavasta, parte centrale dell'istmo che separa la laguna maggiore dal mare, presso la torretta di avvistamento, mosaico di erbosi e pozze salmastre, 0 m., 40° 57'1.08N, 19°28'52.16"E, 06/06/2017, *L. Cecchi* (*FI051562); Karavastasë, dune, 40°58'33"N, 19°28'29"E, 30/06/2018, *F. Selvi* (*FI055530); Prefettura di Fier, distretto di Lushnië, laguna di Karavasta, parte centrale dell'istmo che separa la laguna maggiore dal mare, presso la torretta di avvistamento, mosaico di erbosi e pozze salmastre, 0 m., 40° 57'1.08N, 19°28'52.16"E, 06/06/2017, *L. Cecchi* (*FI051561).

Parapholis incurva (L.) C.E. Hubb.

Shkoder, 3,7 km östlich Velipja, sandstrand,feuchte Mulde, 41.8552 N, 19.47145 (decimal), 11/062014, *T. Gregor & L. Meierott* (FR0121163 photo); (sub *P. incurva* subsp. *incurva*) Vlorë, 1,7 km westsüdwestlich Orikum, m. 2, 40.326017 N, 19.4535 (decimal), 20/05/2016, *T. Gregor*, (FR0126489); Prefettura di Valona (Vlorë), distretto di Saranda, isolotti costieri di Ksamil-isolotto sud occidentale (ALKS003), 39° 46'24.12"N, 19°59'29.99"E (± 100 m), 09/05/2017, *L. Cecchi, L. Kashta & al.* (*FI051504, *FI051505); Prefettura di Valona (Vlorë), distretto di Saranda, isolotti costieri di Ksamil-isolotto sud orientale (ALKS002), 39°46'23.24"N, 19°59'44.57"E (± 50 m), 11/05/2017, *L. Cecchi, L. Kashta & al.* (*FI051506); Karavastasë, dune, 40°58'33"N, 19°28'29"E, 30/06/2018, *F. Selvi* (*FI055531).

Parapholis marginata Runemark

Karavastasë, dune, 40°58'33"N, 19°28'29"E, 30/06/2018, *F. Selvi* (*FI055532).

Parapholis strigosa (Dumort.) C.E. Hubb.

Prefettura di Fier, distretto di Lushnië, laguna di Karavasta, parte centrale dell'istmo che separa la laguna maggiore dal mare, presso la torretta di avvistamento, mosaico di erbosi e pozze salmastre, 0 m., 40° 57'1.08N, 19°28'52.16"E, 06/06/2017, *L. Cecchi* (*FI051563); Dune, Karavastasë, 40° 58'33"N, 19°28'29"E, 30/06/2018, *F. Selvi* (FI055534).

Hainardia cylindrica (Willd.) Gruter

Karavastasë, dune, 40°58'33"N, 19°28'29"E, 30/06/2018, *F. Selvi* (FI055533); Prati melmosi di Vutzindrò (Epiro), giugno 1888, *A. Baldacci* (FI); in pratis humidissimis ad Vutzindrò, junio 1888, *A. Baldacci* (FI) [in Baldacci, 1894 the description of localitie is different: *in pratis hieme inundatis ad Vutzindrò (Epirus)*]; Borsh, am Lumi Borskit, 20/04/1959, *F. K. Mayer 3052* (JE) (two specimens).

Specimens with* have been used in karyologic analysis.

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