PHANEROGAMARUM MONOGRAPHIAE TOMUS XIII

Monograph of the genus *Oplismenus* (*Gramineae*)

By

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With 46 figures and 2 tables

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Table of Contents

Page

6.2 Leaves

7. The reproductive area

7.1 Relative hairiness

7.2 Buildup of inflorescence

7.3 Spikelets, Florets, Fruit

7.3.1 glumes and awns

7.3.2 Studies of the adhesive secretion of the awns

7.3.3 Florets and fruit

7.3.4 Pollen and embryology

8. Physiology and ecology

8.1 Photoperiodism

8.2 Photosynthesis-type

8.3 Ecology

9. Chromosome count and hybrids

10. Cultivated forms

11. Study of notable correlations

11.1 Leaf length/ Spikelet length

11.2 length of side branches / Spikelet length

11.3 length of aperture/ leaf length

12. Specialized section

12.1 Description of genus

12.2 Key to the species

12.3 Conspectus

12.4 Descriptions of species

Introduction

In the secondary literature, the genus *Oplismenus* is frequently ignored. Even with respect to the number of species the estimates fluctuate between 10 and 40. Earlier, the morphologic-systematic research of the genus remained mostly geographically restricted; they focused on specific areas of circulation. (Ex. Hitchcock & Chase: America; Honda; Japan). Mez provides a monographic study of the genus that was begun in the 1920s. However this study was never finished. It remained unpublished and is found as an unfinished manuscript in the Botanical Museum of Berlin-Dahlem.

The apparent disunity in modern floristic-works, the strong polymorphism of the species and, last but not least, the disjunct subtropical region of some taxa prompted me to undertake a monographic study of the genus.

Already during the work period a study of the genus *Oplismenus* appeared by Davey & Clayton (1977) that is supported with mathematical-statistical methods. From the results it can be seen that a

systematic organization of the taxa is very difficult and that, because of this, it is necessary to attempt a fundamental study of the plants of this genus from all geographical regions. The varying definitions and organizations of the genus by earlier authors require a thorough study of the synonyms.

In the relevant floral works, six different species are repeatedly mentioned: *Oplismenus undultifolius* for Europe and Asia, *O. compositus* for Asia, *O. burmanii* for Asia and Africa, *O. hirtellus* for Africa and America, *O. rariflorus* and *O. setarius* for America. The present work should analyze whether different species are being studied or if infra-specific taxa should be recognized. The most important characteristics of the wide-ranging taxa just mentioned will be studied and critically considered in relation to their taxonomic placement, evolutionary history, and geographical origin.

The present monographic study relates to the above mentioned monograph by Mez in some points. This occurred especially by necessary status changes that were recommended by Mez. A new organization of the genus *Oplismenus* will be presented, including a discussion of the remaining questions related to the taxonomic placement, which could not be removed by this study even with its methods.

2. Materials and Methods

Within the scope of this work approximately five thousand specimen documents were evaluated, from the following herbariums: A, B, Bern, Bish, BM, BR, C, CGE, E, F, FI, FR, G, GOET, HBG, K, L, LD, LE, M, MO, NY, OXF, P PNH, PR, PRC, TI, US, W, Z, ZT (Abbreviations, see Index herbariorum).

Special attention was paid to making certain that the the type specimens of all the names included in *Oplismenus*, were located and studied. In total 61 type samples could be discovered, such that most of the names could be clearly placed. Where type samples were not available for different reasons special note was taken. In this case the placement relies either on the original description or on the statement of authors who have seen the type. However this method could not provide results for all names; therefore these taxa needed to be placed under *taxa dubia*.

As far as the scale of specimen materials was concerned they were clearly different down to the individual taxa, despite the total number being so large. For the widely distributed species of *Oplismenus compositus*, *O. burmannii* and *O. hirtellus*, hundreds of pages of evaluation [specimens?] were available, while the more narrowly distributed taxa could only be studied on a minimal number of documents.

The work remained largely confined to the study of morphological attributes. Complete cytological or physiological analyses were not within its scope. Therefore, these kinds of studies from other authors should only be referenced. The measurements of individual organs were statistically evaluated. In most cases either mean values or primary value ranges could be defined, approx. 70% of all values sit within these ranges. Extreme values are generally found within parenthesis. The descriptions of the taxon are resultants essentially of the results from personal studies. They include, however, in some particulars additional studies and similar synonymic results from authors listed in the special section of this work.

Additionally common names, economical impact, ecology, sociology and illustrative evidence were taken from the referenced sources.

The distribution of the taxa was verified in all important floral works. The attached aerial maps contain distribution details, which were taken from specimens. As the majority of the herbarium specimens originate from the 19th century and the beginning of the 20th the actuality of the indicated locations is not always certain. In literature hints are occasionally found that allow a confining of the area.

The author had the opportunity to go on research excursions to Togo and to Switzerland in order to observe some taxa in their natural location, so that some observations concerning the life forms and the ecology as well as sociological statements could be used in this work.

3. Historical Overview

The genus name *Oplismenus* was described by Palisot de Beauvois, Flore d' Oware et de Benin 2: 14, pl. 68 (1810) with the nomenclatoral type of the genus, *Oplismenus africanus*. Most authors give 1807 as the publication date for the Flore d' Oware et de Benin, as this date appears on the title page. From Stafleu (1967) it can be seen that the Flore d' Oware et de Benin appeared in individual printings from 1804 until 1818 and that the section that applies to *Oplismenus* first appeared in September 1810.

Robert Brown, Prod. Fl. Nov. Holl: 194 (1810) described the genus under the name *Orthopogon*; according to Stafleu (1967) this work appeared in April 1810, therefore the name *Orthopogon* has priority over *Oplismenus*. Therefore, the need arose to either instigate the seldom used name *Orthopogon* as a correction or else to conserve the generally well known name *Oplismenus*. Lastly Smith & Kerguelen (1976) suggest, on the basis that the name *Oplismenus* is used by almost all authors, that the genus is widely spread in all tropical and subtropical areas and that all the species described by *Orthopogon* are also published under *Oplismenus*. In regard to the conservation of the genus name *Oplismenus* the "Committee for Spermatophyta" Taxon 27: 287 (1978) voted 12:0 for the conservation. Therefore the genus name is conserved.

Arduino (1764) describes the taxon that is later known as *Oplismenus undulatifolius*, under the name "*Paniculum undulatifolium*". The genus name P*aniculum* would have had priority over *Oplismenus* and *Orthopogon* in the case of validity. It can, however, be determined that this description touches on an error, as the depictions and also the type samples that belong to it are correctly labeled as *Panicum undulatifolium*. Arduino also gives no indication that the described species can be separated from the genus *Panicum*.

Poiret (1816) gave the genus name *Oplismenus* inadvertently as "*Ophismenus*". Schlechtendal (1861-62) and Hasskarl according to Chase (1911) name the genus "*Hoplismenus*", derived from the Greek root of the word όπλίσμενος : the armed, so named due

to the glume with awns. As this case revolves around an orthographic variation, the name *Hoplismenus* is to be seen as a homonym of *Oplismenus*.

Steudel (1854) compiled the monotypic genus name *Hekaterosachne* with the species *H. elatior*. The description itself does not indicate *Oplismenus*. The type could not be studied. Different authors (Cheeseman 1906 and Dalla Torre & Harms 1900) equate the genus with *Oplismenus* and the New Zealand species *H. elatior* with *Oplismenus undulatifolius*. According to my research *O. undulatifolius* is not found in the Australian region; it can only be about *O. compositus*, *O. hirtellus* subsp. *imbecillis* or *O. aemulus* . In light of these facts the classification remains doubtful.

Rumpf (1750) coined the pre-linneisch genus name *Hippogrostis amboina*. This genus name does not, despite common belief, correspond to *Oplismenus*. By Rumpf, Herb. Amb. VI: 14 (1750) two species are described, namely *H. major* and *H. minor*. Both species differ only in size and are combined as *Hippogrostis amboinica*. *H. amboinica* is depicted in table V, f.2 and corresponds neither in picture nor in description to *Oplismenus*. Merrill (1917) referred to the depicted plant as *Ischaemum timorensum* Kunth. On the, above mentioned, table V in f. 3 an *Oplismenus*-species is depicted; it corresponds to *O. burmannii*, so far as one can take it as a relatively rough habitus depiction. From the accompanying text comes the conclusion that a species is being discussed, which Rumpf labels as "eius denotat speciem". Merrill certifies it as *Oplismenus compositus*, which according to his own data is not contained in Rumpf's herbarium. *O. burmannii*, however, is present as evidence, however, it doesn't correspond to Merrill's above mentioned depiction. The name *Hippogrostis* can however, under no circumstances be applied to the plant displayed in f.3. Nevertheless *O.* Kuntze (1891) needlessly picked up this name and changed the combinations of multiple species from *Oplismenus* to *Hippagrostis* (*Hippogrostis*).

The genus *Oplismenus* was not always unanimously defined. Palisot de Beauvois (1810) identified seven species in addition to the type species *O. africanus*. Persoon (1805) had previously put these together as two species groups: "Spic. composita, spicul. compressis secundis" . Valid combination changes of these species that Persoon quotes from *Panicum*, are first found in Palisot de Beauvois, Essai d'une nouvelle Agrostographie: 53 (1812), they are as follows *O. bromoides*, *O. burmannii*, *O. comositus*, *O. elatior*, *O. helvolus* and *O. hirtellus*. Additionally the species *O. foliaceus* and *O. undulatiflolius* were named. The designation of "foliaceus" is clearly due to a typographical error in which *O. loliaceus* is named a synonym, as only *Panicum loliaceum* Lam. appears in the index of the Agrostrograph.

The case of *O. undulatiflolius* is more complicated. In text S. 54 *O. undulatifolius* – like the other species as well – is listed as nomen nudum. In the Index s. 168 "*Panicum undulatifolium* And (Ard.)" is listed as a synonym for *O. burmannii*, and "*Panicum undulatifolium* ? L." is listed as a synonym to *O. undulatifolius*. As no *Panicum undulatifolium* exists this combination is invalid (Niles & Chase 1925; Becherer 1929).

The type species of the genus *O. africanus* was described, depicted and registered as a separate species next to *Panicum hirtellum* L. and *Panicum loliaceum* Lam. by Palisot de Beauvois. No voucher specimen is cited. Two specimens can, however, be studied, as they were well known to Palisot de Beauvois and have comments on them: “types de la Flora d’ Oware et de benin” (G) and “dedit Palisot de Beauvois” (LE). Both plants are similar in their habit (very delicate), they are however, relatively strongly differentiated in their inflorescence area. The specimen 1 from Geneva corresponds to the depiction in the Flore d’oware et de Benin and should therefore be considered the lectotype. The specimen 2 from Leningrad represents a connection between *O. hirtellus* subsp. *fasciculatus* and subsp. *setarius*.

Like Palisot de Beauvois, R. Brown also tightly circumscribed his genus *Orthopogon* (Greek origin: ὀρθός straight, πώγων beard) and only compiled species under it that have awns in the outer three glumes and whose spikelets are pressed together from the sides. He lists *Orthopogon compositus* (= *Panicum compositum* L.) and three further examples of species which he describes himself, *Orthopogon aemulus* , *Orthopogon flaccidus* and *Orthopogon imbecillis*.

The genus *Oplismenus* is related in the same and similar circumscriptions by Roemer & Schultes (1817), Raddi (1823), Nees von Esenbeck (1829 and 1841) , Bentham & Hooker (1883), Domin (1915), Hitchcock (1913 on following pages), Koidzumi (1925) and Honda (1924 and 1930). In contrast to this circumscription, which we want to list as *Oplismenus* s. str. , we have Kunth in Humbolt, Bonpland & Kunth (1816) and Kunth (1833), Desvaux (1831 and E. Fournier (1816) who stretched the genus and placed the currently recognized genus *Echinochloa* as a section of *Oplismenus*. Even so Sprengel (1825) proceeds with the circumscription of the recognized genus *Orthopogon*, later however, like the earlier Poiret (1816) and after him Steudel (1854), he reduces the genus to a section of *Panicum*, while Trinius, in earlier works (1820) takes on *Orthopogon* s. str.. Mez (1917 and 1921) accepts *Oplismenus* (s. str.), adds however, some species to it that belong to different genera.

Schlechtendal (1961-62) divided the genus *Oplismenus* in two sections. This division relates to the varied arrangements of the awns. The species of the genus *Oplismenus* sect. *Orthopogon* (= sect. *Oplismenus*) have strong, red-gold and bald awns, to the genus *Oplismenus* sect. Scabrista’s delicate, whitish and dentate awns. This division appears sensible as the make-up of the awns is an important criteria both in physiological as well as in distributive-biological aspects.

It was Davey & Clayton (1977) who, in their study of some of the species of the genus, followed new points of view; they analyzed the species *O. compositus*, *O. hirtellus*, *O. undulatifolius*, *O. aemulus* , *O. imbecillis*, *O. rariflorus* and *O. setarius* according to the method of “discriminate analysis” (Cooley & Lohnes 1971), From that they compared all species and tried, as much as possible, by means of characteristic combinations to separate them. Thereby they came to the conclusion that some species are easy to separate, when one considers them within individual geographical regions. For example in America, in Africa, in Asia, in Australia; the trans-regional comparison however, produced only a grouping of multiple non-separable species. Davey & Clayton name from there only *O. hirtellus*, *O. compositus* and *O. undulatifolius* and come to the result that for these three species no distinct definition boundaries are present.

The historical consideration of the genus proves clearly how difficult the separation of the species from one another is. This was made especially evident through the very objective research methods of Davey & Clayton. From that one may doubtless conclude that through a classical systematic approach no fully satisfying results can be expected.

4. The systematic placement of the genus

As the consideration of the systematic placement of the genus *Oplismenus* does not belong to the special objectives of this work, only the basic approach of Pilger (1940), Hsu (1965) and Butzin (1969, 1970 a and b) should be referenced. They describe the placement of the genus within the subfamily of Panicoideae and were judged according to different criteria.

Oplismenus belongs to the subfamily of *Panicoideae* that in general, for example according to Pilger (1940), is characterized by double floreted spikelets that contain reduced or male and one dual-gender floret. The individual standing or paired spikelets are similar, either without awns or with a few simple awns. The lemma and palea of a fertile floret are commonly callused. Handel-shaped silicate-cells and dual-celled micro-hairs with smaller end-cells are often present.

In view of the predominant awnless genus, *Oplismenus* stands in an outsider position, however the placement into this group remains uncontested. Pilger combines *Oplismenus* in the *group of the genus containing spikelets with awns with Chaetium Nees, Stereochlaena Hackel, Achritchaete* Pilger, *Oryzidium* C. E. Hubbard & Schweickerdt, *Poecilostachys* Hackel and *Oplismenopsis* (L.) Parodi.

Butzin (1969 and 1970 a and b) attempts to clarify the classification of Tribus *Paniceae*, whose essential taxonomical criteria are as follows: Glumes with awns, web-style venation of the leaves, placement of the hilums, orientation of the spikelets, direction that the spikelets press together and construct of inflorescence. Through the preferential evaluation of these characteristic complexities, *Oplismenus* comes close to the genus *Acroceras* Stapf, *Streptostachys* Desv., *Poecilostachys* Hackel and *Chloachne* Stapf. Clearly *Oplismenus* is different because of the characteristic of adhesive awns that are not dentate, which are present in many species. As the species of the genus *Oplismenus* sect. *Scabriseta* have clearly dentate awns this characteristic cannot be used alone for the genus definition. The notched glumes that are especially noticeable in *O. affinis*, present a further characteristic for the definition of the genus, as this characteristic appears again among the *Paniceae* with awns only in the genus *Mesosetum* Steud.

In studying the leaf venation of *Paniceae*, Butzin (1970 a) determines that clear transverse venation appear in *Oplismenus*. In many cases this proves true. As there are, however, many plants in which simple parallel venation exists this characteristic cannot be genus specific in the specified related circle.

In earlier times the additional attempts would have been made to subdivide *Paniceae*, not only according morphological, but also anatomical and cytological criteria. Hsu (1965) set up a new organization according to characteristics of the epidermis of the lemma, the form of the lodicule and

the base of the style. From that is seen that *Oplismenus* is closer to the genuses *Panicum* L., *Ichnanthus* P. Beauv. and *Echinochloa* P. beauv.

5. Growth and Life-form

In the genus *Oplismenus* both perennial and annual species are found. As no special survival organs and no wooded parts are developed the perennial taxa must be hemicryptophytes. In literature particularly *O. flavicomus*, *O. gracillimus*, *O. comositus*, *O. hirtellus* and *O. undulatifolius* are mentioned as perennial taxa. The clear annuals appear to be *O. affinis* and *O. burmannii*. For *O. burmannii* the author was able to personally check this in Togo, where a specific site was researched during multiple seasons. It is difficult to morphologically differentiate between the annual and perennial species. In some cases stronger growth hints at a multi-year life-type.

6. Vegetative characteristics

6.1 Relative hairiness

In connection with the observation of the morphology of the genus it appears necessary to determine which criteria are vital to the definition of the species and taxa and which are irrelevant. It becomes apparent that a differentiating characteristic may be very important for the grouping of two or more taxa, while for other groups it appears unimportant.

The hairiness of the vegetative area cannot be used as a definitive characteristic to differentiate species or sub-species, as incidences of varying hairiness appear in all taxa. The furrows, the culms, the upper and lower sides of leaves, the sheath; on the edge as well as the flat part, and the ligule can all have hair. The length of the single-celled, undivided hairs (soi-disant macro-hair) varies from 0.5 to 5 mm. Shorter hairs appear mainly on the culm, on the tip of the ligule and mixed with longer hairs on the leaf blade. They stand straight out from their base; they have a wide base that gradually turns into a thin hair point. Longer hairs are found on the edge of the sheath, sometimes on the body of the sheath and on the leaf blade. The density of the hair growth varies greatly. Especially the edge of the sheath and occasionally the leaf blade can have dense hair, such that the upper-flat of the organ appears a wooly-velvet. These hairs either stand up or lean bent over on the organ. The cylindrical micro-hairs need to be mentioned, they are present in almost all taxa on the lower and upper sides of the leaves. Noticeably dense hair on multiple parts of the plant appears in the species *O. hirtellus* and *O. compositus*. The leaf sheaths are, mostly, hairier on the nodes and the points than on other areas. A constant, dense hairiness of the flat of the sheath and also the inflorescence rachilla appears only in *O. hirtellus* subsp. *undulatifolius*, whereby this characteristic in combination with others can be used as criteria. – The length or the hair growth of the leaf-ligule is variable within most taxa, only *O. hirtellus* subsp. *capensis* and partially *O. hirtellus* subsp. *acuminatus* and subsp. *psilostachys* have bare adaxial ligule.

6.2 Leaves

The length of the leaf varies more or less greatly among all the taxa (between 2 and 16 cm), only *O. hirtellus* subsp. *microphyllus* is characterized by consistently short haired leaves.

The leaf shape varies greatly as well. Only *O. hirtellus* subsp. *imbecillis* is noticeably different through small lanceolate leaves.

The leaf epidermis exhibits basically all the characteristics that are typical for Panicoideae, a group of predominantly tropical grasses. The most important taxa of the genus were researched, whereby it should be determined, if criteria for a systematic organization can be found and if the tropical or extra-tropical form-circles exhibit differences in the epidermis. Grob (1896) researched the epidermis of *Oplismenus undulatifolius*. Grob's system is the basis for the following treatment. All the parts of the epidermis, the upper parenchyma as well as the upper vascular tissue (bast), were studied on the upper and lower side of the second leaf under the inflorescence of the plant specimen. The leaf pieces were 0.5 X 0.5 cm; they were boiled and coated with enamel. After a lengthy drying the enamel was carefully pulled off with tweezers and could be studied in a drop of water under the microscope. An exact imprint of all parts of the epidermis was there, only longer hairs were seen only as diffuse hair roots. This method relates to Sampson (1961) as a simplified form. On a total of 50 samples the shape and length of the aperture, the long-cells the short-cells, the other forms which includes silicate-cells, the micro-hairs and the acantha (spike)-hairs were studied. The occurrence of long- and short-cells as well as micro-hairs was considered separately between Parenchyma and vascular tissue.

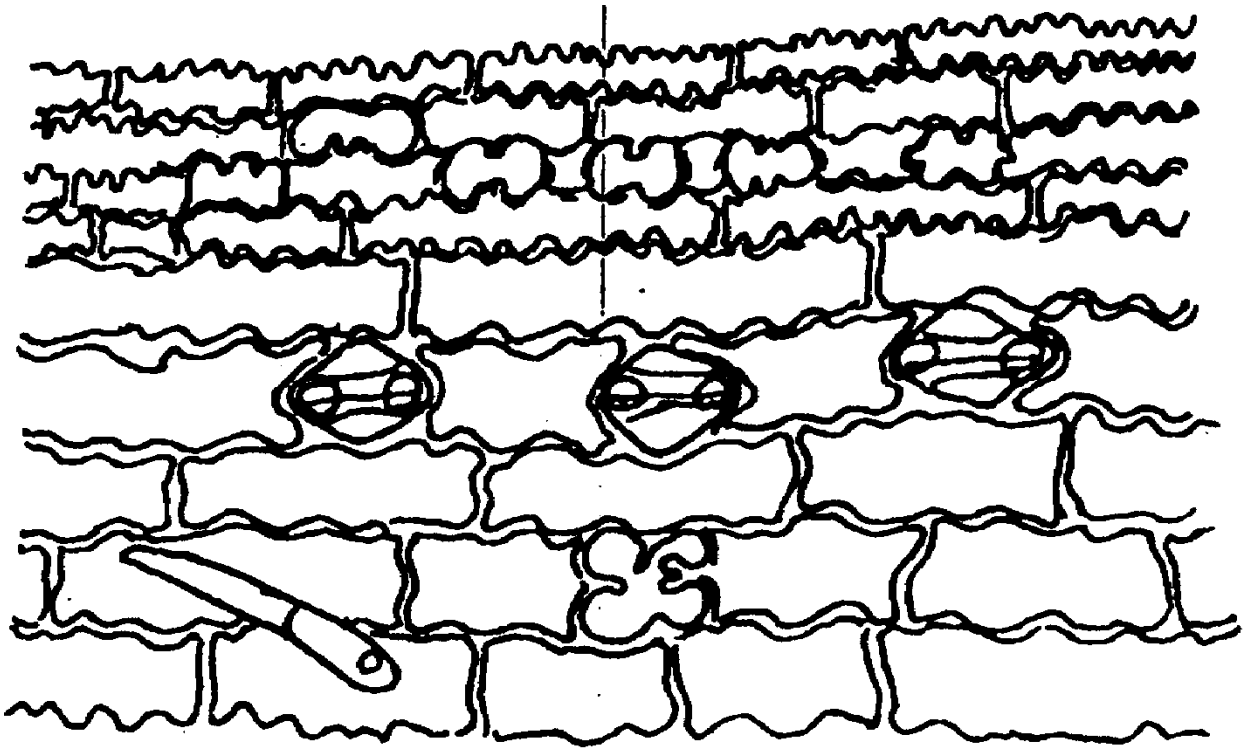


Fig. 1: Epidermis – Inspection

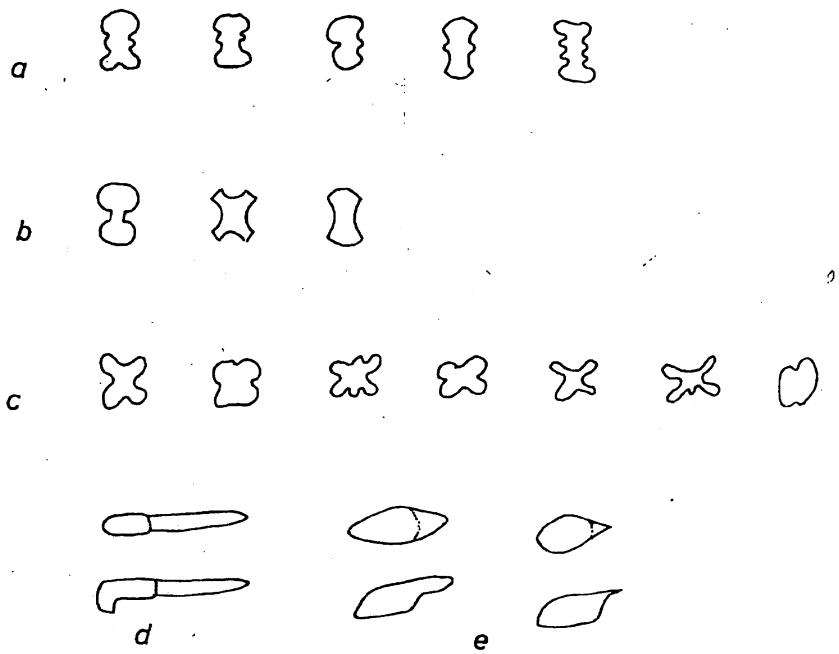


Fig. 2: Short-cells and Hairs (a: node-cells; b: handle-cells; c: cross-cells; d: micro-hairs;

e: acantha-hairs)

Many different shapes of silicate-cells were found, as well as, for tropical grasses, typical cylindrical, duel-celled micro-hairs that lay on the epidermis with the base cell orthogonally broken off, were found (Fig. 2.).

The epidermis can be divided into two areas. (Fig. 1.): 1) The costa-fields over the vascular bundle; and 2) inter-costal-fields over parenchyma tissue. The base cells of the costa-fields are stretched out, small and strongly rippled and are present in all taxa. By *O. hirtellus* subsp. *tschushimensis* (on upper- and lower- sides of the leaf) and by *O. hirtellus* subsp. *undulatifolius* (on the underside of the leaf) no additional cells were found. By all other taxa the row of base-cells is interrupted by silicified short-cells. These short-cells can be handle or node shaped and can be singly or multiply organized in an undisturbed order in one or two rows on the costa-field. Grob alludes especially to the rows of only silicate-short-cells. Handle-cells can alternate irregularly with node-cells. The node-cells are symmetrically or irregularly spread. The length of the silicate-short-cells ranges from 17.4 to 35.4 µm.

Occasionally on the costa-field cross shaped silicate-cells or small acantha-hairs appear. The acantha hairs are 29 to 95.7 µm long, thick walled and single-celled; however their form does not correspond to Grob's (1896) hairs depicted in Abb. X, 52. A clear acantha point is seldom recognizable; mostly the hairs on the point are bluntly rounded off.

The area between two costa strips is referred to as inter-costal field. The base-cells of the inter-costal field are made up of orthogonal, more or less cylindrical cells, whose walls are flat-edged or have a weak to moderate ripple. In extreme cases the cells have a length of 46.4 to 113.1 µm. In addition to that short cells appear that are almost square shaped. Grob defines these as "short" long-cells as they neither anatomically nor chemically differ from remaining long-cells.

Along the edge of the inter-costal field, apertures between the epidermis' base-cells are ordered in a row behind one another. They are found in varying numbers, commonly on the leaf's underside, less

commonly on the leaf's topside. The apertures have an ovular shape, they're occasionally rounded and sometimes cylindrical-small shapes appear. They are (20.3 µm) to 29 to 52.2 µm long and 14.3 to 31.9 µm wide. Grob states that one of the adjoining cells is commonly silicified. This could not be confirmed by the above study.

Like the apertures true short cells are found along the edge of the intercostals field. They have silicified walls and are of characteristic form. Occasionally silicate-cells are also present within the total intercostals area, where they are loosely spread among the long-cells. They are thinly placed, mostly cross shaped and have a diameter of 11.8 to 29 µm. On the leaf's underside of *O. hirtellus* subsp. *tsushimensis*, subsp. *undulatifolius* and *O. affinis* var. *humboldtianus* and on the leaf's topside of *O. burmannii* var. *burmannii* no silicate-cells are found. Acantha hairs appear sometimes in the intercostal field by *O. hirtellus* subsp. *capensis* (top and under sides), subsp. *setarius* (underside) and *O. affinis* var. *humboldtianus*. More commonly cylindrical, delicately walled angular-hairs can be observed, whose end cells in many cases can be lost in older leaves. Grob's (1896) assumption that angular hairs in the genus *Oplismenus* appear predominantly on the underside of the leaf, can however not be confirmed. Angular hairs appear equally as often on the top and the bottom sides.

When the epidermis structure is compared for individual taxa no taxon characteristics appear. As is apparent form table 1, the distribution of every single characteristic is so broad that in the combined values for all taxa clear overlaps need to be registered. Therefore the characteristics of the leaf's epidermis can be given no systematic value. From this can be determined that even the comparison of tropical and extra tropical forms yields no possibilities of separation. By *O. hirtellus* subsp. *tsushimensis* and subsp. *undulatifolius* it is evident that the silicate-cross-cells that are so typical for tropical grasses appears seldom and in a lightly modified form.

	aperture		long-cells		cross-cells			micro-hairs	acantha hairs	
					inter-costal field	costal field				
	length	width	length	width	cross-cells	node-cells	handle-cells		inter-costal field	costal field
O.burmannii var. burmannii	(29)-33--43.5	14.5--20.3	46.4--75	17.4--29	86.1	20.3	20.3--23.2			
O. affinis var. affinis	37.7--46.4	17.4--23.2	40.6--58	17.4--26.1	17.4		20.3	101.5		
O. affinis var. humboldtianus	31.9--49.3	(11.6)-17.4--26.1	52.2--72.5	23.2--31.9	23.2--26.1	29	20.3	58	76.7	
O. compositus var. compositus	34.9--49.3	20.3--23.2	(28.6)-63.8--98.6	20.3--40.6	20.3--26.1-(29)	26.1--34.8	17.4--29	49.3--60.3		52.2--95.7
O. compositus var. sylvaticus	49.3	23.2	58--87	26.1--29	20.3--29	23.2	23.2			
O. hirtellus subsp. hirtellus	(34.8)-43.5--49.5	17.4--29	55.1--107.3	17.4--31.9	14.5--26.1	29--34.8	20.3--23.2	49.3--60.9	29	
O. hirtellus subsp. acuminatus	20.3 (1)-37.7	8.7(1)-17.4	37.7--69.6	20.3--23.2	20.3				29	
O. hirtellus subsp. capensis	29--43.5	14.5--20.3	52.2--75.4	23.2--29	17.4--29	26.1	23.2		14.5--20.3	66.7
O. hirtellus subsp. fascioulatus	40.6--49.3	14.5--26.1	58-75.4	29--31.9	14.5--23.2	20.3--26.1	20.3--26.1			
O. hirtellus subsp. imbecillis	34.8--43.5	16.5--20.3	69.6--75.4	20.3--23.2	11.8--20.3	29	18.9			
O. hirtellus subsp. japonicus	37.7--46.4	17.4--23.2	46.4--98.6	17.4--29	20.3--29	23.2--31.9	17.4			75.4
O. hirtellus subsp. setarious	36.6--46.4	16.5--23.6	52.2--113.1	17.4--43.5	16.7--26	25.8--27.2	25.8--27.2		43.5	
O. hirtellus subsp. tsushimensia	40.1--43.5	16.5--23.6	59	21.3						
O. hirtellus subsp. undulatifolius	31.9--43.5-(52.2)	(15.3)-20.3--23.2	69.6--72	26--37.7	14.5--20.3	35.4	35.4	50.7	40	

Tab. 1: Epidermis Study.

Appendix:

Research materials

O. burmannii var. *burmannii*: India: Wallich 8678, BR.

Biswas 9720, A. – Guatemala: Bernoulli 912, GOET. – Niger: Barter 1267, GOET.

O. affinis var. *affinis*: Columbia: Gaumer 1038, GOET. – Guatemala: Bernoulli 959, GOET.

O. affinis var. *humboldtianus*: Ecuador: Asplund 5811, BR. – Mexico: Conzatti et al. 4642, BR. – Venezuela: Fendler 1705, GOET.

O. *compositus* var. *compositus*: Australia: Mueller s.n., BR. – Ceylon: Thwaites 913, GOET. – Philippines: Cuming 531, GOET. – Taiwan: Tanaka 13424, BR. Thailand: Tagawa 544, A.

O. *compositus* var. *sylvaticus*: Mauritius: Sieber 205, GOET.

O. hirtellus subsp. *hirtellus*: Argentina: Petersen 18, BR. – Brazil: Reitz & Klein 3106, - Cameroon: Zenker 1214, GOET. Paraguay: Fiebrig 366, GOET.

O. hirtellus subsp. *acuminatus*: Madagascar: Hildebrandt 4003, GOET.

O. hirtellus subsp. *capensis*: Liberia: Leeuwenberg 4758, B. – Madagascar: Humbert 4567, B. – Malawi: Stolz 1334, B. – Tansania: Milne-Redhead 10794, B. Schlieben 735, G.

O. hirtellus subsp. *fasciculatus*: Angola: Exell & Mendoka 313, BR. – Liberia: Daniel 425, BR. Oahu: Maximowitsch s.n., BR. – Togo: Ern et al. 1856, B.

O. hirtellus subsp. imbecillis: Australia: Sieber 73, GOET. – New-Guinea: Clemens 1202, GOET. – Philippines: Ramos s.n., G, 49302, BR.

O. hirtellus subsp. *japonicus*: Japan: Takenouchi s.n., s.n., B. Tateoka s.n., B.

O. hirtellus subsp. *setarius*: Argentina: Petersen 2678, BR. – Cuba: Gonzales 161, BR. – Mexico: Müller 1835, BR. – Paraguay: Balansa 159 a, BR. – U.S.A.: Buckley s.n., BR. Lindheimer 1263, BR.

O. hirtellus subsp. tsushimensis: Japan: Makino 8263, BR. Ohwi 164, BR.

O. hirtellus subsp. *undulatifolius*: Italy: Bigo s.n., BR. Hausmann 973, BR. – Switzerland: Gypsberger s.n., BR. Lejeuner s.n., BR.

7. Reproductive structures

7.1 Relative hairiness

The hairiness extends to the culm, the side branches, the inflorescence branches, the spikelets, the lemma and the glumes. The hair on the main and inflorescence branches of the inflorescence grow out of the raised edges and can be long or short (up to 3 mm) and elastic. The spikelet's side shaft usually has a few long hairs that can reach to the middle of the spikelet. By some species (*O. affinis* and *O. burmannii* in the American region) there is an obvious augmentation of the shaft hairs such that it appears that the thick or moderately haired spikelets are even more heavily haired.

Furthermore the first three glumes can be individually more or less hairy. In most cases the hairs grow from the edge of the glumes and some from the rounded backs. *O. affinis* and *O. burmannii* var. *lanatus* have very strong and thick spikelet hairs. These hairs are as long as or longer than the glumes themselves. Especially noticeable is the ring shaped hair growth of the lemma of *O. affinis*, which is almost exclusively concentrated on the middle area and is non-existent in any other species. Thick, but mostly short hair growth is sometimes found on the spikelets of *O. aemulus* var. *aemulus* and var. *densiflorus*, by *O. hirtellus* subsp. *imbecillis* f, *lanceolatus* and by *O. hirtellus* subsp. *fasciculatus* and *O. compositus*. The hairs lean mostly tight against the spikelets and are short. – The Lemma II and Palea II are always hairless.

Lacking or thick hair growth of the inflorescence area plays a part in the separation of *O. aemulus* var. *flaccidus* and var. *aemulus* .

7.2 Inflorescence structure

The inflorescence of the taxa is made up of multiple partial inflorescences and makes a double cluster. The taxa *O. hirtellus* subsp. *acuminatus*, subsp. *capensis* and subsp. *psilostachys* characterize themselves through the lack of side branches compared to all other taxa. The partial inflorescences in the other taxa are also racemose constructed; they are separated from one another and grow alternating out of the triangular culm.

In general longer side branches grow in the lower inflorescence area, while they are shorter or strongly reduced in the upper. The intervals of the partial inflorescences become shorter towards the top of the inflorescences. Exceptions to this are found in *O. aemulus* var. *densiflorus* and *O. hirtellus* subsp. *tsushimensis*, where the intervals remain almost the same with fewer numbers, such that the inflorescence works compacted and in clumps. The constant points contain good characteristics to separate both taxa compared to all the others.

A spikelet pair contains a short shafted and an almost sessile spikelet. When mature the spikelet breaks away on the upper end of the short shaft. In Schlechtendal's examination (1861-62) a clear correlation was determined in relation to the placement of the spikelet pairs on a side branch. In taxa with long side branches like *O. compositus* the spikelet pairs sit clearly behind one another and are usually even

clearly separated from one another. Taxa with short side branches like *O. hirtellus* subsp. *undulatifolius* have the spikelet pairs organized in clusters. For taxa like *O. hirtellus* subsp. *hirtellus*, with spikelet pairs ordered in thick succession, and *O. aemulus* var. *aemulus* and var. *flaccidus*, with spikelet pairs ordered clearly behind one another, the side branch length is almost the same. The length of the side branches is therefore, not decisive to the organization, rather the number of spikelet pairs per-side branch. Fig. 3 shows a diagram view of multiple longer and shorter side branches and their recognizable cicatrices from spikelets that have fallen off. If a longer side branch has multiple spikelet pairs the spikelet organization is thick with multiple rows, while a shorter side branch with less spikelets uses a different effect. Schlechtendal (1861-62) relates these different effects to the partially or fully reduced spikelet of the pair. In actuality, especially by *O. compositus*, single spikelets can be reduced to the glume with trailing awns, or even reduced completely to awns. The organization of spikelets cannot, however, be traced back to this phenomenon alone, as also with intact spikelet pairs more or less thick or thin organization appears on the side branches.

In connection with a further attribute, namely the partial or complete reduction of the awns on the Lemma I, the organization of the spikelets helps differentiate between *O. hirtellus*, *O. aemulus* and *O. compositus*.

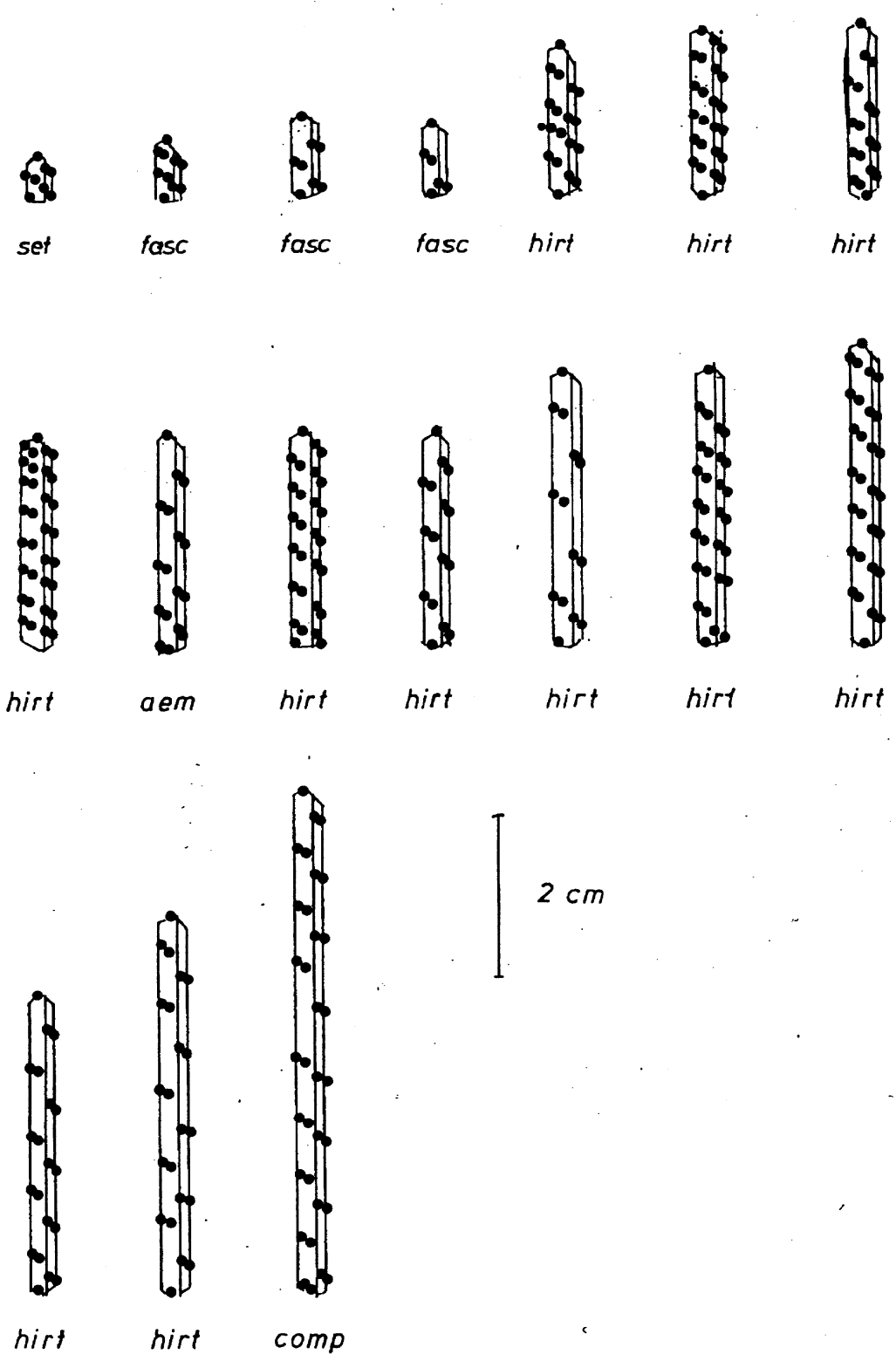


Fig. 3: Side Branches of the Inflorescences with Spikelet cicatrices (diagramed)

7.3 Spikelet, Florets, Fruit

7.3.1 Glumes and Awns

The mainly short shafted 1 – (2)- floret spikelet consists of two glumes with awns, a lower, only occasionally Lower lemmawith awns, a mostly missing lower Palea I and an upper intact floret, that is encased by the Lemma II and Palea II. The lower floret is usually fully reduced or only male.

The individual taxa exhibit a substantial variation in relation to the spikelet length. *O. gracillimus* is clearly differentiated from all other taxa by a spikelet length of 1.5—1.8 mm. That criterion serves furthermore in combination with others to differentiate individual taxa from one another, for example *O. burmannii* (2)-2.8 to (3.5) mm and *O. flavicomus* 3.8 to 4 mm, for *O. affinis* var. affinis (3.3)-3.5 to 4 (4.5) mm and for *O. affinis* var. *humboldtianus* 3-3.3 mm, and for *O. compositus* var. *compositus* (3.3)-3.6-(5.2) mm and for *O. compositus* var. rariflorus (2.5)-2.6-3.2 mm. – Aside from these the taxa of *O. hirtellus* (subsp. *acuminatus*, subsp. *capensis* and subsp. *psilotachys*) can be separated from taxa of this kind with smaller spikelets, with the above criteria in combination with other attributes.

The shape of the glumes varies for almost all taxa more or less greatly; it remains, however, lanceolate. Only *O. baronii* and *O. gracillimus* deviate clearly from the other species by short, broad glumes. For these two species this criteria is crucial. Similarly, there is overlap in the case of the glumes' relative length. For *O. flavicomus* the Gluma II is clearly the longest glume of the spikelet, while for all other species the Lower lemma– or sometimes the Gluma I – exceeds all the other glumes in length.

The number of veins varies in the glumes as well as in the lower lemma, while the Palea I always has two veins, the Lemma II has five veins and the Palea II has two veins. Only *O. hirtellus* subsp. *undulatifolius* develops a constant number of veins (gl I: three veins, gl II: five veins, L I: seven veins), such that this taxon can be separated from other taxa, in connection with other attributes.

The differing makeup of the awns is an important attribute in order to define two sections clearly (s. 3.) – The awn length works as a clear separating criteria only for *O. aemulus* var. *densiflorus*, for all other taxa the range of variation is so great that this attribute has no meaning. – The starting point of the awn, that is under the glume tip (for *O. humbertianus*) or on the tip as an extension of the complete glume (for all other taxa) works as a separating attribute for both of the first mentioned taxa.

Through the observation of living plants, collected in Ticino, it was possible to solidly determine that the hardy awns without dentate also have the characteristic of secreting an adhesive substance when the fruit is ripe. This phenomenon, which is singular among grasses lead to a more precise study of the anatomy of the awns as well as the chemical makeup of the adhesive secretion (s. 7.3.2.). The above mentioned plants of *O. hirtellus* subsp. *undulatifolius* that were collected in Ticino and the awns of *O. burmannii* that were taken from samples, work as research material of this phenomenon.

The dentate awns of *O. burmannii* show a smaller diameter than the bare [smooth?] awns and a uniform scleremacymetic tissue. No clear layering was recognizable.

The awns of *O. hirtellus* subsp. *undulatifolius* were studied in early (Panel 1, Fig1) and in the fruit bearing stages (Panel 1, Fig. 2). The serrations show a strong anatomical difference of the awn tissue. Three zones can be determined: 1. The outer epidermis layer: a layer of palisade ordered cells with thick outer walls; the side and back walls are thin; cell content of the epidermis cells is plasmatic, the plasma is mostly agglomerated in the outer section of the cell, for older awns, and the core is noticeably large. – 2. On the epidermis is a multi rowed layer of thick walled, sclerematized cells; on the cell walls deposits of cellulose are found. – 3. On the inside of the awn wide lumen xylem cells of the vascular bundle are clearly noticeable. The profiles of the awns were inspected on lignin with phloroglucinol-hydrochloric acid. The xylem part turned red, all other cell walls remained uncolored.

The makeup of the awns allows it to be determined that the adhesive secretion is created in the epidermis layer and is also secreted from here. However, in the profiles no exit holes could be determined. For comparison, photos of the upper surface were taken with a raster electron microscope (Panel 1, fig.3.) and (Panel 2, fig.1.-4.). It was determined that the awns upper surface was uneven, but uniform in its cell structure. The enlarged black spots in Panel 2, Fig. 4. cannot be interpreted as exit holes. Aside from the normal form of the awn in Panel 2, Fig.1. – 4. are, occasionally, awns that separated into 2 to 3 small teeth (Panel 1, Fig. 3.).

As no openings or clearly defined raised cell can be found, it must be determined that the adhesive secretion is secreted through thin spots of the epidermis upper layer.

7.3.2 Studies of the adhesive secretion of the awn

After three months of drying, ripe awns of *O. hirtellus* subsp. *undulatifolius* were chemically studied to determine the structure of the adhesive secretion. - The adhesive characteristics remained present, even after extended drying of the material. For very old samples, however, no adhesive awns could be observed. The original adhesive characteristic can, however, be confirmed by the presence dirt stuck to the specimen. As the adhesive characteristic is at least partially still achievable by removing water, it can be determined that the element group is neither glycoside nor polysaccharide.

Attempts to dissolve:

In addition to this assumption the dissolvability of the substance in different media was studied. It was determined that the adhesive substance did not dissolve with water. It dissolved well in diethyl ether and petroleum benzene, even better in ethanol, which indicates that the dissolvability is best in organic, polar dissolvers. The elemental groups saccharide, polysaccharide and mucopolysaccharde can therefore be eliminated for the studied substance. The adhesive material must belong to the group lipophilen substances.

In the following should be studied, whether the secretion should be placed within the group terpenoide. For this purpose the following preliminary tests were be performed: 1. A drop of concentrated sulfate was applied to the awn. The substance on the upper surface of the awn took on a red-brown coloring. This reaction occurs among others with the presence of terpinene or steroids. Also the microtome cross section was handled with concentrated sulfate. The attached substance took on a red coloring; the awn cells remain uncolored, however. That would mean that within the awn no adhesive secretion is present. To compare, sulfate was added to the DC made extract concentrate of the substance. No red coloring developed. 2. The reaction from Liebermann – Burchard with terpenoid was performed. The sample should turn olive-green for a positive reaction. In actuality a very faint ting of green-brown developed. The reaction yielded no more definite results when repeated.

3. The reaction from Brieskorn and Briner with triterpene and sterine was performed. The sample should, for a positive result, turn red with triterpene and brown with sterine. It turned a faint shade of red-brown. This reaction was also inconclusive.

All reactions with terpinene or steroids occurred with only partially positive results. Placing this adhesive secretion in this elemental group can therefore only be done with great reservation.

Studies with help of the thin-layer-chromatography:

Through thin-layer-chromatography studies it should be determined, if the secretion is a single substance or if it is a combination of substances.

For this purpose the awns of the lowest glume were separated and approx. 100 every 15 sec. were swung in petroleum benzene. Thereafter the sample was compressed. The DC-study was performed with DC-silica gel plates (product: 60f – 254).

1. Attempt:

Starting point (1.5 cm): 10, 20, 40 substance pad. Isolating distance: 10 cm. Eluent: a: petroleum benzene 80%, diethyl ether 20%. b: petroleum benzene 80 %, diethyl ether 15%, glacial acetic acid 5%. Spraying medium: sulfuric acid-methanol mixture; carbonization by 130° C.

Analysis: For three starting points of the eluent a three spots with the following Rf-values can be differentiated: Rf 1: 6.75 Rf 2: 8.6 Rf 3: 9.75

For eluent b five spots can be defined: Rf 1: 0.5 Rf 2: 3.5 Rf 3: 3.75 Rf 4: 9.5 Rf 5: 9.8.

This study shows, with certainty, that the adhesive liquid of the awns is a heterogen element with at least five components.

2. Attempt:

Starting point (1.5 cm): The inspissate dried substance will be re-dissolved with a small amount of petroleum benzene and applied in concentration. Isolating distance: 10 cm. Eluent: c: petroleum benzene 80%, diethyl ether 15%, ethanol abs. 5%. d: petroleum benzene 80 %, diethyl ether 10%, ethanol abs. 5%, glacial acetic acid 5%. Spraying medium: sulfuric acid-methanol mixture; carbonization by 130° C.

Analysis: In this attempt eluents with a higher polarity were used. The separation of the substance is hereby unclear. For Eluent c four spots with the following Rf-values can be determined: Rf 1: 3.6 Rf 2: 4.15 Rf 3: 9.45 Rf 4: 9.65.

For the attempt with eluent d five definable spots with similar Rf-values can be defined: Rf 1: 4.75 Rf 2: 5 Rf 3: 5.6 Rf 4: 9 Rf 5: 9.65.

3. Attempt:

This attempt is similar to attempt 2, however, only eluent d was used. Spraying medium: anisaldehyde 1 part, methanol 17 parts, sulfuric acid 2 parts. After spraying the plate was dried at 100° C and analyzed under UV-light.

Analysis: Five possibly even seven spots could be located. Both lower spots were colored red (Rf 1: 0.3 Rf 2: 0.55). The upper spots were Blue-gray. – In the primary florescence; spots 3, 4 and 5 appear with a red tail. They were blotted out at 254 nm UV, which indicates the presence of phenolical groups. In the secondary florescence; spots 3, 4 and 5 appear gray-brown with a yellow-brown tail.

From all of these attempts it can be determined that the adhesive secretion is a heterogen element from the group lipophilical substances. Some results correspond to the hypothesis that it is a terpenoid, others results cast doubt on this conclusion, such that a final placement of this adhesive secretion in this element group must remain open.

In this context the work of Ohmoto (1967) can be referenced, he researched triterpene in *Gramineae*. His research, unlike this analysis, related to all the herbal plants; thereby he isolates *Oplismenus* Cylindrin, Isoarborinol, Friedelin, Campesterol, Sitosterol and Stigmasterol.

7.3.3 Florets and Fruit

The florets of the spikelets are made of two oblong or wide-obovate frail lodicule, that reach a length of 0.4 mm (Fig. 4 a). Three stamens are present; they have an oblong-straight shape and are yellow. The ovary is oblong and carries on its tip a divided long style, which phases out into two incidental, purple-red, feathery branched stubs.

The caryopsis is oblong oval and approx. 2 to 2.5 mm long. The hilum is narrow and reaches a length of approx. 1/3 of the length of the caryopsis (Fig. 4 b).

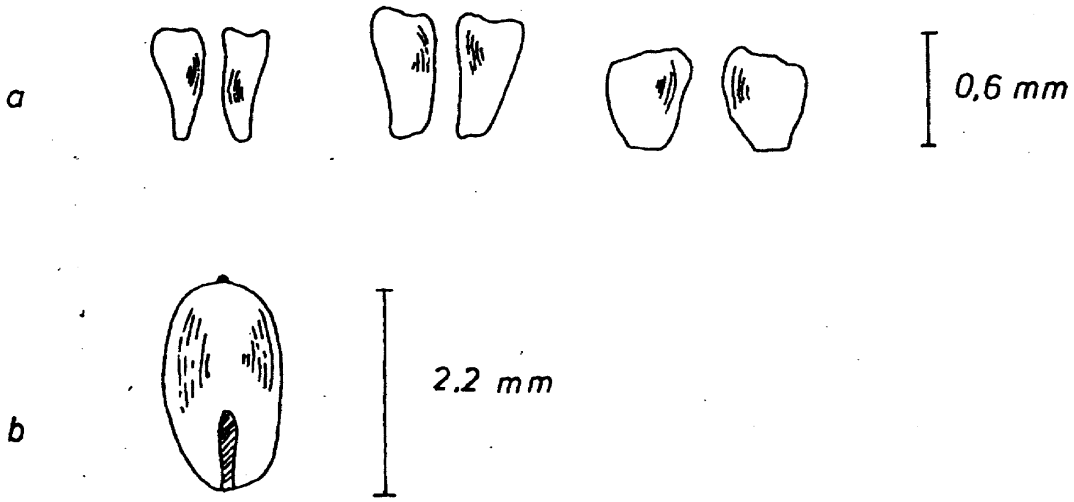


Fig 4: a: Lodicules, - b: Caryopsis.

7.3.4 Pollen and Embryology

The stamen of the genus *Oplismenus* are only pushed half way out of the spikelets when ripe and they open longitudinally. The pollen grains are yellow, mostly polygonal due to meiosis disruptions and are flattened on the sides, seldom round. Their cross-sectional dimension varies between 26.1 and 43.5 µm. Different sized grains were found, even inside an anther. It is almost assumable that the pollen here is sterile; that can, however, be determined with fertility tests from the Maneval-Fuchsin-solution. The above mentioned details make it conceivable that an apomictic reproduction can occur in many cases. The exceptions will be confirmed through the remarks of Chiguryaeva (1976), who describes the correlation between apomixis and polymorphism, as well as between apomixis and polyploidy. Both phenomena are present in the genus *Oplismenus*.

Scnarf (1931) and Shadowski (1926) performed embryological studies on *O. undulatifolius*, whereby the erect embryo sac next to the egg apparatus has, remarkably, two pole cores and an antipodial apparatus of 10 to 18 anitpode-cells, which form for pollination and separate from the rest of the embryo sac. Many of these cells have two nuclei, their plasma is heavily vacuoleized. After pollination the entire antipodial system dies.

8. Physiology and Ecology

8.1 Photoperiodism

A study from Mathon (1970) should be lightly touched on. In which the ambiphotoperiodic reaction of *O. hirtellus* is discussed. The, until now, seldom studied phenomenon of ambiphotoperiodisim states that some plants develop especially well under extreme photoperiodical conditions, namely under

short days- (10 hrs.), or under continual light (24 hrs.), which is the case for *O. hirtellus*. In contrast under intermediate conditions (16 hrs. of light) inflorescence development was heavily delayed.

Kirchner et al. (1908-12) describe *O. undulatifolius* as a typical shade plant that sets its leaves perpendicular to the rays of light.

8.2 Photosynthesis-Type

Hofstra (1972) and Smith & Brown (1973) determined the genus to be a C-3 type of photosynthesis, and determined a clear dependence on the ecology of the plants. The C-3 type, which anatomically manifests itself through the lack of chloroplasts in the vascular bundle-sheath of the grass blades, appears in the subfamily of *Panicoideae* only by shade plants and appears to indicate an intermediate position of these plants between the purely tropical taxa, that belong to the C-4 type, and the taxa of other subfamilies that grow predominantly in temperate climates. This is especially notable in consideration of the tropical-sub-tropical-Mediterranean expansion of the genus *Oplismenus*.

8.3. Ecology

The species of the genus *Oplismenus* are almost exclusively forest grasses that are found either in dense or moderate shade. Open grassland or places with lots of sun are rarely populated. In contrast forests along rivers or streams and swampy shaded areas are favored. Only *O. burmannii* is occasionally found in locations with more sun.

Many taxa are commonly encountered as weeds in shady coffee or coco plantations, their effects as a weed must, however, be relatively minimal. Only Ponert (1977) mentions that the weed *O. burmannii*, which was introduced in Caucasus, was carefully exterminated to prevent its expansion.

The complete spikelet with both glumes with awns, the sterile lemma with short awns and the fertile lemma and palea that go hard when the fruit is ripe, serves as a diaspore. For the epizoochory distribution of the fruit the awns of the spikelet play a major role.

The awns of the species from the genus *Oplismenus* sect. *Scabriseta* function through mechanical anchoring of the dentate awn, a mechanism that is seen often in the relatives of Poeceae. The awns of the species form the genus *Oplismenus* sect. *Oplismenus* function through a principle of adhesive shoots. The adhesive effects were studied on masculine hairs, on skin and on sheep's wool and were present in all three cases.

9. Chromosome count and Hybrids

For the widely distributed taxa chromosome counts were found from different authors in the sixties and seventies. The base number is denoted as x=9. For the Asiatic forms of *O. burmannii* Sharma & Hevi

(1959) 2n=18 is stated, for *O. compositus* Mehre & Chaudhary (1974) n=9. The diploid plant appear, however, to be in the minority; All the other published numbers point clearly to Polyploidy.

For *O. burmannii* tetraploid, hexaploid and octaploid plants are known (2n=36, Mehra & Sharma 1973; 2n=54, Koshla & Mehra 1973; 2n=27, Kammacher et al. 1973), and that was for Asiatic as well as African material.

Kammacher et al. (1973) attempt to show for *O. hirtellus* that the octoploid plants developed more robustly than the hexaploid. They studied multiple plants form the Ivory Coast and determined that they have three giant-forms 2n=72 and one dwarf-form 2n=54. The samples (Adjanohoun 907, 942, 943, 946) were studied by the author. It was possible to determine that according to morphologic criteria all four plants belong to *O. hirtellus* subsp. *hirtellus*, i. e. that they have long side shoots and one of the spikelet organizations typical of subspecies. Now is the fundamental question whether or not *O. hirtellus* subsp. *hirtellus* is possibly just one of the polyploid forms of the frail *O. hirtellus* subsp. *fasciculatus*. As no live plants were available for cytological research, the size of the pollen grains of the robust plants and the dwarf form Kammachers et al. and additionally some especially frail specimens of *O. hirtellus* subsp. *fasciculatus* were studied. With the result that the size of the pollen grain varied between 31.9 and 34.8 µm for all the plants studied. Therefore, no difference could be solidly defined between the robust and frail plants.

Notable connections for *O. compositus* are pointed out by Mehra & Sharma (1977). The authors indicate a hybrid population *O. compositus* x *O. burmannii* with a chromosome count of 2n=54. In my opinion the number 54 alone does not give grounds for the successful hybridization, as it is also mentioned in many studies from other authors. A study of the morphological characteristics through Mehra & Sharma revealed, however, a clear middle placement of the relevant plant. The arrangement of the awns played a major role here and such plants with intermediary awns are seen in the hybrid species *O. thwaitesii.* The explanation suggested by Mehra & Sharma that hybrids are among these was also confirmed through further cytological studies. The pollen was up to 70% sterile, the organization of chromosomes was not homologue. Missing chromosomes were definable in the daughter generation.

In conclusion it can be said that in the genus *Oplismenus* mostly polyploid forms are found. These appear, however, not to differ from the diploid forms through larger pollen grains or hardier growth.

10. Cultivated forms

In central Europe taxa of the genus *Oplismenus* are occasionally kept as house plants, as they appear very decorative due to the sometimes heavily rippled leaves. Especially garden forms with green-white long-striped leaves were cultivated. In van Houtte, Flores des Serres 17:5 (1867-68) an example of this cultivated form is depicted.

Most of the cultivated material available to the author belongs taxonomically to *Oplismenus* sect. *Oplismenus*, specifically to the species *O. hirtellus* and *O. aemulus* . A more specific placement is impossible due to the possible impoverishment of the form by cultivating for specifics.

Occasionally also plants of *Oplismenus* sect. *Scabriseta* are cultivated. A form of *O. burmannii* with striped leaves originates in Kew and was placed in literature under the name *O. burmannii* var. *albidum* N.E.Br..

Schlechtendal (1851) describes a species found in gardens as *O. gracilis* with unknown wild origins. He places it in *Oplismenus* sect. *Scabriseta* and separates it from all other taxa by the one vein first glume and the 3-veined lower lemma. As the type was not available, the species could not be classified taxonomically. It is referenced under Taxa dubi.

11. Studies of Attribute Correlations

In these reports it should be studied whether, and in which combinations several chosen attributes are combined. The goal is to eventually use this method to create more criteria for taxon definitions. Through graphical representations it will be shown how large the region of variation is for individual attributes and how far such relations are reliably useful.

11.1 Leaf Length / Spikelet Length

In the Fig. 5-8 diagrams the leaf length are set in relation next to the spikelet length for three taxa. The Fig. 5 diagram represents *O. hirtellus* subsp. *fasciculatus*, subsp. *hirtellus* and *O. compositus* var. *compositus*, which are taxa with short, medium length and long side shoots. The distribution of values is large for all three taxa; a correlation of the two attributes is clearly definable for *O. hirtellus* subsp. *hirtellus*. The crosses mark the approximate center of the statistical distribution.

Fig. 6 represents the taxa *O. hirtellus* subsp. *setarius*, *O. compositus* var. *compositus* and var. rariflorus. Attribute correlations are not available. However, this combination allows a, more or less, clean separation of *O. compositus* var. *compositus* and *O. hirtellus* subsp. *setarius* and of *O. compositus* var. *compositus* and var. rariflorus.

Fig. 7 represents three taxa with short side shoots. While *O. hirtellus* subsp. *setarius* and subsp. *fasciculatus* can be relatively well separated, *O. hirtellus* subsp. *undulatifolius* represents a connection that cannot be separated from either of the other taxa through this attribute correlation.

The taxa in the Fig. 8 diagram have an even greater amount of overlap; even their statistical centers are close.

From this chain of studies it is clear that the chosen attributes are, in general, not enough to separate the taxa. Only in combination with other attributes does their worth in defining the taxa begin to increase.

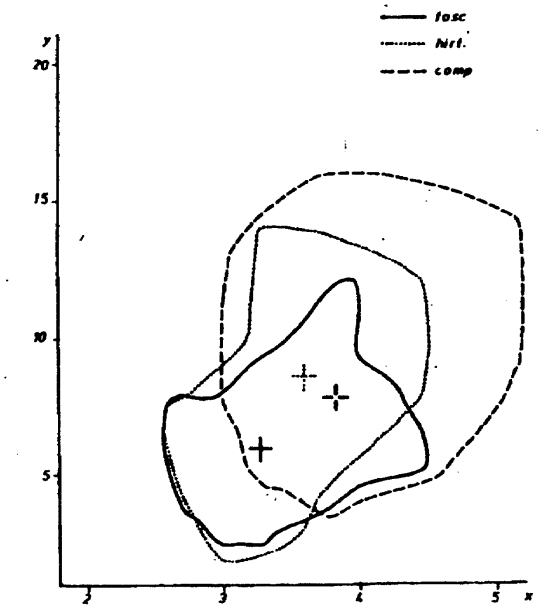


Fig. 5

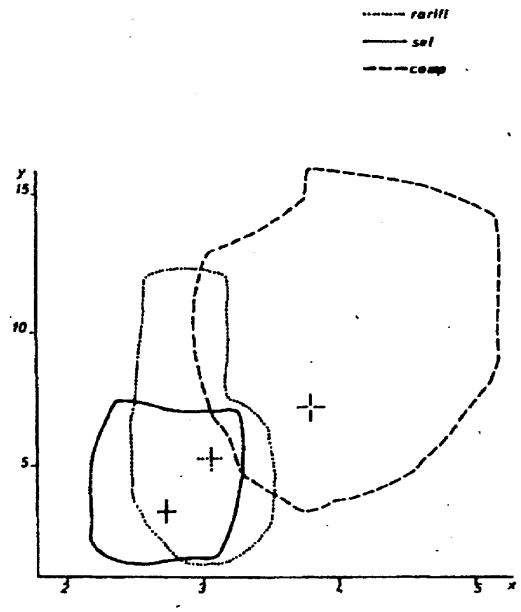


Fig.6

Fig. 5 – 6 Spikelet length in relation to leaf length (x: spikelet length (mm); leaf length (cm)). 5: *O. compositus* var. *compositus*, *O. hirtellus* subsp. *hirtellus, O. h.* subsp. *fasciculatus*. – 6: *O. compositus* var. *compositus*, *O.* c. var. *rariflorus*, *O. hirtellus* subsp. *setarius*. – Fig. 7–8. Spikelet length in relation to leaf length (x: spikelet length (mm); leaf length (cm)). Fig. 7: *O. hirtellus* subsp. *fasciculatus, O. h.* subsp. *undulatifolius*, *O.* h. subsp. *setarius*. – 8: O *aemulus* var. *aemulus* , *O. compositus* var. *rariflorus*, *O. hirtellus* subsp. *setarius*.

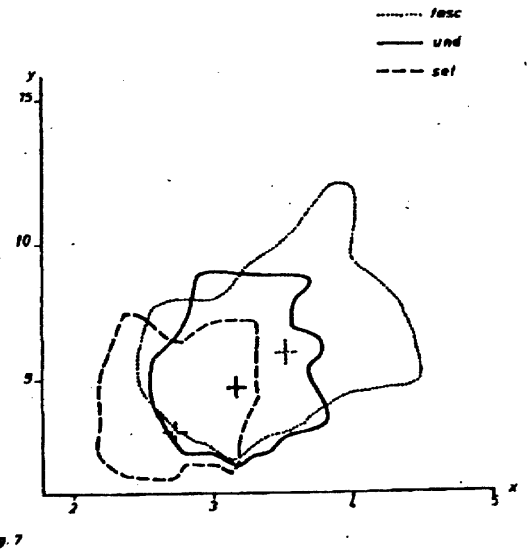


Fig. 7

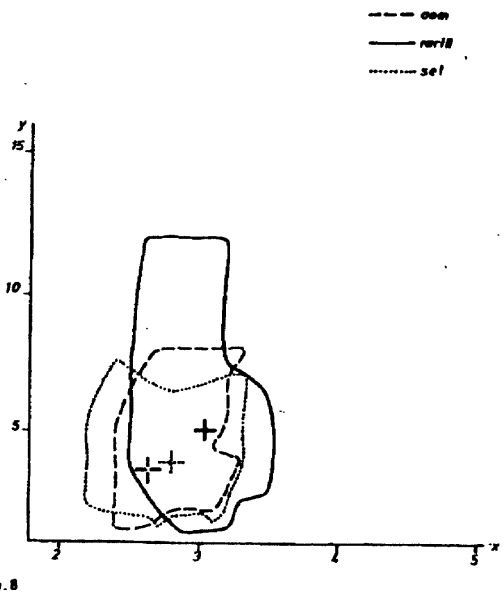


Fig. 8

11.2 Length of the Side Shoots / Spikelet Length

In a second attempt the attributes “length of the side shoots” and “length of the spikelets” was studied and set in relation to one another. Naturally only the taxa that have well developed side shoots are considered in this section. In the Fig. 9 diagram *O. hirtellus* subsp. *fasciculatus*, subsp. *hirtellus* and *O. compositus* var. *compositus* were compared, while the Fig. 10 diagram compared *O. aemulus* , *O. compositus* var. *compositus* and var. rariflorus. A correlation between both attributes is unachievable. Nevertheless, the graphical depiction makes it clear that the individual attributes (especially the length of the side shoots) has a broader distribution than other attributes.

Through combinations of attributes all taxa can be, more or less, well separated, which boils down to the key determining factors.

In connection with the leaf anatomy a further attempt will be made in the following section to relate attributes and discover correlations. Even when such microscopic attributes do not qualify to be used as decisive keys, they do offer, however, the possibility to clarify the relating structures.

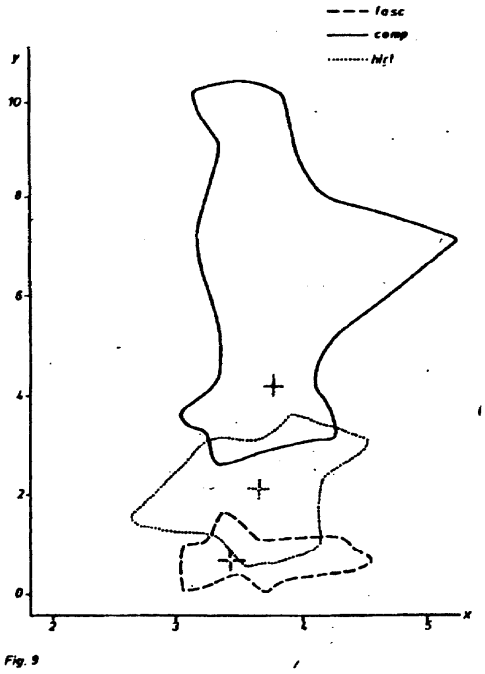


Fig. 9

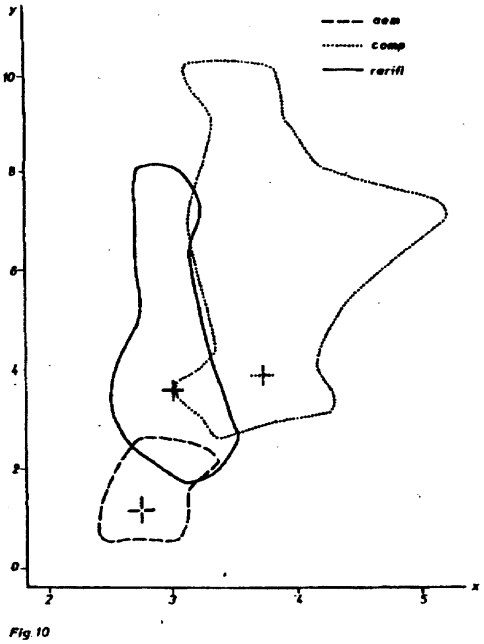


Fig. 10

Fig. 9 – 10: Spikelet length in relation with the length of the side shoots of the inflorescence (x: spikelet length (mm); y: length of the side shoots (cm)). 9: *O. hirtellus* subsp. *hirtellus*, *O.* h. subsp. *fasciculatus*, *O. compositus* var. *compositus*. – 10: *O. aemulus* var. *aemulus* , *O. compositus* var. *compositus*, *O.* c. var. *rariflorus*.

11.3. Length of Stomates/ Leaf Length

Leaf length alone cannot distinguish the taxa. There are some taxa, however, that show similar values in relation to this attribute that can be assembled into groups. The mean value of the aperture length should be connected with this. Taxa with short leaves (2 to 6 cm long) are represented in Fig. 11 group 1. The mean length of the aperture is 38.3 to 41.5 µm. Group 2 covers taxa with medium length leaves (4 – 11 cm) and medium apertures of 38.9 to 44.9 µm. The values are almost completely overlapping. *O. hirtellus* subsp. *fasciculatus* has the highest value (44.9 µm) and tends already toward the third group, in which the taxa with large leaves (6 to 14 cm) are combined. Here the mean values for the aperture are 43.5 to 46.4 µm. With that can be pointed out a clear enlargement of the aperture to taxa with longer leaves.

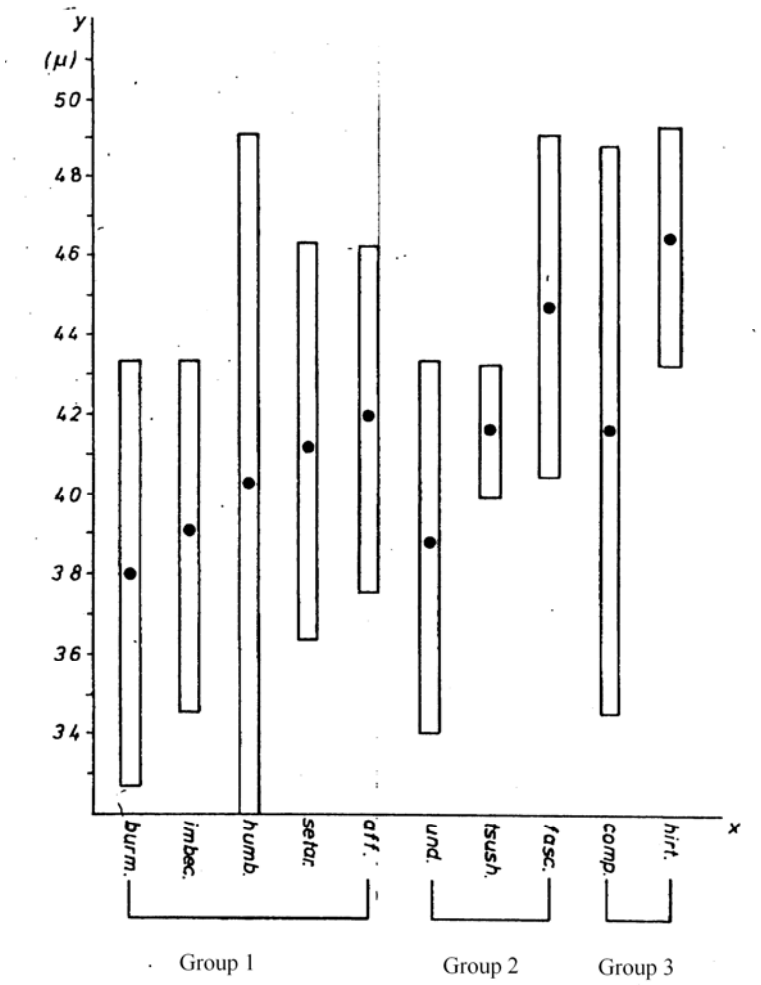


Fig. 11: Leaf length in relation to stomate length (x: leaf length (groups 1, 2 and 3); y: stomate length (µm)).

12. Taxonomic Section

Oplismenus P. Beauv., FL. D'Oware et de Benin 2: 14 (1810, t.p. 1807), nom. Cons. Prop.

Orthopogon, R. br., Fl. Nov. Holl. 194 (1810).

Hippagrostis Rumpf, Herb. Amboin. 6: 14, t.5 (1750) ex. *O.* Kuntze, Rev. Gen. 777 (1891).

Paniculum Ard., Anim. Bot. Sp. Alt. 14 (1764), err. Orthogr. "*Panicum*"

12.1 **Generic description**

Perennial or annual, procumbent and thick carpet forming grasses with protruding floret stems. Regeneration process intravaginal; rooted at the nodes; Roots fine, few and branching.

Culm rounded, lightly grooved, bare or haired, 15 to 105 cm long.

Leaf blade ovate to lanceolate, acuminate, commonly more or less strongly rippled, asymmetric at the base, rough on the edges; leaves on the lower shoots are mostly smaller than those higher up.

Sheath open, over lapping edges, grooved, mostly hairy on edges and occasionally across the flat.

Ligule clipped, mostly turns into a thick hairy collar on the upper edge, (0.2) to 0.4 to 1.5 to (2.5) mm long.

Inflorescence racemose or doubley racemose; cross-section of culm is triangular, usually ends in a single spikelet, haired or bare, alternating spikelet pairs, has either spikelet clumps or 0.5 to 10 cm long side shoots. – Side shoots asymmetric triangular, with alternating spikelet pairs on two flats, a single end spikelet at the point. Spikelet pairs either sparse or thickly packed or clumped, one spikelet is almost sitting the other is short shafted.

Spikelets 1.8 to 5.5 mm long, with a hermaphroditic upper and a completely reduced or only masculine lower floret. Always dentate on the lanceolate, sometimes rounded glume and often on the lower lemma; haired or bare. Gluma I 0.8 to 5 mm long, 3 – 7 veins. Upper glume 1.1 to 4.5 mm long, 3 – 9 veins and Lower lemma1.5 to 5.3 mm long, 7 – 11 veins. Outer veins in the upper part of the glume coalesce with the inner and finally with the strong middle vein. Cross veins weakly defined, occasionally present. Palea I lacking or sometimes present as a linear cross cutting, 2 veined, frail leaf. The upper floret is encircled by the bare, glossy Lemma II and Palea II, which harden when the fruit is ripe. – Awns of the Gluma I 1.5 to 17 mm long; Lemma II without awns or awns up to 4.3 mm long.

Lodicules 2, frail, elongated or broad-ovate and wide in the upper part and clearly bilabiate, approx. 0.4 – 0.6 mm long.

Stamens 3; ovaries elongated-ovular with two terminal styles and purple-red, feathery divided cicatricial branches.

Caryopsis glossy, tightly encircled by the upper lemma and palea; hilum elongated, approx. 1/3 as long as the caryopsis.

Type species: *Oplismenus* africanus P. Beauv.

Species 9; 4 endemic in Madagascar, 1 new world, 1 confined to Oceania and Australia, 3 distributed in all tropical and partially subtropical areas of the planet.

12.2. **Key to the species**

1. Awns frail, whitish, dentate ..... 2.
1. Awns hardy, red-gold, bare, adhesive when ripe 7

2. Awns originate under the top of the glumes, glumes acuminate, or dentate ..... *O. humbertianus*
2. Awns terminal, glumes duel toothed or entire ..... 3.
3. Glumes notched on the tip, awns originate between two teeth; spikelets heavily haired.....*O. affinis*
3. Glumes entire on tip, awn terminal; spikelet thick or fairly heavily haired ..... 4.
4. Second glume clearly longest glume of the spikelet; spikelet 3.8 – 4 mm long; lowest side branch 2 cm long; 20 spikelets thick or loosely organized in clusters..... *O. flavicomus*
4. Lower lemma longest glume of the spikelet ..... 5.
5. Glumes oblong-round, almost as wide as long..... 6.
5. Glumes oblong-lanceolate, clearly longer than wide ..... *O. burmannii*
6. Lowest side shoot up to 1.5 cm long; spikelets 2.7 – 3 mm long ..... *O. baronii*
6. Lowest side shoot 5 – 6 cm long; spikelets 1.5 – 1.8 mm long..... *O. gracillimus*
7. Spikelets in pairs, clearly organized behind one another, more or less strongly distanced; Lower lemmacommonly without awn; side shoots (1.5) – 3 – 10 cm long. ..... O. *compositus*
7. Spikelets in pairs, clumped, clumped lengthwise or organized behind one another in multiple rows; side shoots lacking or up to 3 cm long..... 8
8. Lower lemmashort with awn, spikelet in pairs on the culm, clumped or in dense succession on side branches, 2.2 – 5.6 mm long, if smaller than 3 mm, then the spikelet is always organized in clumps .....*O. hirtellus*
8. Lower lemmawithout awns or few only short pointed; spikelet pairs thick or clearly in succession, but not distanced from each other; spikelets 2.4 – 3.2 mm long..... O. *aemulus*

12.3.**Conspectus**

Oplismenus P. Beauv.

sect. ***Scabriseta*** Schlecht.

1.1. *O. affinis* Schult. var. *affinis*
1.2. *O. affinis* var. *humboldtianus* U. Scholz

2. *O. baronii* Camus
3.1. *O. burmannii* (Retz.) P. Beauv. var. *burmannii*
3.2. *O. burmannii* var. *lanatus* (Buse) Backer
3.3. *O. burmannii* var. *multisetus* (Hochst. ex. A. Rich.) U. Scholz
4. *O. flavicomus* Mez
5. *O. gracillimus* Mez
6. *O. humbertianus* Camus

sect. ***Oplismenus***

7.1. *O. aemulus* (R. Br.) Roem. & Schult. var. *aemulus*
7.2. *O. aemulus* var. *flaccidus* (R. Br.) Domin
7.3 *O. aemulus* var. *densiflorus* U. Scholz
8.1. *O. compositus* (L..) P. Beauv. var. *compositus*
8.2. *O. compositus* var. *rariflorus* (Presl) U. Scholz
8.3. *O. compositus* var. *sylvaticus* (Lam.) U. Scholz
9.1. *O. hirtellus* (L.) P. Beauv. subsp. *hirtellus*
9.2. *O. hirtellus* subsp. *acuminatus* (Nees) U. Scholz
9.3. *O. hirtellus* (L.) P. Beauv. subsp. *capensis* (Hochst.) Mez ex U. Scholz
9.4. *O. hirtellus* subsp. *fasciculatus* U. Scholz
9.5 *O. hirtellus* subsp. *imbecillis* (R. Br.) U. Scholz
9.5.1 *O. hirtellus* f. *imbecillis*
9.5.2 *O. hirtellus* f. *lanceolatus* U. Scholz
9.6. *O. hirtellus* subsp. *japonicus* (Steud.) U. Scholz
9.7 *O. hirtellus* subsp. *microphyllus* (Honda) U. Scholz
9.8 *O. hirtellus* subsp. *psilostachys* (Honda) U. Scholz
9.9 *O. hirtellus* subsp. *setarius* (Lam.) Mez ex Ekman
9.10 *O. hirtellus* subsp. *tsushimensis* (Honda) U. Scholz
9.11 *O. hirtellus* subsp. *undulatifolius* (Ard.) U. Scholz

12.4 **Descriptions of the Species**

Oplismenus sect. *Scabriseta* Schlecht., Linnaea 31: 301 (1861-62).

Oplismenus affinis Schult., Mant. II: 273 (1824).*Panicum schultesii* Steud., Nomencl. 2.ed. II: 263 (1841). - Type: "In insula Sancta Martha", Bertero 2579, M, Holotypus.

> *Panicum francoi* Steud., Syn. Pl. Glum. I: 44 (1854). – *Oplismenus mollissimus* Hochst. Ex Steud., Syn Pl. Glum. I: 44 (1854), pro syn. – Type: “Oaxaca” Franco s.n., (W?); n.v.

Key to the varieties:

1. Spikelets mostly between 3.5 and 4 mm long, very hairy, Lower lemmain the middle region with a thick hairy collar, dentate on the tip of the Lower glumes mostly rounded off ..... var. *affinis*
1. Spikelets 3 – 3.3 mm long, glumes heavily haired, Lower lemmausually only slightly haired; dentate on the tip of the glume mostly acuminate.....var. *humboldtianus*

var. *affinis*

Oplismenus cristatus K.B. Presl, Rel. Haenk. I: 323 (1830); Lamson-Sribner, F., Studies on American grasses: 7 (1897). – *Panicum cristatum* (K. B. Presl) Steud., Syn. Pl. Glum: I: 46 (1854). *Oplismenus burmannii* (Retz.) P. Beauv. *F. cristata* (K. B. Presl) Hier. Ex Peter, Feddes Repert. Spec. Nov. Regni Veg. Beih. 40, 1 A: 222 (1938) – type: Mexico: Haenke s. n. (PR); Location "Luzon" indicated by an additional label.

Fig. 12: O. affinis var. affinis (F. S. 1038, LE; Mexico)

Annuals, frail or hardy grass; culm 15 to 50 cm high, bare or haired in the grooves. Leaves ovate-oblong to oblong-lanceolate, mostly heavily haired, especially on the base, usually long rippled on the edge, (0.6) to 0.9 to 1.2 to (1.6) cm wide, (2) to 3 to 5 to (7) cm long. Sheath thin or thick long hairs around the edge, likewise haired or bare on the flat. Ligule has a hairy collar on the end, 0.6 to 1.1 mm long. Inflorescences racemose placed together, compact; rachis 3 – 7 cm long; side shoots upright, leaning over or distant. Rachis as well as side shoots thick and long hair growth; the hairs are 2 to 3 mm long. The length of the side shoots decrease from the bottom up, the lowest is 0.5 to 1.5 cm long and carries unilaterally 10 to 20 spikelets, in thick succession. Separation of side shoots is very short, inflorescences almost connected. Spikelets stand together in pairs, mostly surrounded by a thick collar of long hair around the base. Spikelets oblong-lanceolate, (3.3) to 3.5 to 4 to (4.5) mm long, thick long hair, flattened or almost round on the back. Gluma I lanceolate, (2) to 2.2 to 3.3

to (3.6) mm long, (0.7) to 1 to (1.2) mm wide, very thick, long hairs on the edges and on the flats, (3) to 5 veins, deeply notched on the tip, dentate rounded; with awn. Gluma II lanceolate, 2.6 to 3.4 to (3.8) mm long, (0.8) to 0.9 to 1.2 to (1.4) mm wide, very thick and long hairs on the edges and on the flats, (5) to 7 veins, deeply notched on the tip, dentate rounded; with awn. Lower lemmaoblong tappers toward the top, (3.1) to 3.3 to 3.8 to (3.9) mm long, (1.6) to 1.9 to 2 to (2.3) mm wide, has a thick hairy collar in the middle region, 9 veins, little or no notch on the tip. Palea I not present. Caryopsis pale or brownish, approx. 2 mm long. Awns frail, whitish and dentate; awn of Gluma I (7) to 8 to 15 to (17) mm long, of Gluma II (2.4) to 3.8 to 7 to (10) mm long and of Lower lemma(0.4) to 0.9 to 1.6 to (2.4) mm long (Fig. 12).

Distribution: Tropical Regions of the New World.

Selected voucher specimens:

Brazil: Conias and Maranho prov. (Martius s. n.; M); prov. Pianhy (Martius s. n.; M). - Columbia: Santa Marta (G). - Costarica: Altos "de Santa Barbara (H. Pittier 1078; M) Bomca (Tonduz 4466; M) Prov. Guanacaste (Jimenez 2727; NY); Nicoya (Tonduz 13758; G). – Dominican Republic: Manie1 de Ocoa (Türckheim 3610; PR). - Ecuador: west of Duran (Schimpff 1068; G); Guayaqui1 (Jameson 365; LE). – El Salvador: Dep. Sonsonate, Armenia (Standley 23486; NY). - Guatemala: Alta Vera Paz (Türckheim 473; G); Chi1ion near Majatenango (Bernoulli 468; G); Dep. Santa Rosa (Heyde & Lux 6276; G); Osuna (ZT); Tiquisati (N. Johansson s. n.; G). - Honduras: Dep. Morazan (J. G. Hawkes 1994; G). - Mexico:

Chiapas, Mapastepec (Tateoka 1005; US); Guatu1co (Liebmann 375; US); State of Guerrero (Y. Mexia 8718; B); Chilpancingo (Conert s. n.; FR); Between Huixtla and Tapachula (W. Boege 1079; FR); La Correa (Lang1asse 440; G) Maria Madre (Ferris 5674; US); Sierra de Tonalo (Purpus 7412; US); Sonora (Scott Gentry 4820; US); Yucatan, Calotmul (G. F. Gaumer 2429; G); Izama1 (G. F. Gaumer 1038; G); San Anselmo (C. F. Millspaugh 2428; G). - Nicaragua: Grenadu (P. Levy 24; G) Managua (Zelaya 38; NY). - U.S.A.: Lower California, Miraflores (Brandegee 75; NY). - Venezuela: Caracas (Funck 418; G); Tovar (A. Fendler 1705; G).

Common names:

Lacate (Mexico); Gram. De conejo (Central America).

Ecology: In shady woods.

Economic Impact: Weed in coffee plantations.

Anthesis: September to December.

1.2 var. *humboldtianus* U. Scholz, nom. nov.

Op1ismenus humboldtianus Nees, Agrost. Bras.: 264 (1829), nom. illeg. - Op1ismenus *humboldtianus* Nees var. genuinus E. Fourn., Mex. PI. 2: 37 (1886), nom. illeg. - Type: Brazil, Bahia: Nees s. n., M, Lectotypus.

Op1ismenus affinis K. B. Presl, Rel. Haenk. I: 323 (1830), nom. il1eg. - *Oplismenus* pres1ii Kunth, Enum. Pl. I: 141 (1833). - Type: Panama, Ganomenzes: Haenke s. n., PR, Holotypus.

Hippagrostis burmannii O. Kuntze, Rev. Gen.: 777 (1891), non *Panicum burmannii* Retz. - Supporting Source: Kuntze 2126; NY.

Orthopogon burmannii Spreng., Syst. I: 306 (1824, t.p .. 1825). non *Panicum burmannii* Retz. - *Panicum 1appaceum* Wi1ld. ex Spreng., Syst. I: 306 (1824, t.p. 1825), pro syn.

Frail plants, 18 to 25 cm high; Spikelets 3 to 3.3 mm long; Gluma I 2 to 2.4 mm long, 0.7 to 1 mm wide, 5 to 7 veins, deeply notched on the tip, pointed dentate; Gluma II 2.1 to 2.6 mm long, 1 to 1.2 mm wide, deeply notched on the tip, pointed or blunt dentate; Lower lemma2.9 to 3.2 mm long. 1.7 to 1.9 mm wide, Slightly notched on the tip. Glumae thick and long hair, Lower lemmafairly heavy to little hair.

Distribution: Tropical regions of the New World.

Selected Supporting Specimens:

British Honduras: All Pines (W. A. Schipp 783; G). - Costarica: (Tonduz 1481; LE). – Dominican Republic: (Bertero s. n.; M). - Ecuador: Guayaquil (Spruce 6326; OXF). – El Salvador:: Dep. Santa Ana (Weberling 2681; M). - Guatemala: Dep. Jutipa (W. C. Shannon 3672; G). - Haiti: Vallee des Trois-Rivieres (E. L. Ekman 5103; G). - Mexico: Atoyac (Kerber 166; LE); Veracruz (J. A. Purpus 2893; M); Morelos, near Yautepec (C. G. Pringle 11330; B). - Panama: Culebra, Canal Zone (A. S. Hitchcock 421; G); Chiman (Lewis et al. 3254; NY); Chagres, Isthmus of Panama (A. Fendler 273; OXF); prov. Panama (Killip 4191; NY). - Venezuela: Prov. de Carabobo (J. Linden 1.559; G); Maracay (C. Vogl 121; M).

Ecology: In Rainforests; in Deciduous Forests (Mexico).

Anthesis: September to January.

2. ***Oplismenus baronii*** Camus, Bull. Soc. Bot. France 75: 911 (1928). – Type: Madagascar: Baron 909, P, Holotypus.

Frail plants, 20 to 25 cm high; Culm bare or slightly hairy; Leaves oblong-lanceolate, 0.2 to 0.3 cm wide, 1.5 to 2.5 cm long, bare or slightly hairy; Sheath overall bare or slightly hairy around the edges. Ligule with a more or less heavily haired collar on the end, 0.4 to 0.7 mm long:

inflorescence 3.5 to 4 cm long, with multiple side shoots. The lowest side shoot is 1.5 cm long and has 10 to 15 spikelets thickly behind one another. The rachis and the side shoots are slightly hairy. The distance between the lowest two side shoots is 0.5 cm. Spikelets in thick succession. Rachis as well as side shoots have little hair. The distance between the bottom two side shoots is 0.5 cm. Spikelets arranged in pairs, ovate-lanceolate, 2.7 to 3 mm long, little hair growth. Gluma I oblong-rounded, 1.3 to 1.6 mm long, 1.2 to 1.3 mm wide, 3 veins, with awn. Gluma II oblong-rounded, 1.8 to 2.2 mm long, 1.3 to 1.5 mm wide, 3 veins, with awn. Lower lemmaoblong-rounded, 2.4 to 3 mm long, 2.1 to 2.2 mm wide. Palea I narrow, 2 veins, frail. Awns frail, whitish and dentate; Awn of Gluma I 5 to 7 mm long, of Gluma II 0.8 to 1.5 mm long. The Lower lemmais only pointed.

Distribution: Madagascar.

Supporting Source:

Madagascar (Baron 909; P).

3. *Oplismenus burmannii* (Retz.) P. Beauv., Ess. Agrost.: 54 (1812); Bor, N.L. in Rechinger, K. H., Fl. Iranica: 484 (1970): Bosser, J., Gram. Pat. et Cult. Madag.: 353; Cooke, T., Fl. Pres. Bombay 2: 443 (1958); Gamble, J. S., Fl. Pres. Madras 3: 1232 (1967); Haines, H. H., Bot. of Bihar and Orissa 3: 1045 (1961); Hara, H., Fl. Eastern Himalay: 369 (1966); Komarov, V. L., Fl. U.S.S.R. 2: 34 (1934); Koorders, S. H., Exkursionsflora von Java 1: 137 (1911); Mitra, N. J., Flow. Pl. of Eastern Ind. 1: 197 (1958); Nakai, T., Fl. Koreana 2: 349 (1911); Prain, D., Bengal Plants 2: 883 (1963); Ridley, H. N., Fl. Malay Penins. 5: 221 (1925); Robyns, W., Fl. Agrost. Congo Belge & Ruanda-Urundi: 150 (1934); Roxburg., W., Fl. Ind. 1: 298 (1832); Stapf, 0., in Prain, D., Fl. Trop. Afr. 9: 636 (1934); Stewart, R. R., Fl. West Pakistan: 120 (1972); Tzvelev, N. N., Poaceae U.S.S.R.: 655 (1976).

Key to the varieties:

1. Spikelets bare; lowest side shoot 2 cm long..... var. *multisetus*
1. Spikelets hairy; lowest side shoot usually only 1.5 cm long..... 2.
2. Spikelet fairly heavily haired.....var. *burmannii*
2. Spikelets silvery, thick and long hair..... var. *lanatus*

3.1. var. *burmannii*

> *Panicum burmannii* Retz., Obs. III: 10/1783). – *Orthopogon burmannii* (Retz.) R. Br., Prod. Fl. Nov. Holl.: 194 (1810). - Type: India, Madras: Konig s. n., LD, Holotypus; C. Isotypus.

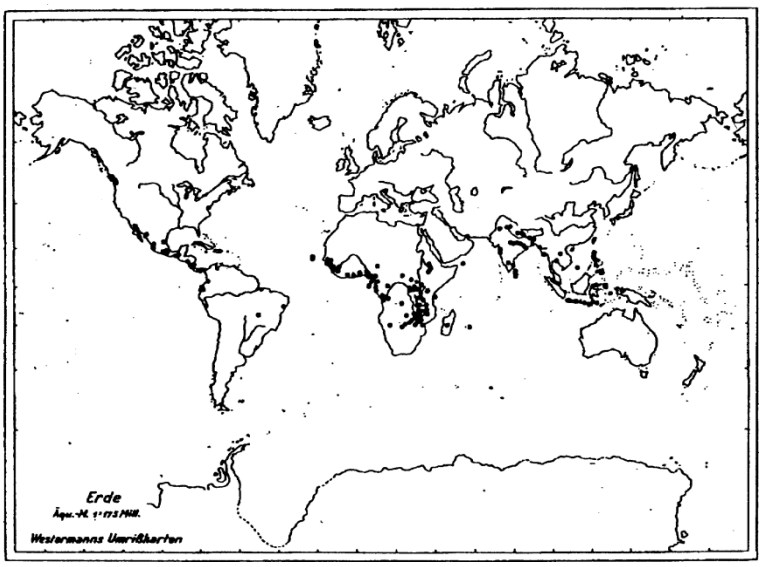
Panicum bromoides Lam., Tab. Encyel. I: 170 (1791). - *Oplismenus bromoides* (Lam.) P. Beauv., Ess. Agrost.: 54 (1812). - Type: "Ile de France", Commerson s. n., C, HOlotypus; FI, Isotypus.

Hybrids:

Oplismenus thwaitesii Hook., f. in Trim., Fl. Ceylon 5: 169 (1900). = *O. burmannii* x *O. compositus*.

Ic.: Bosser, J., Graminees des paturages et des cultures a Madagascar: 353, f. 133 (1969). - Burmann, N. L., Fl. Ind.: 24, t. 13, f. 1 (1768) ("*Panicum hirtellum*"). - Koechlin, J., Fl. Gabon 5: 59 (1963). - Reichenbach, L., Ic Fl. Germ. I: t. 28, f. 1410 (1834). - Rose Innes, R., Manual of Ghana Grasses: 192, f. 62 (1977).

Annuals, mostly frail grass; culm (16) to 25 to 45 to (65) cm high, Usually hairy in multiple grooves and more so on the nodes. Leaves light green, smooth or lightly rippled, oblong - lanceolate or ovate-oblong, usually has long white hairs, 0.6 to 1.3 to (1.6) cm wide, (2) to 3 to 7 to (8) cm long. Middle vein is weak, side veins 2 to 3 on both sides; cross veins present. Sheath thin or thick long hairs around the edge, usually sparse long hairs or bare on the flat. Ligule usually has a hairy collar on the end, 0.6 to 1.2 to (1.8) mm long. Inflorescences racemose placed together; rachis (3) to 4 to 8 to (11) cm long, sometimes hairy; side shoots 3 to 10, stand upright at an angle to the rachis. The length of the side shoots decreases from the bottom up, the lowest is (0.2) to 0.5 to 1.5 to (3) cm and carries unilaterally (3) to 10 to 20 to (25) spikelets, in thick succession, they are in pairs, usually encircled at the base by a collar of long hair that almost reaches the length of the spikelets. Spikelets oblong-lanceolate, (2) to 2.8 to (3.5) mm usually fairly heavily haired, flattened or almost round on the back. Gluma I oblong-oval, (1.3) to 1.9 to (2.4) mm long, 0.7 to 0.9 to (1.2) mm wide, fairly heavy hair growth, 3 to 5 to (7) veins, with awn. Gluma II similar in shape, (1.5) to 2 to (2.3) mm long, (0.7) to 1.2 to (1.5) mm wide, fairly heavily haired, 5 to 7 veins, with awn. Lower lemmaoblong, (2) to 2.6 to (3.5) mm long, (1) to 1.7 to (2.4) mm wide, (5) to 7 to 9 to (11) veins, pointed or with a short awn. Palea I not present. Caryopsis oblong-lanceolate, convex on the back, almost flat on the front. Awns frail, whitish and dentate; awn of Gluma I (3) to 6 to 11 to (15) mm long, of Gluma II (0.4) to 3 to 6 to (9) mm long; Lower lemmahas either a short point or a short awn - 0.6 to 2 to (2.3) mm (Fig. 14).



Distribution: Tropical to subtropical regions of the Old and New World (Fig. 15).

Selected Voucher specimens:

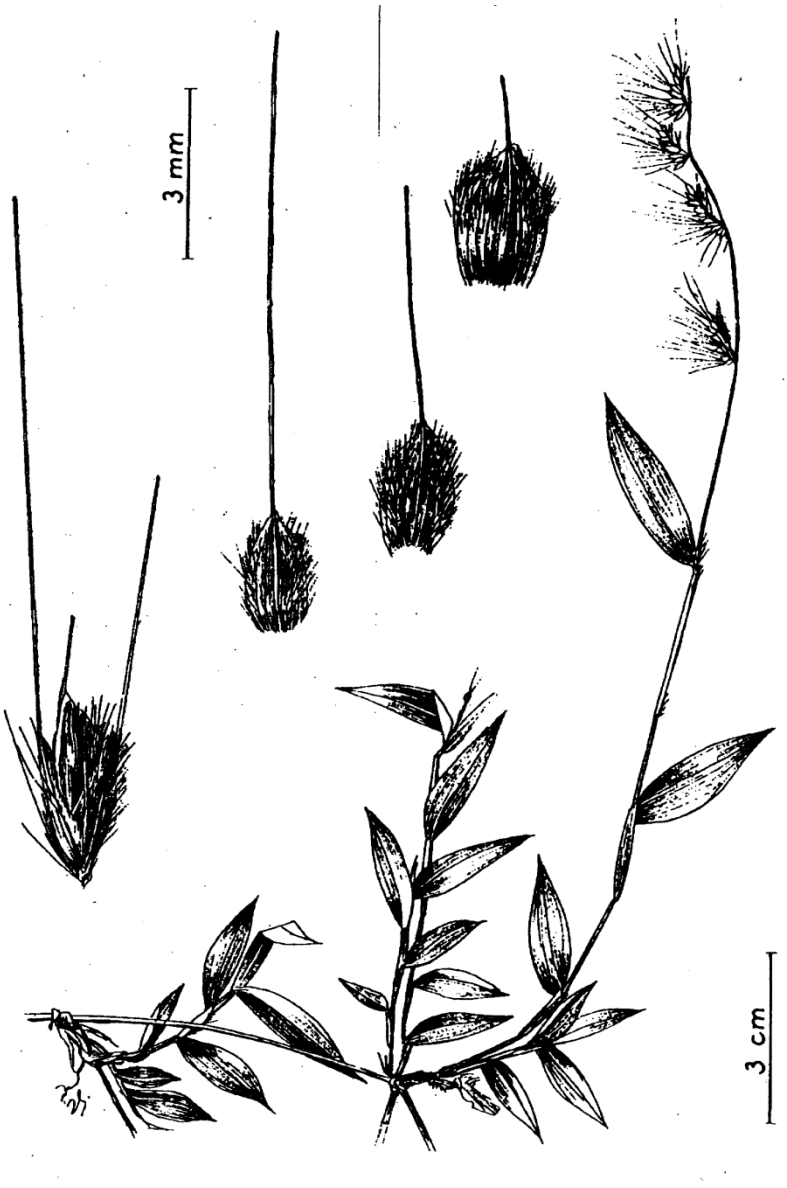


Fig. 14: O. burmannii var. burmannii (E. Milne-Redhead & P. Taylor 9561, B; Tansania)

Ethiopia: (Chiovenda 320; FI); 11 km SW of Bure (I. Frils et al.. 1904; K); Erytrea - Amasen, Fil-Fi1 (A. Pappi 5426; P) Gambela (0. Parker E. 454; K); 55 km W of Lekemti '(W. de Wilde 8926; BR). - Angola: Go1ungo Alto (Welwitsch 7252; 3003; BM). - Annobon_I.: (M. Rose 592; P). – Equatorial Guinea: Riomuni (J. A. Guerra 3879; FR)-. - Botswana: Kasane (A. Blair Rains 73; K). - Burundi: Bururi (J. Lewalle 4565; BR). – S. Antao: Cape Verde (R. J. Lowe s. n.; K). – Ivory Coast: Abengonzom (G. Roberty 12612; Z, 12638; G); near Abidjan (A. S. B. 13, 518; K); Singrobo (Adjanohoun 375 A; K).J:. – Fernando Po: (E. Guinea 576; K). - Gabun: Booue (J. Anton-Smith 295; K). - Gambia: W. of Jabang (A. Blair Rains 25; K), - Ghana: Anum (R. Rose Innes 31173; K); At Ho (Phillips 30552; K); Chebi (R. Rose Innes 30871; BR); Fosu (E. *O.* Asal 1775; K); Kumasi (BannermannBruce 4423; K). - Guinea: Badabon (R. Schnell 7552; K); Conakry (Maclaud 116; P); Dyeke (J. T. Baldwin j. 9654; K); Kouria (A. Chevalier 14924; K); Kousankoro (Adam 7078; P); Macenta (H. Jacques-Felix 1296; Pl. - Cameroon: Bankim (A. Meurillon 1069; P); Buea (F. D. Maitland 30; K); Douala and M. Bamboutos (A. Meurillon 52; P); Kribi (J. Schröder s. n.; FR) Victoria (Winkler 57; PRC). (F. D. Maitland 69; K); Yabom (R. Letouzey 7948; P); Yaounde (J. & A. Raynal 9422; P). - Kenia: (J. A. Allen 115; K); 20 m. S of Mombasa (D. Napper 1272; K); Gede. 60 m. N of Mombasa (A. Bogdan 4716; K); Kwale Distr., 18 m. S of Mombasa (R. B. Drummond & J. H. Hemsley 3998; FI); Malindi (Echlin 3; K); Marrarani. Boni (J. B. Gillespie 267; K); Nairobi (M. E. Church 80; K). - Liberia: Vonjama Distr. (J. 1. Baldwin 12030; K). – Madagascar: Central (G. W. Parker s. n.; FI); lhosy (H. Humbert 14451; G); North (M. Bernier 49; G); Tananarivo (J. M. Hildebrandt 4105; W). - Malawi: Distr. Dedza (E. A. Banda 439; BM); Chipata M. (W. C. Verboom 979; K); Citala R.

(G. Jackson 488; K); Nyassa-See (Simons 1876; BM): near Zambia (B. Cormack 160: K). - Mozambique: Malema (A. R. Torre & J. Paiva 11189; BR); Manica e Sofala (Garcia 622; BM). - Namibia: Distr. Grootfontein North (H. Merxmüller & W. Giess 2025; M). - Niger: Nupe (Barter 1267; GOET). - Nigeria:· Prov. Abeokuta, Distr. Glokemeji (G. Jackson 3161168; K); Abiya (A. Blair Rains 246; K); 40 m. W. of Benin (Oshogbo 22; BM); Distr. Egba (Wit & Daramola 838; K); Gembu (Ekwuno 77232; K); lbadan (I. T. Swarbrick 2881; K); Lagos (W. McGregor 100; K); Distr. Orlu (Emwiogbon & Onyeachusim 65905; K); North, Panshanu Pass. (D. W. Lawlor & I. B. Hall 223; K). – Pemba I: Mahwikwi (J. H. Vaugham 205; BM). - Sambia: Abercorn Distr. Chilongolwelo (M. MacCallum Webster A 295; K); Kalomo (W. L. Astle 2276; K); Luangwa Valley (W. L. Astle 4636; K); Lukusuzi (J. A. Sayer 1160; K); Mapanza (E. A. Robinson 1358; M); Distr. Mporokoso, Kundabwika Falls (J. B. Phipps et. al. 3166; K); Mu-Lungushi (J. Kornas 3501; K), Mwembeshi (D. Vesey-Fitzgerald 4037; BM); Namwala (W. L. Astle 2956; K); Ngoni, Fort Jameson Distr. (W. C. Verboom 572; K). - Senegal: (Hudelst 590; OXF); Casamance (G. Roberty 6415; G), (J. G. Adam 18186; K); Bassin de la Gampie (R. P. Berhaut 2780; p); Jardin de Honu (A. Chevalier 44,097; P); Thies-Diourbel (R. P. Berhaut 4054; P); Tiazoye (G. Roberty 6287; Z). – Sierra Leone: Bumbuna (N. W. Thomas 3343; K); Freetown *(D.* Gledhill 503; K): Kambia (J. C. Deighton 806; K); Keneme (J. C. Deighton 417; K); Koinadugu Distr. (H. Mead 232; K); Newton (J. C. Deighton 1453; K); Njaja (Morton & Jarr 2359; K). - Socotra: Tamarid (G. Schweinfurth 422; K). S. Thome: Nova Moka (A. Moller 140; K). - Equatorial prov. (J. Wyld 267: BM). - Tansania: Chimala Hospital (R. A. Nicholson 213: K); lringa Distr., Lukosi R. (J. Procter 3341; K); Milepa (D. P. Pielon 139; K); Shinyanga (B. D.; Burtt 2583; BR); Songea Distr., Rovuma R. (E. Milne-Redhead & P. Taylor 9561; B); Wala R. (R. Böhm 99; W); Ufipa Distr., Kisa-Rukwa (M. McCallum Webster 176; K). - Togo: Anecho (P. G. Mahoux 313; P); N of Palime. Daye Povohi (H. Scholz 126; B). – Peoples Republic of Congo: Brazzaville (Coomay s. n.; BR). - Zaire: Bambesa (P. Gerard 4.636; BR): Route de Boma (R. Devred 3351; BR); Gandayika (L. Liben 2792; BM); 50 km NE of Lubumbashi (S. Lisowski 591; K); Prov. Katanga, Kundelungu (de Witte 6015: K): Kialo (A. Thiebaut 295 b; BR); Kimpako (H. Vanderyst 5333; BR): Kisantu (R. Germain 2059; K); Leopoldville (W. Fasseaux 1071; K); Popokabaka (L. Pauwels 2279; BR); Stanley Distr., Mokoba (H. Vanderyt 3780; K); Kiunda, Route de Tumba a Thysville (P. Compere 2123: BR); Thysville (Bequaert 7733; BR). – Central African Republic: Haute-Kotto (G. le Testu 3.272; P). - Zimbabwe: Darwin Distr. (J. B. Phipps 2441; M); Gokwe Oistr. (BM); Kariba· Distr. (BM); Lomagundi Distr. (J. B. Phipps 2489; M); Marandellas (J. B. Phipps 1532: K); Mrewa (S. Mari 920; K); Mtoko (J. B. Phipps 2533: K): Salisbury (F. Eyles 3429; K); Selukwe Distr. (H. M. Biegel 2042; BM); Umtali (A. *O.* Crook 911; BR): Urungwe: Ruesi R. (R. Goodier 553; K); Victoria Falls (Simon 2141; K); Walobo Distr. (0. B. Willen 5816; BM).

Burma: Kyauktan (Po Khant 1346; K); Rangoon (C. E. Parkinson 15192; K); Syriam (H. S. McKee 5793; K). - Ceylon: Hambantola Distr. (F. R. Fosberg 50166: K): Paranatotopola (R. G. Cooray 691 20728; K); Vavuniya Distr. (D. Clayton 5298; K). - India: M. Abu (E. Blatter 2714:

K); Ananthapura (A. Meebold 10484; . K); Assam Shillong (Thakur Rup Chand 8256; K); Bengal (Mokim 1520; G); Baidyanath (J. *O.* Nusker 1179; M); Bihar (E. Janaki 1453; B); Bombay (R. R. Fernandez 773; K); Hiran R. (K. T. B. Hodd 251; K); Madras, Bison Hill (5099; K) Madras; Calicut (K. Rungache s. n.; K); Dehra Dun (U. Singh 492; K); Madras, Ganjam Distr. (V. Narayanaswami 4682; K); Ghatoli (B. M. Wadhwa 7551; K); Prov. Khasia, Mairong (Schlaginweit 127; PR); Malad (G. L. Shah 801; K); Morabad (J. Thomson 8)25; K); Surguja State (N. Koelz 19034; K); W. Himalaya Saharanpur (J. F. Duthie s. n.; K); Orissa, Jojomura (H. F. Mooney 2; K); Sikkim, Selim (C. B. Clarke 36709; K); Travancore (M. Rama Rao 1807; K). - Indonesia: Kl. Sunda I., Alor (0. Jaag 1367; ZT); Celebes, Prov. Minahassa (S. H. Koorders 17625 b; K); Seran, Boano (Kornassii 1322; K); Wetar, Tarra (5. Bloembergen 3726; PNH); Bali; M. Prapat (Kostermans et al. 52; K). - Nepal: Butwal (Stainton et al. 8847; K); Godovari, S of Kathmandu (A. *O.* Schilling 1083; K); Okhaldhunga (A. Zimmermann 862; G); Singpur (D. Schaaf 117; K); de Thari a Ganga (A. Zimmermann 1250; G). – New Guinea: Saroa (Murhy S. n.; G). - Philippines: Prov. Rizal, Luzon (E. D. Merrill 830; G);- Lamao R., Mt. Mariveles, Luzon (R. S. Williams 135; K); Prov. Batangas, Luzon (M. *O.* Sulit 22474; PNH); Antique Prov., Panay (V. Aligaen 22147: PNH). - Thailand: Chiengmai (T. Sφrensen et al. 5927; K). – U.D.S.S.R.: Georgia, Adsharistan, Transcaucasus (Achanastilivi s. n.; K).

Brazil: Mattogrosso (Pilger 339; B). - Columbia: Dep. Cauca (A. Asplund 10525; G); El Tambo(K. v. Sneidern 165; G). - Costarica: Reventazon R. (G. Cufondoti 566; G). - Cuba: Papayo (E. L. Ekman 10335; G). Dominican Republic: Constanza (H. Türckheim 2883; M);·Ecuador: Ambato (E. Heinrichs 140; G); Guayaquil (E. Asplund 15988; G); Naranjapata (Schimpff 545; G); Pichincha Prov. (I. Holmgren 860). – EL Salvador: Dep. Morazan (J. M. Tucker 441; G). - Guatemala: Dep. Quezaltengango (L. *O.* Williams 22990; G); San Jose (Brenning 445; B); Dep. San Marcos, Palo Gordo (L. *O.* Williams 25992; G). - Mexico: Cuernavaca (C. G. Pringle 6209; PRC); Jalisco (J. R. Reeder 2350; FR); Morelia, Rincon (Arsene 38;.G); Puebla (H. J. Conert s. n.; FR); Valee de Mexico (Bourgeau 1301; G). - Nicaragua: Dep. Matagalpa (L. *O.* Williams 23396; G). - Panama: Prov. Panama (H. Pittier 6822; G); Sabanas, near Chepo (A. A. Hunter & P. H. Allen 13; G). - Peru: Dep. Huanuco (E.

Asplund s. n.; G).

Common name:Burmannischer Fennich (South Tyrol).

Ecology: In shady, half shady and open forests; forests along rivers, dry forests and thorn patches, occasionally in the savannah between shaded rock outcroppings and crops; sandy soil on basalt.

Sociology: Under Palmen, Acacia campylocantha, tamarindus indica, Trichilia emetica, Eucalyptus, Ficus, Bridelia macrantha, Mango. Companion plants: Impatiens, Pilea, Ponzolchia arachoindea.

Economic Impact: Weed in coffee, cocoa, banana and kapok plantations, in peanut and corn fields. Removal resource: 0.4 % Perepod (fungicide).

Anthesis:In tropical regions: Usually August to December or March to May. – In subtropical regions: September to November.

Pests: *Tilletia vittata* (Berk.) Mundkur, *Tilletia vittata* var. *burmannii* Mishra; *Ustillaginoidea oplismeni* Ramakrishnan & Sundaram; Dub.: *Ustilago oplimeni* Viennot-Bourgin

Chromosomes:

2n = 18: Koshla (1972); Mitra & Datta (1967); Narayan & Muniyamma (1972); Saxena & Gupta (1970).
2n = 28: Larson, fide Kammacher et al. (1973).
2n = 36: Mehra & Sharma (1973); Pohl & Davidse (1971); Reeder (1971).
2n = 44: Mehra & Chaudhary (1974).
2n = 46: fide Kammacher et al. (1973).
2n = 54: Koshla & Mehra (1973).
2n = 72: Kammacher et al. (1973).

Remarks:

Deviant forms with very small leaves (up to 1.5 cm long) are known in: India, Silhet: Dehlus s. n., CGE, Cameroon, Yaunde: Zenker & Staudt 515, Z. probably handled these plants as potential problems or as adjustments to step-plants.

Host (1805) listed a *Panicum hirtellum* for Europe. It deals however, with *O. burmannii*, at least as far as Host's herbalized samples which originate from the Hostchen Garden. However, according to Reichenbach (1846) and Mertens & Koch (1823) they were taken from the natural location (swampy spots on the seaside by aquilegia). It appears in this case to be a onetime find, perhaps a carryover from the distributive area in India. The clearly recognizable species has never been found in Europe again.

Long ago the species was once found in Caucasus. This appearance can be explained by anthropological carryover, in connection with the introduction of new subtropical grain forms (Komarov 1934). Ponert (1977) references a report from Makasvili (1936), whereby, in 1930 a population on a 20 by 30 m^2piece was destroyed in order to prevent the expansion of this weed. This was probably a success as, other than one example from 1940 (Achanastilivi s. n.; K) no other plants were found in the Herbarium from Caucasus. For this reason the historical occurrence of the species in Caucasus was not included on the distribution areal.

3.2. var. *lanatus* (Buse) Backer, Handb. Fl. Java 2: 172 (1928).

Orthopogon burmannii (Retz.) R. BR. var. *lanatus* Buse in Miq., Pl. Jungh.: 370 (1854). - Type: Java, Pidjugan: Junghuhn s. n., n. v.

Panicum album Poir., Encycl. Suppl. IV: 274 (1816). - *Oplismenus albus* (Poir.) Roem. & Schult., Syst. Veg. II: 890 (1817). - *Orthopogon albus* (Poir.) Nees ex Steud., Syn. Pl. Glum. I: 44 (1854), pro syn.; Nees ex Miq., Fl. Ind. Bat III: 442 (1857, t.p. 1855). - Type: Java: Thunberg s. n., FI, Holotypus.

Oplismenus javanicus Klotzsch ex Schlecht., Linnaea 31: 309 (1861-62), nom. nud. - Type: Java, LE (dub.).

Panicum hirtellum Burm. f. non L.: Fl. Ind.: 24, t. 13 (1768).

Leaf sheath thick and long hair on the edge, on the flat dense or sparsely hairy. Rachis usually thick and long hair growth. Side shots 0.5 to 1.2 cm long, 10 to 16 spikelets in placed thick succession on the lowest. Spikelets 3 to 3.5 mm long, thick long hair; glumes entire, not notched on the tip (s. *O. affinis*).

Distribution: Indonesia

Selected Voucher specimens:

Tschad: Lac Tschad (A. Chevalier 6067; P). - Indonesia: Java: Batavia (C. Schröter s. n.; ZT), (Junghuhn s. n.; L), (v. Steenis 5298; K), (de la Savinierre 1568; G), Labillardiere (P. B. Webb s. n.; K); Semarang, Telomajo (Koorders 27777 b; K); Kl. Sunda I., Alor (0. Jaag 1017; PNH). - Japan: (9777; L). Vietnam: (M. Germain s. n.; K); Massif du Grand Eperon (Poilane 579; K); near Saigon (M. Godefroy-Lebeuf s. n.; K).

3.3. var. *multisetus* (Hochst. ex A. Rich.) U. Scholz, novo stat.

Panicum (*Oplismenus*) *multisetum* Hochst. ex. A. Rich., Tent. Fl. Abyss. II: 377 (1850). - Type: Ethiopia: Schimper 149, BM, Holotypus, FI, Isotypus.

Inflorescence not hairy, side shoots 0.5 to 2 cm long, carrying 5 to 15 spikelets, arranged in succession. Spikelets 2.4 mm long, never with hair.

Distribution: Ethiopia

Supporting Source:

Ethiopia: Tacozethal by Djeladjeranne (Schimper 1469; FI).

4. ***Oplismenus flavicomus*** Mez, Noizbl. Bot. Garden, Berlin-Dahlem 7: 55 (1917). – Type: Madagascar. Forsyth-Maajor 208, B, Holotypus; G, Isotypus.

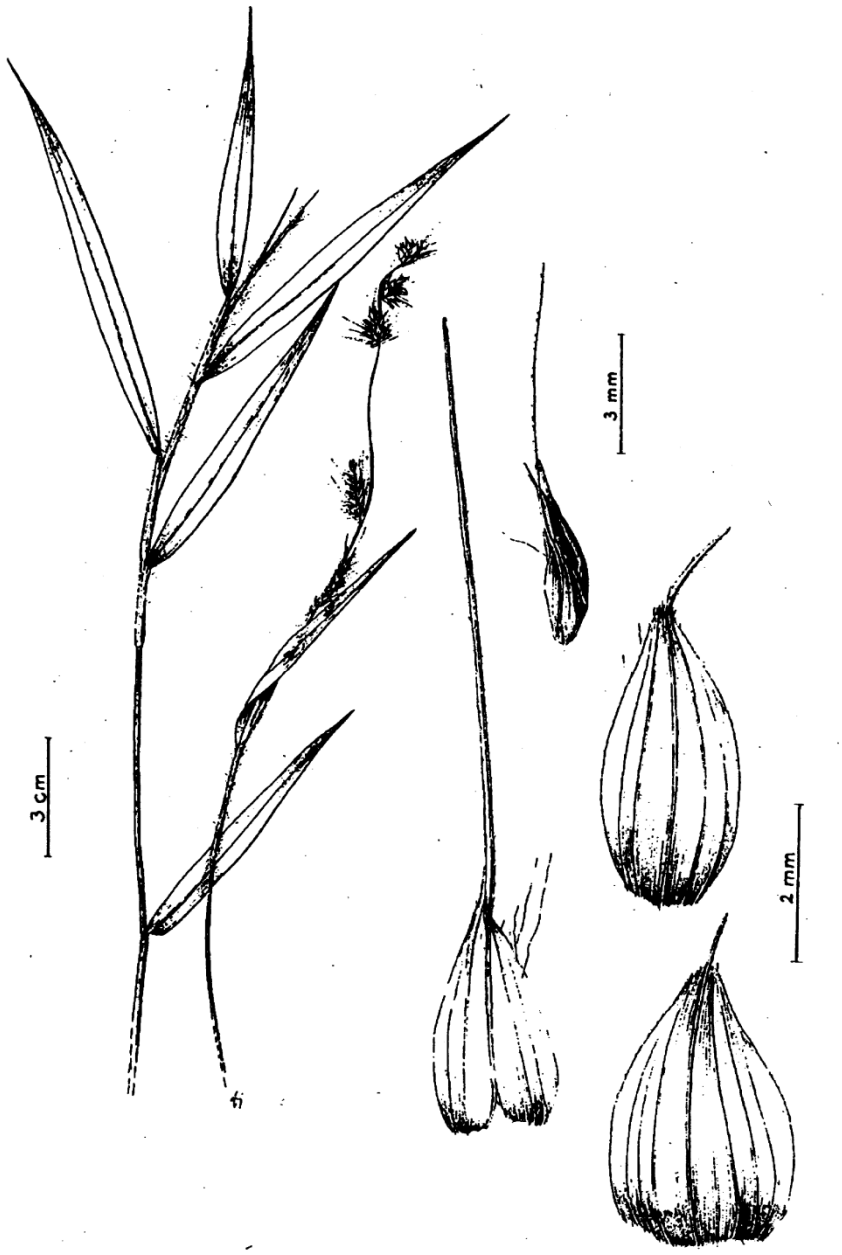


Fig. 16: O. flavicomus (Forsyth-Major 208, B; Madagascar; Typus).

Perennial grass; culm 30 to 45 cm high. Leaves lanceolate-linear, 0.6 to 0.9 cm wide, 6.5 to 10 cm long; Mid-vein clearly defined. Sheath lightly wedged open in the upper part, very long (up to 5mm) sparse hair on the edge, sparse and long on the flats, thick long hair on the upper part. Ligule Hairy collar on the end, 0.7 to 1.4 mm long. Inflorescences racemose, placed together, 10 to 11 cm long, no hair, somewhat coiled. Side shoots upright, heavily haired. The length of the side shoots decreases from the bottom up, the lowest is 1.5 to 2 cm long and carries, unilaterally approx. 20 spikelets, arranged in clumps or oblong clumps. The distance between the lowest side shoots is 3 cm. Spikelets placed together in pairs, lanceolate, 3.8 to 4 mm long, either without hair or only a little on Gluma I. Gluma I oblong, 2.6 to 2.9 mm long, 1.6 mm wide, 3 to 5 veins, with awn. Gluma II longest glume of the spikelet, oblong, 3.7 to 3.9 mm long, 1.9 mm wide, 5 veins, with awn. Lower lemmaoblong, 3.6 to 3.8 mm long, 1.5 to 2.3 mm wide, 7 veins, sometimes with awn. Awns frail, yellowish and dentate; awn of Gluma I 3.3 to 8 mm long, of Gluma II 1.1 to 1.3 mm long. Lower lemmahas no awn or has an awn with a length of 0.7 mm.

Distribution: Madagascar.

Supporting Source: Madagascar, Ambohimitombo forest (Forsyth-Major 208; B).

5. ***Oplismenus gracillimus*** Mez, Notizbl. Bot garden, Berlin-Dahlem 7: 55 (1917). – Type: Nossi-be: Boivin s. n., B. Holotypus; W, Isotypus.

Probably perennial grass; culm 30 to 40 cm high. Leaves oblong-lanceolate, 0.4 to 0.7 cm wide, 5 to 7 cm long. Sheath not wedged open in the upper part, long thick hair only on the edge. Ligule hairy collar on the end, 1.1 to 1.5 mm long. Inflorescences racemose, placed together, 12 to 20 cm long, no hair. Side shoots upright, leaning away. The length of the side shoots decreases from the bottom up, the lowest is 5 to 6 cm long and carries 11 to 22 spikelets loosely in succession. The distance between the lowest side shoots is 2 cm. Spikelets placed together in pairs, rounded, 1.5 to 1.8 mm long, without hair. Gluma I rounded, 0.8 to 1 mm long, 0.7 mm wide, 5 to 7 veins, with awn. Gluma II 1.1 to 1.3 mm long, 0.6 to 1.1 mm wide, 9 veins, pointed. Lower lemmaoblong, 1.5 to 1.7 mm long, 0.6 to 1.1 mm wide, 9 veins. Awns frail, whitish and dentate; awn of Gluma I 8 to 9 mm long. Gluma II only has a point and Lower lemmahas no awn.

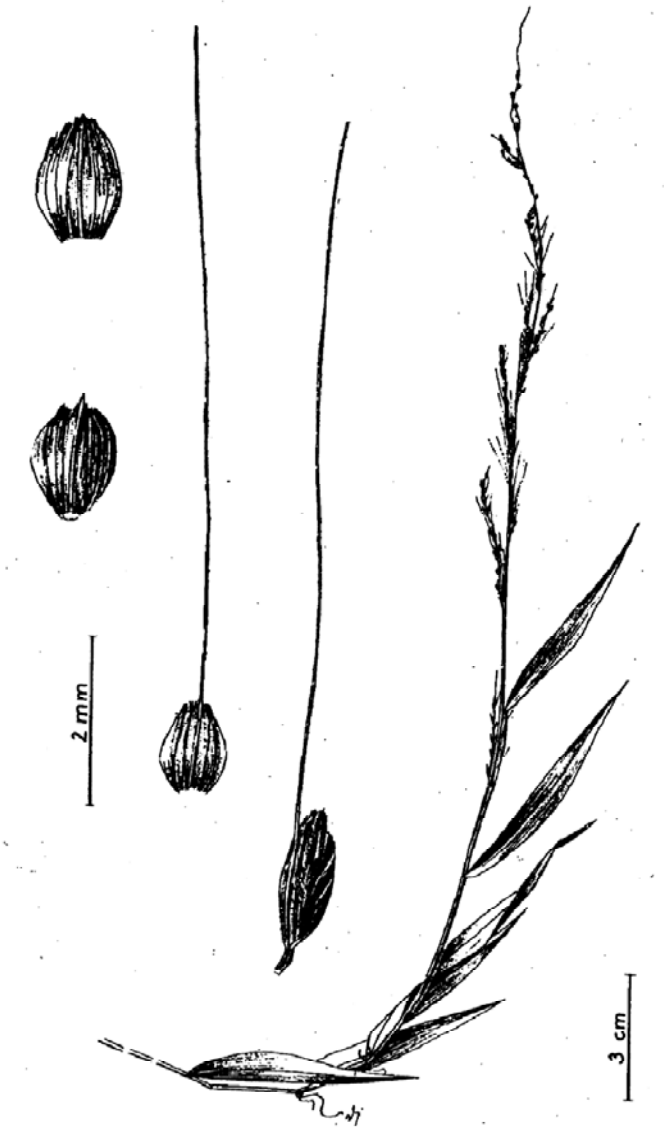


Fig. 17: O. gracillimus (Boivin s. n., B; Nossibé; Typus).

Distribution: Nossi-be (an island to the northwest of Madagascar)

Supporting Source:

Nossi-be: Boivin s. n.; B.

6. ***Oplismenus humbertianus***

Camus, Nat. Malagache 5: 146 (1953). – Type: Madagascar, Vallee de l'Ifasy: Humbert & Capuron 25889; P, Holotypus.

Culm bare or little hair. Leaves oblong, 0.6 to 1 cm wide, 3 to 5 cm long, heavily haired on the upper and lower sides. Sheath bare on the flats, mid-length hairs along the edge. Ligule has hairy collar, 1.1 mm long. Inflorescence 5 to 6 cm long, hangs over partially. The side shoots are 1 to 2.5 cm long, the lowest carries 10 to 15 spikelets clearly arranged in succession. The distance between side shoots is 0.2 to 0.5 cm, The Inflorescence is thereby heavily pressed and compact. Spikelets arranged in pairs, the sitting one is usually reduced to an awn; 3.7 mm long, very little hair. Gluma I linear-lanceolate, 3.6

mm long, 0.9 mm wide, 5 veins, with awn; the awn originates 0.6 mm below the tip of the glume. Gluma II lanceolate, 3.4 mm long, 1.2 mm wide, 7 veins, with awn; the awn originates 0.4 mm below the tip of the glume. Lower lemmaoblong-lanceolate, 3.4 mm long, 1.9 mm wide, 9 veins, with awn; the awn originates a little below the tip of the lemma. Palea I narrow, 2 veins. Awns frail, white-reddish, dentate. Awn of Gluma I 16 mm, of Gluma II 1.1 mm and of Lower lemma0.3 mm long.

Distribution: Madagascar.

Supporting Source: Madagascar: Vallee de l'Ifasy, Distr. Ambilobe (Humbert & Cauron 25889; P).

Oplismenus* sect. *Orthopogon (R. Br.) Schlecht., Linnaea 31: 301 (1861-62).

7. ***Oplismenus aemulus*** (R. Br.) Roem. & Schult. 'O. aemulans' , Syst. Veg. II: 487 (1817).

Key to the Varieties:

1. Rachis bare, Spikelets 2.4 to 3.1 mm long and clearly successive; Awn of Gluma I 2.4 to 3.1 mm long. ..... var. *flaccidus*
1. Rachis and usually the side shoots of the inflorescence heavily haired. 2
2. Awn of Gluma I 6 to 9 mm, of Gluma II 1 to 1.5 mm long, Lower lemmapointed or blunt; side shoots clearly separated from one another. Spikelets clearly successive. ..... var. *aemulus*
2. Awn of Gluma I 1.5 to 3.5 mm long, of Gluma II 0.2 to (1.1) mm long, Lower lemmano awn; side shoots in thick succession, the inflorescence work into a clump; spikelets in thick succession ..... var. *densiflorus*

7.1. **var. *aemulus***

Orthopogon aemulus R. Br., Prod. Fl. Nov. Holl. 194 (1810). - *Panicum aemulum* (R. Br.) Steud., Nomencl. 2.ed. II: 252 (1841). – *Oplismenus setarius* (Lam.) Roem. & Shult. var. *aemulus* (R. Sr.) Bailey, Quensland Fl. 6: 1838 (1902). - *Oplismenus aemulus* (R. Br.) Roem. & Schult. var. *pilosus* Domin, Biblioth. Bot. 85: 328 (1915). - Type: Australia, Keppel Bay: R. Brown 6132, BM, Holotypus.

Oplismenus aemulus (R! Br.) Roem. & Schult. var. *lasiorhachis* Domin, Biblioth. Bot. 85: 329 (1915). - Type: Australia, rainforests in the Tambourine Mountains: Domin s. n.; n. v. (PR?).

Oplismenus burmannii (Retz.) P. Beauv. var. *intermedius* Honda, Bot. Mag. Tokyo 38: 191 (1924). - *Oplismenus compositus* (l.) P. Beauv. var. *intermedius* (Honda) Ohwi,

Acta Phytotax & Geobot. 2: 35 (1942). - Type: Taiwan, Kobayashi 486, TI, Lectotypus; Owatari s. n., Sasaki 19, TI, Syntypi.

Oplismenus compositus (L.) P. Beauv. f. *pubescens* F. Brown, Bernice P. Bishop Mus. Bull. 84: 68 (1931). - Type: Marquesas (1.), Nukuhiva, Taipi Val: F. Brown 594; BlSH, Isotypus.

Usually frail grass; leaves oblong-lanceolate, 0.4 to 1.1 cm wide, 3 to 8 cm long, More or less thickly haired. Sheath long thick hair growth on edges. Ligule has short hairy collar, 0.4 to 1.1 mm long. Inflorescences racemose, placed together, 8 cm long. Culm has long thick hair; side shoots usually have long thick hair as well; the lowest is 1.5 to 2.5 cm long and carries approx. 15 spikelets more or less in thick succession. Spikelets placed in pairs, oblong-lanceolate, long or short thick hair, 2.8 to 3.2 cm long. Awns robust, yellowish, bare; the awn of Gluma I is 6 to 9 mm long, of Gluma II 1 to 1.5 mm long. Lower lemmais pointed or blunt.

Distribution: Tropical East Asia and Australia.

Selected Voucher specimens:

Australia: Brisbane (Clemens s. n.; U. S.); Moreton Bay (F. v. Mueller s. n.; W); N. Queensland (N. Michael 920; E); N. S. Wales, Byron Bay (Meebold 3380; M). - N Caledonia: Babrongho, Sentani (C. Versteegh 4742; PNH). – N. Hebriden: Aneitum (Cuming 17; G). – Phillipiens: Luzon, Baguio (Sulit 7602; PNH).

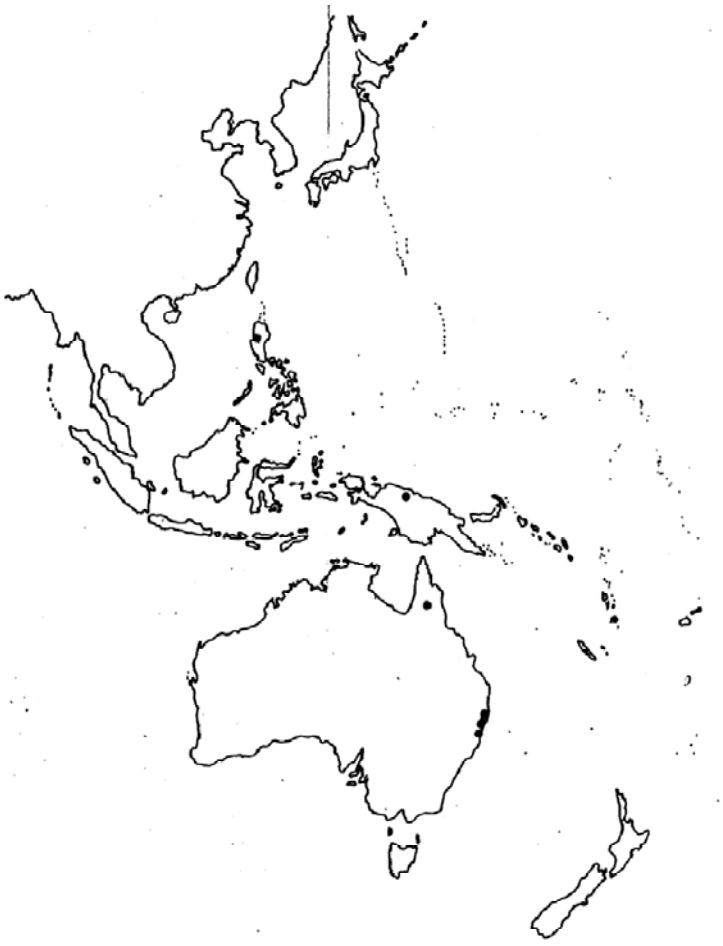


Fig. 18: Distribution of *O. aemulus* var. *aemulus* .

7.2. **var. *flaccidus*** (R. Br.) Domin, Biblioth. Bot. 85: 328 (1915).

Orthopogon flaccidus R. Br., Prod. Fl. Nov. Holl.: 194 (1810). - *Oplismenus flaccidus* (R. Br.) Roem. & Schult., Syst. Veg. II: 487 (1817). - *Panicum flaccidum* (R. Br.) Steud., Nomencl. 2. ed. II: 256 (1841). - Type: Australia,

Newcastle Distr.: R. Brown, 6131, BM, Holotypus.

Usually frail grass; leaves ovate-oblong or oblong lanceolate, 0.8 to 1.1 cm wide, 5 to 7 cm long. Sheath sparse thin hair on the edge. Ligula has a hairy collar, 0.6 to 1.6 mm long. Inflorescences racemose, placed together, 7 cm long.; culm and side shoots bare. Side shoots 0.5 to 3 cm long; the lowest carries 6 to 15 spikelets more or less in thick succession. Spikelets placed in pairs, oblong lanceolate, sometimes a little hairy, (2.2) to 2.4 to 3.1. to (3.7) mm long. Awns robust, yellowish and bare; the awn of Gluma I 2.6 to 7 mm long, of Gluma II 0.2 to 1.9 mm long; Lower lemmahas a short point or is blunt.

Distribution: Tropical East Asia and Australia.

Selected Voucher specimens:

Australia: (Sieber 73; LE); Cape York. Queensland (L. J. Brass 18214; L); Middle Percy Isl., Queensland (M. Lazarides 5645; B); Hastings R., near Richmond R. (Beckler s. n.; M) Lord Howe I. (Marder s. n.; G) Ceylon: (Walker s. n.; G). – Community-I.: (Forster s. n.; M). - Indonesia: Bali (Kosterman et al. s. n.; NY); Java; Mt. Gede (Hochreutiner 1198; G); Tongatabu (T. B. Cartwright s. n., OXF). - Malaysia. Borneo, M. Kinabalu (J. & M. S. Clemens 32613; G). - Mauritius: (Commerson 135; LD). – N. Caledonia: (Germain s. n.; W). - N. Zeeland: (Hooker 1754; G); Tutu (L). Philippines: Luzon, Mt. Mariveles (Merrill 6987; G); Lepanto; Mt. Data (M. Ramos & G. Edano s. n.; W). - Samoa: (S. J. Whitmee s. n.; W); Nu'ulua (A. Whistler 1935; B). - Taiwan: Tammi (U. Faurie 117; PNH).

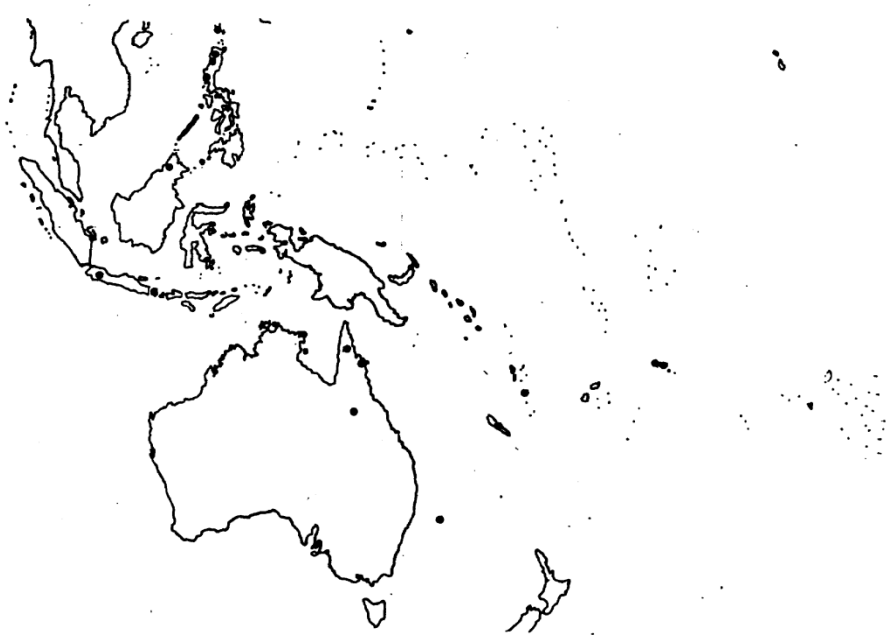


Fig. 19: Areal of *O. aemulus* var. *flaccidus*

Ecology: In rainforests and treed savannah.

Sociology: Under Casuarina, Pandanus, Melaleuca; with Ottochloa nodosa.

Anthesis: April to November.

Remarks: An especially small leaved and frail form is well known from Ceylon: Sittampalam s. n., HBG.

7.3. var. ***densiflorus*** U. Scholz nov. var. – Type: New Guinea: W. Vink 16332, L, Holotypus.

Diagnosis: Lamina foliorum ovata – lanceolata vel lanceolata; inflorescentia racemiformis, rami coarcti. Spiculae ovatae – lanceolatae, dense contingentes; arista glumae I 1.5 – 3.5 mm longa, glumae II 0.2 – (1.1) mm longa. Lower lemmamuticam.

Ovate oblong, sometimes oblong leaves; side shoots arranged in thick succession, an almost clumped inflorescence; Spikelets inserted in thick succession, ovate-oblong. Awn of Gluma I 1.5 to 3.5 mm long, of Gluma II 0.2 to (1.1) mm long; Lower lemmahas no awn.

Distribution: New guinea, Australia.

Selected Voucher specimens:

Australia: Brisbane (Clemens s. n.; US); Mossmann Distr., (H. S. Mukee 9091; l). – New Guinea: Eastern Highlands Distr. (R. D. Hoogland & R. Pullen 5370; PNH); Nondugl (Womersley & R. D. Hoogland 4943; PNH); Nona-Minji Div. (Vink 16332; HBG); Wabag (R. D. Hoogland & Schodde 6711; L). – Community I.: Taiti (J. E. Tilden 335; G).

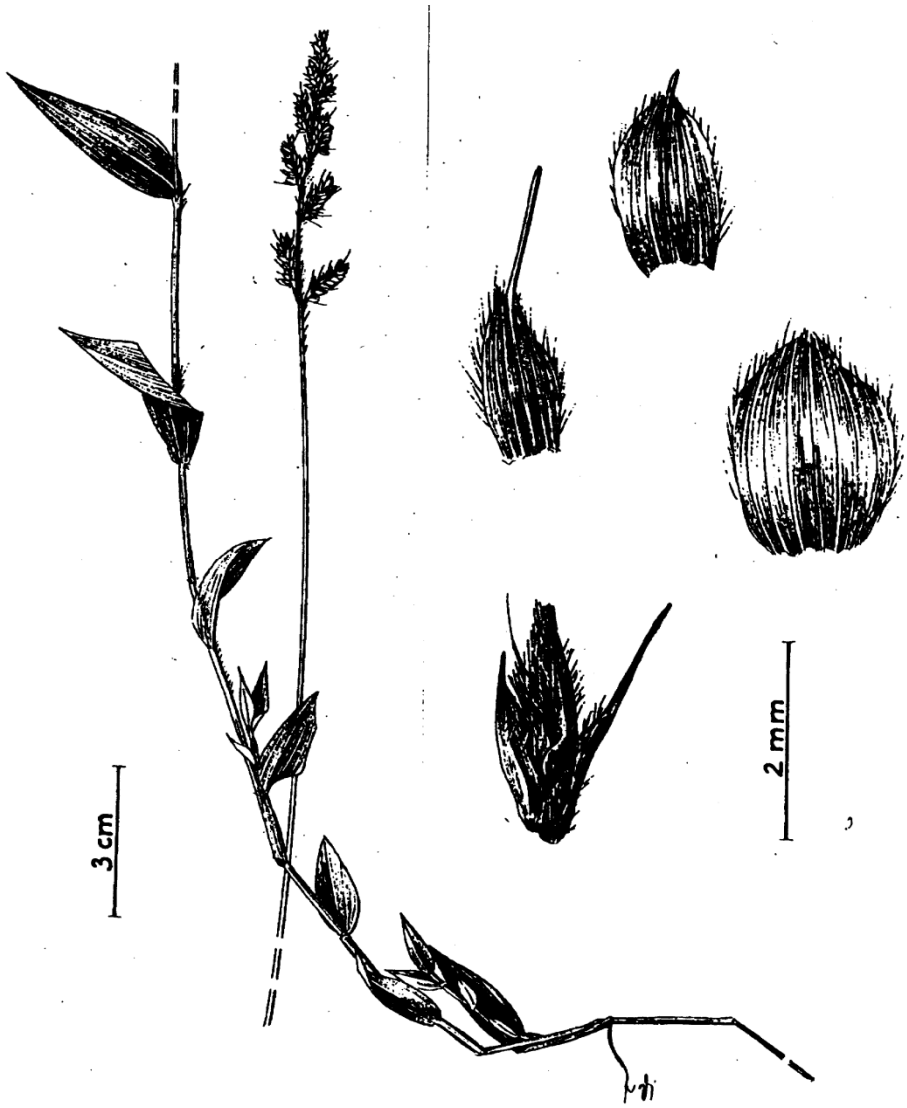
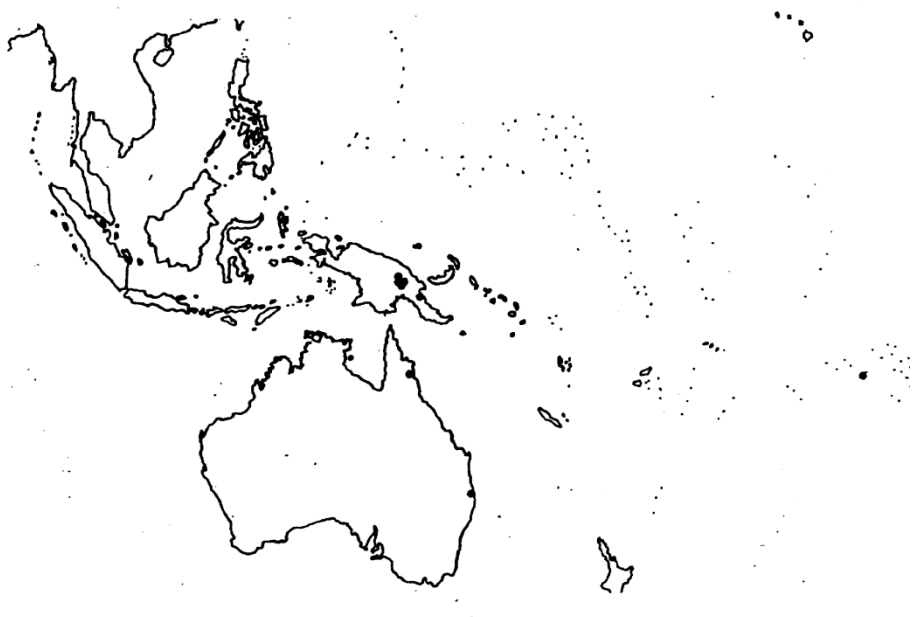


Fig. 20: *O. aemulus* var. *densiflorus* (W. Vink 16332, L; New Guinea; Type).

Fig. 21 Areal of *O. aemulus* var. *densiflorus*.



Common name: Sunsba-Magngak (New guinea); Tauri (New Guinea: Enga-language).

Ecology: Weed in cultivated fields.

8. ***Oplismenus compositus*** (l.) P. Beauv., Ess. Agrost.: 54 (1812); Bor, N. In Rechinger, K. H., Fl. Iranica: 484 (1970); Bosser, J., Gram. Pat. et Cult. Madagascar: 355 (1969); Cooke, T., Fl Pres. Bombay 3: 443 (1958); Diels, F. L. E., Fl. Centr. China Bot. Jahrb. Syst. 29: 223 (1901); Engler, A., Plant World of East Africa: 104 (1904); Gamble, J. S., Fl. Pres. Madras 3: 1231 (1967); Hara, H., Fl. Eastern Himalaya: 369 (1966); Haines, H. H., Bot. Bihar and Orissa 3: 1045 (1961); Koorders, S. H., Exkursionsflora von Java 1: 138 (1911); Mitra, N. J., Flow. PI. East. Ind. 1: 197 (1958); Prain, D., Bengal Plants 2: 883 (1963); Ridley, H. N., FI. Malay Penins. 5: 221 (1925); Stapf, *O.* in Prain, D., Fl. Trop. Afr. 9: 634 (1934); Stewart, R. R., Fl. West Pakistan 120 (1972).

Key to the Varieties:

1. Lowest side shoot 2.5 to 3 cm long; spikelets 2.4 to 4.1 mm long, arranged in thick succession; Mauritius.....var. *sylvaticus*
1. Lowest side shoot 1.5 to 10 cm long; spikelets 2.6 to 5.2 mm long, loosely arranged in succession. 2
2. Plants usually frail, spikelets 2.6 to 3.2 mm long; side shoots 1.5 to 5 to (7) cm long.... var. *rariflorus*
2. Plants robust; spikelets (3.3) to 3.6 to (5.2) mm long; side shoots 3 to 10 cm long ....var. *compositus*

8.1. **var. *compositus***

Panicum compositum L. Spec. PI. 57 (1753). - *Orthopogon compositus* (L.) R. Br., Prod. FI. Nov. Holl.: 194 (1810). – *Orthopogon remotus* (L.) Trin., Fund. Agrost.: 181 (1820), nom. illeg. - *Hippagrostis composita* (L.) *O.* Kuntze, Rev. Gen.: 777 (1891). - Type: Ceylon, Hb. Hermann (BM?)

Panlcum aristatum Retz . Obs. IV: 17, (1786-87). Typus: China: Wennerberg s. n. (LD?).

Panicum composito-proximum Rottl. ex Willd., Ges. Naturf. Fr. N. Schrift. 4: 224 (1804), - *Oplismenus* indicus Roem. & Schult., Syst. Veg. II: 484 (1817). - *Panicum* certificandum Steud., Syn. Pl. Glum. I: 44 (1854). - Type: India, Bengal: Rottler 869, M, Holotypus.

Oplismenus de*compositus* Nees in Endl., Prod. Fl. Norf.: 19 (1833). - *Panicum* peninsularum Steud., Syn. Pl. Glum. I: 44 (1854). – *Panicum* compositum Rottl. ex Steud., Syn. Pl. Glum. I: 44 (1854), pro syn. - Type: India: Wight prop. 62, NY, Holotypus.

Panicum bidentulum Steud., Syn. PI. Glum. I: 45 (1854). - *Orthopogon junghuhnii* Nees ex Steud., Syn. Pl. Glum. I: 45 (1854), pro syn.; Nees ex Miq., Fl. Ind. Bat. III: 444 (1857, t. p. 1855). - *Panicum bidentatum* Steud., Syn. Pl. Glum. I: 45 (1854), err. pro P.

bidentulum Steud., - *Oplismenus junghuhnii* (Nees ex Miq.) Boerlage, Ann. Jard. Bot. Buitenzorg 8: 63 (1890). -Type: Rebo Running: Nees S. n., B, Lectotypus.

Orthopogon compositus (l.) R. Br. var. *glabrescens* Buse in Miq., Pl. Jungh.: 370 (1854). - Type: Java, Merapi: Junghuhn s. n.; L, Holotypus:

Panicum gonyrrhizum Steud., Syn. Pl. Glum. I: 44 (1854). *Orthopogon gonyrrhizus* (Steud,) Miq., FI. Ind. Bat. III: 443(1857, t. p. 1855). - Type: Java: Goering 199, P, Holotypus.

Panicum longeracemosum Steud., Syn. Pl. Glum. I: 45 (1854). - *Orthopogon longeracemosum* (Steud.) Miq., Fl. Ind. Bat. III: 443 (1857, t. p. 1855). - Type: Java: Zollinger 915, P, Lectotypus; 719 (P?). Syntypus, n. v.

Oplismenus compositus (L.) P. Beauv. var. *lasiorhachis* Hack., Bur. Gov. Lab. 35: 81 (1905). - Type: Philippines, Separation Point, Paraguai: Merrill 826 (PNH, destr.?), n. v.

Oplismenus formosanus Honda, Feddes Repert. Spec. Nov. Regni Veg. 20: 361 (1924). - Type: Taiwan: Hayata s. n., TI, Holotypus.

Oplismenus owatarii Honda, Feddes Repert. Spec. Nov. Regni Veg. 20: 361 (1924). - *Oplismenus compositus* (L.) p, Beauv. var. owatarii (Honda) Ohwi, Acta Phytotax. Geobot. 11: 35 (1942). - Type: Taiwan, Buizan: Matuda-Bizi 316, TI, Lectotypus; Owatari s. n., (TI?), Syntypus, n. v.

Oplismenus patens Honda, Feddes Repert. Spec. Nov. Regni Veg. 20: 360 (1924). - *Oplismenus compositus* (L.) P. Beauv. var. patens (Honda) Ohwi, Fl. Jap.: 149 (1953). - Type: Japan, Oshima: Uchiyama s. n., TI, Lectotypus; Kuroiwa s. n., (TI?), Syntypus. n. v.

Oplismenus compositus (L.) P. Beauv. f. glabratus F. Brown, Bernice P. Bishop Mus. Bull. 84: 68 (1931). - Type: Marquesas, Nukuhiva: F. Brown 736, BISH, Lectotypus; 927 (BISH?), Syntypus, n. v.

Oplismenus undulatifolius (Ard.) Roem. & Schult. var. elongatus Honda ex Nakai, Koryo Shikerin No Ippan: 80 (1932). - Type Nakai 13237, TI, Isotypus.

Oplismenus coreanus Nakai, Bull. Sei. Nat. Mus. 31: 140 (1952), p. p., nom. illeg. ,- Type: n. v. (TI?)

Oplismenus burmannii auct. non Retz.: Mez in Perkins, Frag. Fl. Phil.: 144 (1904): Thwaites, Enum. Pl. Zeylan.: 358 (1854), Supporting Source: Thwaites s. n., W.

Hybrids:

S. u. *Oplismenus burmannii* (Retz.) P. Beauv.

Ic.: Bosser, J., Gram. Pat. et Cult. Madagascar: 355 f. 133 (1969). – Fröman, B. & Persson,S., An ill. Guide to the Grasses of Ethiopia: 359 L 219 (1974). - Hsu, K. - S., Fl. Taiwan 5: 564 f. 1433 (1978). - Pilger, R., Panicoideae in A. Engler, Die Nat. Pflanzenfamilien 14 e: 48 f. 25 (1940).

Perennial, usually hardy plants; culm 30 to 106 cm high. leaves oblong-lanceolate or – less often – ovate-oblong, hairy or bare , (0.4) to 0.8 to 1.6 to (2.2) cm wide, (3) to 4 to 9 to (16) cm long. Sheath long or short haired along the edge, seldom hair on the flat, loose long or short. Ligula hairy collar on the end, (0.3) to 1.3 to (2) mm long. Inflorescences racemose, placed together, the rachis is flat to triangular, between 6 and 32 cm long, almost always bare. Side shoots 6 to 10, sanding out at an angle. The length of the side shoots decrease from bottom to top, the lowest is 3 to 10 cm long. The side shoots are far apart, usually with at least the distance of their own length. The lowest shoot carries 8 to 20 to (40) spikelets unilaterally, arranged loosely to very loosely in succession (separation of up to 1 cm between spikelet pairs). Spikelets placed in pairs, dark green, sometimes purple overrun, lanceolate, (3.3) to 3.6 to (5.2) mm long, bare or hairy. Gluma I oblong-oval, (1.8) to 2.6 to (3.7) mm long, (0.7) to 1.2 to (1.6) mm wide, (3) to 5 veins, with awn. Gluma II oblong-oval, (1.8) to 2.5 to (3.8) mm long, (1) to 1.5 to (1.9) mm wide, (5) to 7 veins, with awn or occasionally with a short point. Lower lemmaoblong, (2.7) to 3.3 to (5) mm long, (1.5) to 2.1 to (2.9) mm wide, with a short point (0.2 – 0.4 mm) or blunt. Palea I thin, translucent, 2 veins, sometimes missing. Caryopsis Oblong, convex on the back, flattened on the front. Awns robust, yellow-reddish, bare, becomes adhesive when fruit is ripe; awn of Gluma I 3 to 15 mm long, of Gluma II 0.7 to 5 mm long.

Distribution: Tropical and subtropical regions of the Old and New World.

Selected Voucher specimens: Ethiopia: Eritrea-Amassen , Fil-Fil (A. Pappi 5426; FI); Ghinda (A. Pappi 4526; FI); Jimma (Massa 280; FI). - Kenia: Kisumu, Nairobi (R. A. Dümmer 1640; BR); Kwale Distr. Longomwagandi (F. Magogoa & P. Glover 940; BR). - Madagascar: Tamatare (M. Goudot s. n.; G). - Malawi: Chipata M. (W. C. Verboom 971; 8M); Kyimbila (A. Stolz 1239; Z); Dedza Distr., Nchisi For. (I. D. Chapman 1311; 8M); Kota-Kota Distr,. (J. Brass 17044; BR). - Mozambique: Sofala Prov., Chimoio (N. C. Chase 6874; BR); Between Nicuadala und Narral (A. R. Torre 4427; BM); Serra da Morrumbala, Massingire (A.R. Torre 5-231; BM). – Pemba I: Mkumbua (J. H. Vaughan 211; BM). - Sambia: Dlstr . Mporokoso, Kundabwika Falls (J. B. Phipps & D. Versey-Fitzgerald 3159; BM). - S.Africa: Prov. Cape, Distr. Port St. Johns (M. Y. Wells 3392; BR); Mariepskop (H. van der Schijff 4325 A;W). - Tansania: Usambara, Gonja (C. Holst 4241; PR); Usambara; Lutini (C. Holst 3279; P); Mahenge Distr., Sali (H.J. Schlieben 1997; M); Massagati. Ruhudje (H. J. Schlieben 1179; HBG); East-Usambara, Amant (A. Peter 20189; W); Zansibar, Muyuni (J. H. Vaughan 2208; BR). - Zimbabwe: Chihi Distr., Madzivire Dep. (R. _B. Drummond 7895; BM); Gokwe Distr.,

Lasame R. (M. Y. Bingham 640; BM); Nyumquarara Valley (H. B. Gilliland 1549; BM); Selukwe (H. Wild 4290; BR); M. Sindinda Distr. (H. Wild 1901; FI); Umtali, Mennine R. (N. C. Chase 4485; BM). - Australia: Queensland, Cape York Penins~ (J. Brass 19318; G); Queensland, Rockingham Bay (F. Müller s. n.; G). - Burma: Myitkyina (R. *O.* Belcher 840; G); Kyajkiyu, Ramree I.. (G. C. Wallace 9022; B); Fort Stedman (A. Huk s. n.; M). - Ceylon: Kandy, Roseneath (F. Ballard 1007; B); (Thwaites 913; FR). - China: Fukien Prov. Hinghwa (lin Pi 6424; W); Hainan, Tao (C. Wang 35294; G); Kiangsi; Lungnan Distr. (S. K. Lau 4449; G); Prov., Kwangtung, Tao poo (S. S. Sin et al. 113; B); Prov. Kwangtung, Wan Shan Toi (C. *O.* Levine 10172; PNH); Yunnan, Ma Shan, Mekong Yangtze Div. (G. Forrest 132.00; E). – Fidii I: Ovalan (A. V. Hugel 99; CGE). - India: Assam, Tirap R. Valley (R. *O.* Belcher 22 C 903; G); Calcutta (P. Drain S. n., G); Cote Coromandel (M. Belanger 149; G); Darjeeling (C. B. Clarke 24832; G); East Himalaya (Griffith s. n.; OXF); Himalaya (Hooker s. n.; OXF); N. W. Himalaya, Mussoorie (R. R. Stewart 11421; G); Malangor (Hohenacker 368; G); Saharanpur, Rajpur (J. J. Duthie 7720; G); Sikkim (I. D. Hooker s. n.; M); Shembaganur (Foreau 1778; M). - Indonesia: Borneo, Bangarmassing (J. Motley 151; CGE); Borneo, Banguey I. (P.' Castro & F. Melegrito 1486; G); Borneo, Mt. Kinabalu (Clemens 51051; G); Borneo, Penibukan (Clemens 51567; HBG); Borneo, Sarawak (A. Brooke 8148; G); Borneo, Serawai (Winkler 100; HBG); Borneo, Tenompok (Clemens 30289; HBG); Celebes, Provo Minahassa (S. H. Koorders s. n., L); Java, Manau, near Buteng

(Kostermans & Wirawan 496; G); Salak, near Bogor (Kurz 1837; M); Java, ldjengebirge (C. Schröter 7; ZT); Java, Merapie (Junghuhn s. n.; L); Java Pengalengan (Hochreutiner 1329; G); Java Gede Tji-Beureum (Hochreutiner 15; G); Java Viah Tanabong (E. de la Savinierre 1637; G.l; Sumatra, Buidjei, Deli (L. Martin S. n.; M); Sumatra, Laut Kawar (Frey-Wyssling 8053; ZT); Sumatra, Asahan (A. Krukoff 4056; J); Sumatra, Tiga Dolok (Surbeck s. n.; ZT); Kl. Sunda I., Alors (0. Jaag 327; ZT); Lombok (J. Elbert 1893; PNH); Timor (0. Jaag 53; ZT). - Japan: Kyushu, Ambo (M. Togasi 1475; G); Ryukyu, Taketomi (F. R. Fosberg 37617; L). - Malaysia: Langkawi, Sungai Raya (E. 1. H. Corner S. n.; PNH). - Mollukken: Amboine (Webbs. n.; G). - Nepal: away from Azidunga toward Belzat (A. Zimmermann 2117; G). – N Calendonia: (G. Bonati 391; HBG); Yahoue; (1. Franc 2143; G). – New-Guinea: Kiwori (Murphy s. n.; G); Waikaiuna (L. J. Brass 25394; PNH); Sepik Distr., Mori (P. J. Darbyshire & R. D. Hoogland 8085; B). - Pakistan: Saidpur (R. R. Stewart 23667; W). - Philippines: Luzon: Ilocos Norte Prov. M. Quebrada (G. E. Edana 17856; PNH); Provo Rizal, Antipolo (E. D. Merrill 200; PRC); Provo Sorsogon. Irosin (E. D. Merrill 15347; B); Mindanao: Agusan Prov., Butan (D. R. Mendoza 42021; PNH); Cotobato prov. (H. Kerr 35211; PNH); Davao Prov. M. McKinley (G. E. Edana 1026; PNH); Mindoro: Bongabon (E. Maliwanag 171; PNII); Mt. Yagaw (M. D. Sulit & H. C. Conklin 16896; PNH); Guimaras: (A. Usteri s. n.; ZT); Leyte: Takuranga R. (B. Santos 39931; PNH); Palawan: Tarateon R. (G. E. Edano 14160; PNH); Puerto Princesa (G. E. Edano 222; PNH). - Panay: Ilvico Prov. (A. T. Taleon 33866; PNH). - Polillo: (R. B. Fox 9117; PNH). Samar: M. Capotoan (G. E. Edano 15576; PNH); Mt. Purog (G.

E. Edano 15455; PNH). - Samoa: Upolu (Reinecke 13; L); Lanuto See (Hochreutiner s. n.; G). – Sevchellen I: (C. Jeffrey & A. Maulinie 790; P). - Thailand: Doi Sutap (Hosseus 305; M); Soi Dao, Chantaburi (N. L. Bor 329; C); Kanchanaburi (C. F. V. Bensehom 3506; L). - Vietnam: Vallee de Lankok, Tonkin (B. Balansa 1605; G). - Ecuador: Guayas (A. S. Hitchcock 20429; US); Guayaquil (E. ASplund 15925; G). - Hawai: Halawa Valley (5. Ishikawa 134; L). - Mexico: La carrea (Langlasse 444; US); Jalisco (R. Me Vaugh 14190; G); Morelia (Arsene 39; G); Sierra Cordiellera (H. Galeotti 5847; G). - Panama: Canal Zone, Fort San Lorenzo (E. L. Tyson et al. 3704; MO); Prov. Chiriqui (G. Davidse 10, 154; MO). - Venezuela: Prov. Caracas (Funck & Schlim 161; G).

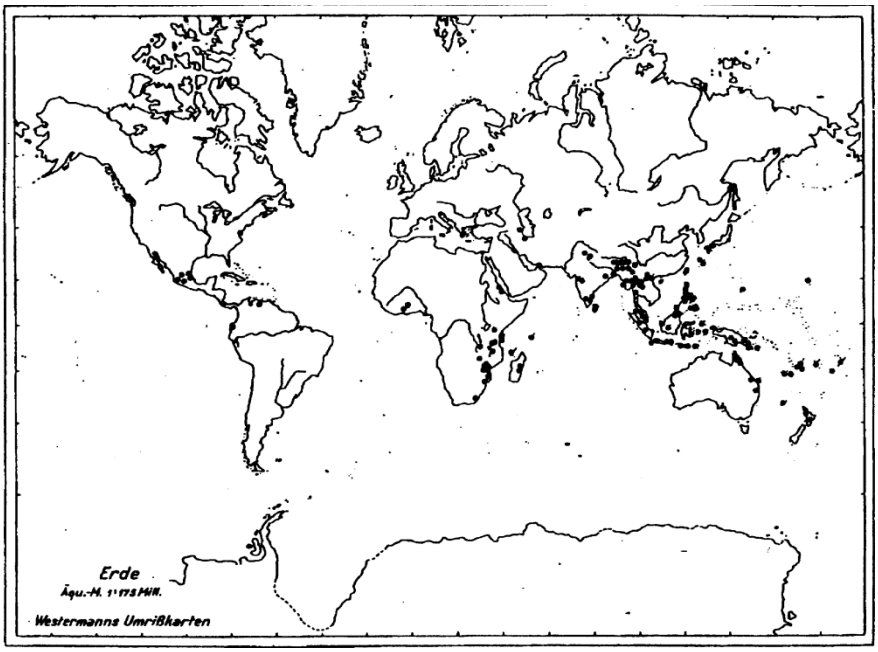


Fig. 23: Areal of *O. compositus* var. *compositus*.

Common name: Taru (Pogatumo-language, Sumo); Tepe (Orne-language, Mafoka); Sihuhu Mairoro (Orokaiva-language) – New Guinea.

Ecology:In humid Rainforests: along rivers in cloud forest and secondary forests; in bamboo thickets and in reed vegetation; on granite.

Sociology: Under Newtonia, Artocarpus, Northea, Eugina uniflora, Morinda citriflolia, Leucaena; Quercus (Mexico). Companion plants: Philippines: *Panicum* philipes, Echinochloa colona, Carex, Sida, Hyptis.

Economical impact: weed in coffee plantations.

Vermin:

Fig. 22: O. compositus var. compositus (Ballard 1002, B; Ceylon).

Claviceps viridis Padwick & Azmatullati; *Helminthosporium oplismeni* Sawada & Katsuki; *Phakopsora oplismeni* Cummius; *Phyllachora oplismeni-compositi* Sawada; *Phyllachora oplismeni* Syd. var. major Batista; *Physopella oplismeni* B. U. Patil & Thirumalachar;.

Anthesis: January to December; especially march to May and October to December.

Chromosomes:

n = 27: Koshla (1972).

2n = 54: Koshla & Mehra (1973); Mehra & Sharma (1973).

n = 36: Gupta (1971).

2n = 72: Avdulov fide Bor (1960); Gould & Soderstrom (1974); Hsu (1967); Narayan & Muniyanna (1972).

Remarks:More hairy forms are appearing: 1. Culm, leaves, flats of the sheath have thick long hair: Mozambique, Manica e Sofala: Chase 7436; BM; Tansania, Mahenge: Schlieben 1997; HBG; Samoa, Upolu: Whistler 1615; B. - 2. Leaves, flats of the sheath have thick long hair: Java, Semarang: Koorders 27780 b; B; Malaysia, Sabah: Nooteboom 1193; B; Thailand, Fang: Sφrensen et al. 1519; C; Payab: Sφrensen et al. 3045; B; Japan, Kyushu: Togasi 1475; B. - 3. Spikelets partially, rachis and side shoots have thick, long hair: Australia: Müller s. n.; G; India: Griffith s. n.; OXF; Bacungan, Edano 222; PNH.

Another form that has deviated from *O. compositus* is the species described by Honda as *Oplismenus patens*. It is distinguished by especially wide leaves (2 to 3 cm): Ceylon: Koenig s. n.; M; Faurie 6407; G; Japan, Tokyo: Tagshi 7276; L; Java: Nagler 15; B; Vietnam, Tonkin: Balansa 1605; G.

8.2. **var. *rariflorus*** (K. B. Presl) U. Scholz. nov. stat.

Oplismenus rariflorus K. B. Presl, Rei. Haenk: I: 320 (1830); Hitchcock, A. S., Contr. U.S. Natl. Herb. 22,3: 131, f. 24 (1920), North Amer. Flora 17,4: 309 (1931); - *Panicum* parciflorum Steud., Syn. Pl. Glum. I: 45 (1854). – Qplismenus hirtiflorus K. B. Presl in Kew Index (err. pro *O.* rariflorus K. B. Presl. - Type: "Acapulco", Haenke S. n. (PR?), n. v.; PR: Labeled as Type: "in Bengalia circa Calcuttam", Helfer "annls 1838-40".

Oplismenus latifolius Haenke ex Steud., Nomencl. 2. ed. II: 220 (1841). - Type: Peru: Haenke s. n.; n. v.; fide Hitchcock (1920).

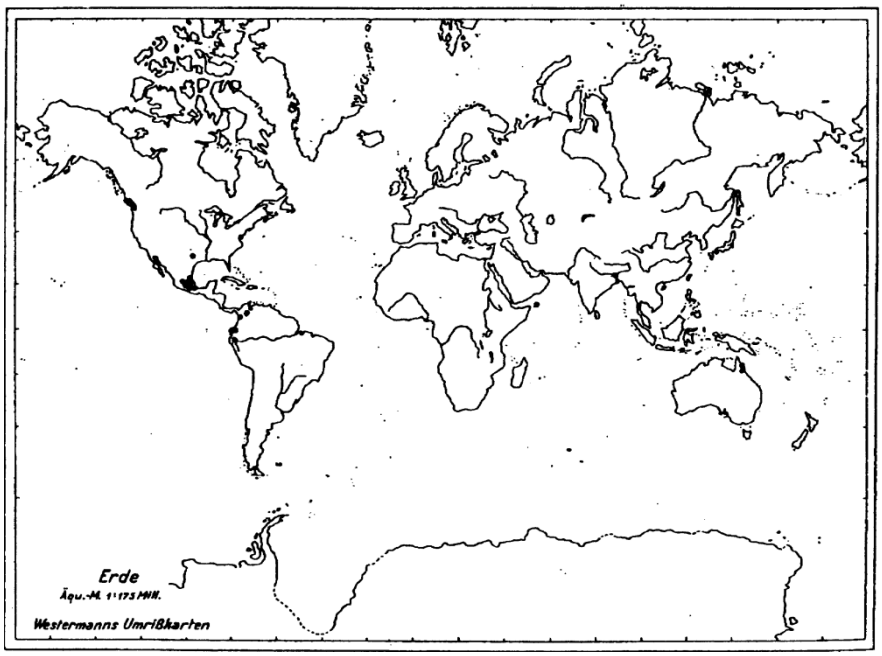
Oplismenus liebmannii E. Fourn., Mex. Pl. 2: 38 (1886). - Type: Mexico: "in campis inter la

Galera et Pochutta", Liebmann 372, C, Lectotypus; Mexico, Zacuapan: Liebmann 373, C, Syntypus; Liebmann 374, Syntypus.

Oplismenus thiebautii E. Fourn., Mex. Pl. 2: 39 (1886). - Type: Mexico, Acapulco: Thiebaut 1074, P, Holotypus.

Oplismenus polliniifolius Honda, Feddes Repert. Spec. Nov. Regni Veg. 20: 362 (1924). - Type: Taiwan, Hokuto; Nakahara s. n., TI, Lectotypus; Miyake 24, TI, Syntypus, n. v.Ic.: Hitchcock, A. S., Contr. U.S. Natl. Herb. 22,3: 132, f. 24 (1920). - Matuda, E., Las

Gramin. del Estado de Mexico: 54 (1958), ("*Oplismenus hirtellus*"). - Swallen, J. R., Fl. Guatemala 2: 229, f. 72. Fieldiana: Bot. 24. 2 (1955).



Usually frail grass: culm 30 to 50 cm high, bare or haired. Leaves ovate-oblong, bare or with little hair, (0.5) to 0.8 to 1.4 to (2.6) cm wide, (3) to 4 to 8 to (13) cm long. Sheath short, thick or sparse hair along the edge, usually bare on the flats. Ligula usually has a hairy collar, (0.2) to 0.4 to 1.3 to (2.2) mm long. Inflorescence placed together, racemose; rachis 5 to 15 cm long, usually bare; side shoots up at an angle and out from the main axis. The length of the side shoots decreases from bottom to top, the lowest is 1.5 to 5 to (7) cm long and carries 8 to 20 spikelets arranged in loose succession. Spikelets placed in pairs, heavily haired at the base. Spikelets oblong- lanceolate, (2.5) to 2.6 to 3.2 mm long, usually without hair. Gluma I oblong, (1.8) to 1.9 to 3.2 mm long, (0.9) to 1.1 to 1.2 to (1.4) mm wide, 3 to 5 veins, with awn. Gluma II oblong, 2 to 2.4 to (2.9) mm long, (1.2) to 1.3 to 1.6 to (1.9) mm wide, 5 to 7 veins, with awn. Lower lemmaoblong, (2.4) to 2.7 to 3.2 mm long, (1.5) to 1.9 to 2.1 mm wide, 7 to (9) veins. Palea I is not present. Caryopsis 2.5 mm long. Awns hardy, yellowish and bare; awn of Gluma I (2.7) to 4.2 to 8 to (13) mm long, of Gluma II 0.2 to 1.2 to (1.7) mm long. Lower lemmahas a short awn (0.4 to 0.6 mm long) or is blunt.

Distribution: Tropical regions of the New and Old World.

Selected Voucher Specimens: Columbia: Dep. del Valle, Alto del Dinde (Cuatrecasas 22940; US); Highland of Popayan (Lehmann 454; L). – Ecuador: Prov. Chimborazo, Huigra (Camp 3176; US); Prov. Guayas, Guayaquil (E. Asplund 16646; G). - Mexico: Jalisco, Mazamitla (US); Jalisco, Zapotlan (Hitchcock 7237; US); Michoacan, Cerro de Carboneras (King & Soderstrom 4837; US); Michoacan, Morelia (Arsene 3115; US); ,Oaxaca, Sierra de San Felipe (C. G. Pringle 4944; M); Rincon del Carmen, Temascaltepec (Hinton 1952; W); Veracruz, Banderilla (Soderstrom 471; US). - Peru: Dep. Piura, Huancabamba (Ferreyra 10876; US). - Socotra I.: Wadi Dilab (G. Schweinfurth 587; P). - Australia: Queensland, Cairns (Helms 1158; US); Queensland, Port Mackay (A. Dietrich 92; B). - India: Bengal, near Calcutta (W. Helfer s. n.; LD). -Indonesia: Kl. Sunda I., Wetar, Klisana (S. Bloemberger 3834; PNH).

Fig. 24: Distribution of *O. compositus* var. *rariflorus*.

Ecology: In moist, shady areas - coppices and along rivers or streams.

Sociology:Under Pterocarpus (Sunda I.), Pinus, Quercus (Mexico). With Tristania sp. and Imperata cylindrica.

Notes:

Here also there are especially hairy forms: 1. Inflorescence and inflorescence branches are thick and long-haired: Ceylon: Reynard s. n.; B; India: Waitz s. n.; L; Maligodam: Rebu s. n.; G; Malaysia: Kampong: Sinclair 39114; E; Philippines, Luzon: Merrill 738; B; Samoa, Upolu: Whistler 1909; B. – 2. Spikelets are thick and long-haired, inflorescence are short-haired: Philippines, Luzon: Ramos 200/00; K. – 3. Spikelets, inflorescence branches, blades, and sheaths are thick-haired: Australia, Queensland, Middle Percy I.: Lazarides 5617.

8.3. **var. *sylvaticus*** (Lam.) U. Scholz nov. stat.

> *Panicum sylvaticum* Lam. Encycl. IV: 743 (1798). – *Oplismenus sylvaticus* (Lam.) Roem. & Schult., Syst. Veg. II: 481 (1817). – *Orthopogon sylvaticus* (Lam.) Miq., Fl. Ind. Bat. III: 443 (1857, t. p. 1855). – Type: "Ile de France", Commerson s. n., L. Holotype.
>
> *Andropogon undatus* Jacq., Coll. III: 237 (1791, t. p. 1789). – Polinia undata (Jacq.) Spreng., Plant. min. cogn. Pugillus II: 12 (1815). – *Oplismenus* jacquini Kunth, Rev. Gram. I: 44 (1829), nom. Illeg. – *Panicum* undatum (Jacq.) Steud., Nomencl. 2. ed. II: 264 (1841). – Type: Mauritius, n. v.
>
> *Orthopogon pratensis* Spreng., Syst. Veg. I: 306 (1824, t. p. 1825). – *Oplismenus* pratensis (Spreng.) Schult., Mant. II 597 (1824). – *Panicum* pratense (Spreng.) Steud., Nomencl. 2. ed. II: 261 (1841). – Type: Mauritius: St. Vincent 43, B-WILLD, Lectotype.

Mostly robust grass; Culm 25 to 50 cm high. Blades elongated egg-shaped to oblong lanceolate, 0.5 to 1.2 cm wide, 4 to 8 cm long. Sheath sometimes short-haired on the edges, otherwise bare. Ligule have a hairy collar, 0.7 to 1.1 mm long. Inflorescence compact, racemose; rachis approx. 10cm long, bare. Inflorescence branches angle out, but remain straight.The lengths of the inflorescence branches get smaller higher up. The bottommost is 2.5 to 3 cm long and has 10 to 20 thick consecutive spikelets. Spikelets in pairs, 2.4 to 4.1 mm long. Awns robust, redish, hairless. Lower lemmahave no awn or are only short and pointed.

Distribution: Mauritius

Selected Voucher specimens:

Mauritius: (E. B. Blackburn s. n.; CGE; Bojer s. n.; M; sieber 13; M; Sieber 205; G).

9. ***Oplismenus hirtellus*** (L.) P. Beauv., Ess. Agrost.: 54 (1812); Adams, C. D., Flow. Plants of Jamaica: 185 (1972); Angely, J., Fl. Anal. e Fintogam. do est. de S. Paulo 6: 1191 (1970); Clayton, W. D. in Hepper, F. N. (ed.), Flora of West Tropical Africa ed. 2, 3, 2: 437 (1972); Hitchcock, A. S., Contr. U. S. Natl. Hebr. 22, 3: 129 (1920); Robyns, W., Fl. Agrost. Congo Belge & Ruanda-Urundi 2: 147, p.p. (1934); Schnell, R., Ic. Plant. Afr. 2: 47 (1953); Stapf, *O.* in Prain, D., Fl. Trop. Afr. 9: 631 (1934).

Keys to the Subtypes:

1. Inflorescence branches missing or very short (0.3 cm); Spikelets in pairs on the culm or clustered on the inflorescence branches..... 3
1. Inflorescence branches 0.5 to 3 cm long; Spikelets in pairs, clustered, consecutive thick multi-rowed, or in consecutive pairs..... 2
2. Inflorescence branches 0.5 to 0.7 cm long; Spikelets in a clustered arragement, 3 to 3.4 to (4.5) mm.
..... subsp. *fasciculatus*
2. Inflorescence branches 1 to 3cm long; Spikelets arranged thickly consecutive, 3.3 to 3.6 to (5) mm long
. ..... subsp. *hirtellus*
3. Inflorescence branches absent..... 4
3. Inflorescence branches very short; Spikelets in a clustered arrangement..... 7
4. Plant delicate; Blades up to 2 cm long, lanceolate; Spikelets 2.7 to 3.1 mm long.
..... subsp. *microphyllus*
4. Plants delicate to robust; blades 3 to 7 cm long; Spikelets 3.7 to 5.6 mm long; Ligule for the most part hairless 5
5. Plants delicate; spikelets 4 mm long, hairy; blades 3 to 4 cm long; East Asia..... subsp. *psilostachys*
5. Plants delicate to robust; spikelets 3.7 to 5.6 mm long; blades 3 to 7 cm long; 6
6. Plants robust; Spikelets in the upper part of the inflorescence in pairs, on the lower part up to seven, sparsely haired or hairless. ..... subsp. *acuminatus*
6. Plants delicate to robust; Spikelets always in pairs, always hairless; Ligule glabrous.. subsp. *capensis*
7. Blades lanceolate; spikelets 2 to 5 on the lowest inflorescence branch (?secondary) 8
7. Blades elongated ovals to oblong lanceolate; spikelets on the lowest inflorescence branch (?secondary), in clustered arrangement..... 9
8. Blades 2 to 5 cm long; spikelets sparsely hairy..... subsp. *imbecillis* f. *imbecillis*
8. Blades 4 to 9 cm long; spikelets shortly but densely hairy. ..... subsp. *imbecillis* f. *lanceolatus*
9. Sheaths and culm long, thick haired; lower glumes 3-nerved, upper glumes 5-nerved, lower lemmas 7-nerved; spikelets 3 to 7 on the lowest inflorescence branch (?secondary); blades elongated ovals. ..... subsp. *undulatifolius*
9. Sheath and culm bare or rarely haired; Lower glume (3)- to 5-nerved, lower glume (5)- to 7-nerved, lower lemma 9- to 11-nerved; 4 to 25 spikelets on the lowest inflorescence branch (?secondary) 10

10. Spikelets (2.2) to 2.7 to (3.3) mm long, blades oblong; Plant delicate. ..... subsp. *setarius*
10. Spikelets (2.8) to 3.2 to 3.7 to (4.1) mm long, blades for the most part elongated ovals..... 11
11. Spacing between the inflorescence branches 0.2 cm, seldom more, spacing does not increase on lower parts; Inflorescence compact. ..... subsp. *tsushimensis*
11. Spacing of the lowest inflorescence branches 1 to 3 cm, going upward spacing decreases; Inflorescence loose. .....subsp. *japonicus*

9.1. **subsp. *hirtellus***

Panicum hirtellum L., Syst. 10. ed.: 870 (1759). – *Orthopogon hirtellus* (L.) R. Br., Prod. Fl. Nov. Holl.: 194 (1810). – Typus LINN, fr. microfiche.

Panicum loliaceum Lam., Tabl. encycl. meth. I: 170 (1791). – *Oplismenus* foliaceus (Lam.) P. Beauv., Ess. Agrost.: 54 (1812), sphalm. *Oplismenus loliaceus* (Lam.) P. Beauv., Ess. Agrost.: 168, 170 (1812); Ettinghausen, E., Beitrag zur Kenntnis der Nervatur der Gramineae: 413 (1866). – *Orthopogon loliaceus* (Lam.) Spreng., Syst. Veg. I: 306 (1824, t. p. 1825). – *Panicum* foliaceum (Lam.) Steud., Nomencl. 2. ed. II: 256 (1841), pro syn. Hippagrostis loliacea (Lam.) *O.* Kuntze, Rev. Gen.: 777 (1891). *Oplismenus compositus* (l.) P. Beauv. var. *loliaceus* (Lam.), Hack. in Stuckert, Anales Mus. Nac. Hist. Nat. Buenos Aires, ser. 3,6: 438 (1906). - *Oplismenus hirtellus* (L.) P. Beauv. subsp. *loliaceus* Mez ex Peter, Feddes Repert. Spec. Nov. Regni Veg., Beih. 40,1 A: 219 (1938). - *Oplismenus hirtellus* (l.) P. Beauv. f. foliaceus Stehle, Carribean Forest., Suppl. 6: 283 (1945), cit. err. (v. Chase & Niles (1962) - "not verified"). - Type: Philippines: Commerson s. n.; n. v. (P?).

Panicum velutinum G. F. N. Meyer, Prim. Fl. Essequ. 51 (1818). - *Orthopogon* velutinus (G. F. N. Meyer) Spreng., Syst. Veg. I: 306 (1824, t. p. 1825). - Opl ismenus velutinus (G. F. N. Meyer) Schult., Mant . II: 271 (1824). - Type: Essequibo (Suriname: "Sophienburg": G. F. N. Meyer (LE?), n. v.

Panicum oahuaense Steud., Nomencl. 2. ed. II: 260 (1841), nom. nud. - *Oplismenus* oahuaensis Nees & Meyen ex Steud., Nomencl. 2. ed. II: 220 (1841), pro syn. - Type: Sandwich I.: Meyen s. n., BR, Lectotype.

Oplismenus chondrosioides E. Fourn., Mex. Pl. 2: 39 (1886). - Type: Mexico: Liebmann 367, C, Lectotype; Bourgeau 1668, Schaffner 281 b, n. v., Syntypes.

Oplismenus compositus Bauer, Ill. Fl. Nov. Holl: t. 135 (1813), non *Panicum* compositum L. - Beleg: Norfolk I.: Bauer s. n., W. Milium *undulatifolium* Moench, Meth. Pl. 202 (1974), non *Panicum undulatifolium* Ard. – Beleg: cult. Hort. Marburg, n.v.

Ic.: Fröman, B. & Persson, S., An ill. Guide to the Grasses of Ethiopia: 360, f. 220 (1974). - Hitchcock, A. S., Contr. U. S. Natl. Herb. 22,3: 130 f. 23 (1920).

Perennials, mainly robust plants; Culm 28 to 70 to (95) cm high. Blades oblong lanceolate but sometimes elongated ovals, (0.5) to 0.9 to 1.8 to (2.5) cm wide, (2) to 5 to 12 to (17) cm long. The midrib is prominently over the base, there are 3 to 5 side nerves on each side, and 5 to 7 intermediate nerves. Sheath is around the edges thick, long and loose, or short haired, in the middle sometimes long and loose, but usually hairless. Ligule usually have a hairy collar, (0.4) to 1 to 2 to (2.5) mm long. Inflorescence compact, racemose, (5) to 7 to to 18 to (20) cm long, seldom very hairy, usually short. Inflorescence branches 3 to 10, stand straight up or deviate to the side a small amount. The lengths of the inflorescence branches get smaller, the higher up one goes. The bottommost is (0.5) to 1 to 3 to (3.5) cm long and has secundly (8) to 15 to 20 to (30) spikelets that are thickly arranged in a consecutive fashion. The spacing between the two bottom most inflorescence branches is (1) to 2 to 4 to (5). Spikelets are in pairs, oblong lanceolate, (2.6) to 3.6 to (5) mm long, loosely haired or hairless. Lower glume oblong, (1.6) to 2.9 to (5) mm long, (0.9) to 1.3 to (1.5) mm wide, (3) to 5 to 7-nerved, with awn. Upper glume oblong, (1.5) to 2.5 to (3.7) mm long, (1.1) to 1.6 to (2.1) mm wide, (5) to 7 to (9)-nerved, with awn. Lower lemmaoblong, (2.5) to 3.3 to (4.3) mm long, (1.5) to 2.1 to (2.8) mm wide, (7) to 9 to (11)-nerved, with awn. Palea l slender, 2-nerved, or missing. Caryopsis oblong lanceolate, 2 to 2.5 mm long. Awns robust, redish-yellow and hairless. When the fruit become the ripe, the awns become adhesive or sticky. The lengths of the awns are as follows: (7.8) mm long, and Lower lemma(0.2) to 0.4 to 1.3 to (4.3) mm long.

Distibution: Tropical regions of the Old and New World

Fig. 25: O. hirtellus subsp. hirtellus (Irwin et al. 55750, B; Surinam).

Selected voucher specimens: **Argentina**: Tucuman (Roth s. n.; NY); Dep. Trafi (M. Sillo 3356; G). - Bolivia: North Yungas (O. Buchtien 778; G); Lake Rogagua (White 1203; NY). - **Brazil**: Baixo Amazonas (Goeldi 104; NY); Braco Joaquim, Mata (Reitz & Klein 3.163; M); 5 km above Labrea (G. T. Prance s. n.; M); Obidos, Prov. Parà (R. Spruce s. n.; OXF); Serra do Caparao (Chase 814; NY); Torres (B. Rambo 45997; B). – **British Honduras**: Toledo Distr., Cero (P. H. Gentle 6967; G); El Dorado Road (P. H. Gentle 6983; G); Manga Camp (P. H. Gentle 6519; G). - Chile: (Poeppig 2007; G). - **Colombia**: Santa Marta (H. Smith 2168; G); Dep. Santander, Tona (Killip & Smith 19471; NY). - **Cuba**: East (C. Wright 751; G), (Poeppig s. n. W). - **Dominican Republic**: (M. Poiteau s. n.; G); Prov. La Vega (H. C. Allard 14203; B). - Ecuador: Guayaquil (Hartweg 705; G); Prov. Pichincha, W from Quito (E. Asplund s. n.; G); Quito (W. Jameson 166; G). - **Guadeloupe**: (Krauss s. n.; G). – **French Guiana:** (Leprieur s.

n.; G). – **Hawaii I**.: Oahu, Sacred Falls (O. Degener s. n.; B); Hawai (W. Hillebrand s. n.; B); Maui (G. Spence 138; L). - **Martinique**: (Sieber 263; PR). Mexico: Cuernavaca (C. G. Pringle 6203; G); State of Morelos (A. S. Hitchcock 423; G); Veracruz (L. Williams 8609; PR). - Nicaragua: Dep. Matagalpa (L. *O.* Williams et al. 24936; G). - **Panama**: R. Chagres (P. N. Allen 4114; G); Paraiso (M. Wagner s. n.; M). - **Peru**: Dep. Loreto, Tarapoto (PR). - Puerto Rico: Maricao (P. Sintenis 72; G). - **Paraguay:** Cordillera de Altos (K. Fiebrig 366; G). - **Trinidad**: (Sieber s. n.; G). – **Venezuela**: Valle die Aragna (W); Tabay (W. Gehringer 544; G); E from Merida (B. & F. Oberwinkler 13426; M).

New Guinea: W Sepik Distr., M. Amdutakin (C. Kalkman 5308; L).

Ethiopia: Afresa (A. Vatova 693; FI); 5 km from Asbe-Tefferi (16; FI); Amasen, Faghenat (A. Pappi 5326; G); Godjam, Bahar Dar. (O. Sebald 452; B); Mega (R. Corradi 1252; FI); Valle di Mugar Bolè (H. Sonford 42; FI); 9 km N from Jimma (Mooney 6036; FI). - Burundi: (J. Lewalle 4588; G). - **Ivory Coast**: (G. Roberty 12610; Z); 11 km E from Akribelekrou (G. Roberty 12740; G); Bouroukrou (A. Chevalier 16972; K); Kokondekro (Adjanohoun 322 A; K); 15 km E from Béréby (Oldeman 564; BR); Thiébissou (Leeuwenberg 2091; BR); Touba (8215; K). **Gabon**: Sibange Farm (M. Dinklage 551; HBG). - **Ghana**: Kumasi (G. Roberty 12890; G). - **Cameroon**: (Büsgen s. n.; B); Bipinde (G. Zenker 1214; Z); Buea (F. W. H. Migeod 24; K); Dehane (M. Dinklage 409; HBG); Cameroon M. (Dunlap 66; K); between Makay and Nemeyong (R. Letouzey 11790; P); Esele (T. D. Maitland 1037; K); Mbalmayo (H. Jacques-Félix 9137; P); 40 km S from Ndikinimeki (R. Letouzey s. n.; BR); Victoria (Preuss 1305; K). **Kenya**: Mara Masai Res. (Bally 5374; G). - **Liberia**: Boporo Distr. (I. T. Baldwin 10368; K); 20 m from Kakatown (A. White s. n.; K); Nimba (J. G. Adam 20242; K); So (D. H. Linder 1130; K). **Mozambique**: Manica e Sofala (Garcia 830; BM). - **Nigeria**: Prov. Benin (J. P. M. Brenan & P. W. Richards 8471; K); Calabar R. (D. R. Rosevear 25; K); lbadan, Gambari For. Res. (C. F. A. Onochie 34949; K); Kabba Road (A. C. Parsons 26; K); Lagos (J. M. Dalziel 1324; K); Mambilla Plat. (J.D. Chapman 2846; K). – **Republic of South Africa**: Cap Prov. Omcoma (Drege s. n.; P); Bokfontein (A. *O.* D. Mogg 14271; BR); Kentani (Pegler 2035; Z); Magoebaskloof (B. de Winter 95; B); Natal, Buchanan (Munro s. n.; W); Natal, Durban (A. Rehmann 8649; W); Pondoland (Bachmann 148; Z); Shilovane (Junod 2322; Z); Wilhelmina Gebergte (H. S. Irvine & al. 55750; B). **St. Thomas**: S. Vicente (J. Espirito Santo 92; BR); Santa Anna (A. Moller 142; K); Boa Estrada (A. Chevalier 14339; bis). – **Sierra Leone**: Magboloko (R. R. Glanville 99; BM); Lolehun (Katta 27; BR).- **Tanzania**: Irangi (B. D. Burtt 1572; BM); Kilimanjaro (Geillnger 3897; Z); Kokola, Ngurdoto Nat. Parc (Greenway & Kanuri 11.963; BR); Usambara (C. Holst 458; B). - **Togo**: Bassar (de Plaen 50; BR); Klouto (de Plaen 57; BR). - **Uganda**: Bukiga (J. D. Snowden 1213; BM). - People's Republic of Congo: Niari, near Mouyondzi (B. DesCoings 5607; P). - **Zaire**: Terr. Dibaya (L. Liben 2957; BM); Parc Nat. Albert (J. Lebrun 8114; B); Kisanga (E. Detilleux 567; BR); North Kivu, Virunga Mountain Range (U. Stauffer 409; Z); Marungu (Vanden Prande 282; BR); Nioka Res. (Taton 297; BR);

Parc Nat. de l'Upemba (de Witte 3556; BR); Walikale (R. Gutzwiller 2673; BR); Wamba (H. Gallens 4099; BR). – **Central African Republic**: Mbaiki (C. Tisserant 3459; P). - **Zimbabwe**: Distr. Inyanga (O. West 4842; BM).

Fig. 26: Areal of *O. hirtellus* subsp. *hirtellus*.

Common Names: Luhunda (Bahundi language, Zaire); Matunda-Muindu, Muinza (Nord du Mayombe, Zaire); Tudama-dama (Region de Kisantu, Zaire); Lakasi (South Zaire). Tamakoesji (Kar., South America); Herbe à barbes (Martinique).

Ecology: In shady forests and in forests along rivers or streams.

Sociology: Under Aleurites, Tectona, Cola nitida, Albizzaiz; in the Raphia palm grove

Economic Meaning: Weed in forest plantations

Chromosomes:

2n = 54 : Kammacher et al. (1973); Tateoka (1965).

2n = 43, 57, 60 (63) : fide Kammacher et al. (1973).

2n = 72: Kammacher et al. (1973); Reeder (1967); Tateoka (1965).

2n = 90: Pohl & Davidse (1971).

Notes:

The are multiple heavily haired forms: 1. Culm, blades, sheaths, and infloresence shafts thick and long-haired: British Honduras, El Cayo Distr.: Gentle 9036; G; Cuba, Bayata: Ekman 3310;

G. – 2. Infloresence shafts thick and long-haired: Peru, Pampayacu: Macbride 5026; G; Tonga I., Kao: Yuncker 15,876; G.

9.2. **subsp. *acuminatus*** (Nees ex Steud.) U. Scholz nov. stat.

> *Panicum acuminatissimum* Steud., Syn. Pl. Glum. I: 45 (1854). - *Oplismenus acuminatus* Nees ex Steud., Syn. Pl. Glum. I: 45 (1854), pro syn. –
>
> *Panicum* balfourii Baker, Fl. Mauritius: 438 (1877), nom. superfl. - *Oplismenus hirtellus* (L.) P. Beauv. var. *acuminatus* (Nees ex Steud.) Mez ex Peter, Feddes Repert. Spec. Nov., Beih. 40,1 A: 220 (1938). - Type: India: Wight s. n., W, Holotype.
>
> *Panicum* (*Oplismenus*) barbifultum Hochst. ex Schlecht., Linnaea 31: 307 (l861-62). - Type: India, M. Nilagiri, Hohenacker 1279; HBG, Isotype.

Perennial plant, Culm 30 to 50 cm high, hairless. Blades oblong lanceolate, (0.3) to 0.5 to 1 to (1.7) cm wide, 3 to 8 to (12) cm long. Sheath on the edges thick or loose or short and thickly haired, in the middle very rarely long and loosely haired. Ligule often with a hairy collar, 0.4 to 1.1 to (1.5) mm long. Infloresence simply racemose; Main shaft 5 to 10 to (14) cm long, bare. Inflorescence branches are not present, or very seldom under but never over 0.5 cm long. Spikelets stand in pairs, directly on the the main shaft, or up to 7 on short inflorescence branches; spikelet pairs are separated from one another. Spikelets (3.6) to 4.3 to (5.5) mm long, usually hairless. Lower glume lanceolate, (2.4) to 3.4 to (4.1) mm long, (1) to 1.5 to (1.9) mm wide, 5-nerved, with awn. Upper glume lanceolate, (2.4) to 3.2 to (4.5) mm long, (1.4) to 1.8 to (2.1) mm wide, 5- to 7-nerved, with awn. Lower lemmaelongated, (3.8) to 4.3 to (5.2) mm long, (1.9) to 2.1 to (2.4) mm wide. 7- to 9-nerved, with awn. Awns robust, redish and bare, becomes sticky when ripe; awn from the: Lower glume 4 to 13 mm long, Upper glume 2.6 to 3.2 mm long, and lower lemma0.4 to 1.1 to (1.9) mm long.

Distribution: India, Madagascar.

Selected Voucher specimens:

Madagascar: Ambatowang (L.)

India: (Griffith s. n.; L;); (Wight 1653; CGE); Himalaya (J. J. s. n.; G); Kaity (R. F. Hohenacker 1279; HBG); M. Khasia (J. D. Hooker & J. J. s. n.; G). Nepal: (Wallich s. n.; LD).

Notes:

There is also a different form that has the following characteristics: blades lineal, bottommost side shaft 2.2 cm long, with 8 spikelets that are arranged in a consecutive order: Bourbon: 150; LD.

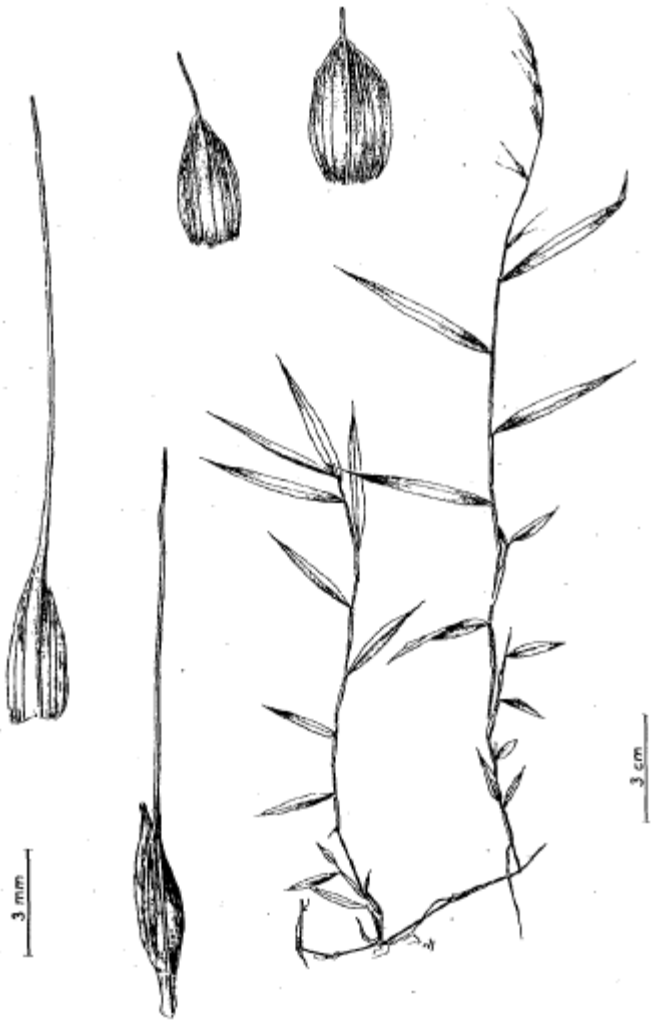


Fig. 27: O. hirtellus subsp. capensis (Amshoff 4750, B; Liberia).

9.3. **subsp. *capensis*** (Hochst.) Mez ex U. Scholz, nov. stat.

Oplismenus (*Orthopogon*) *capensis* Hochst., Flora, Neue Reihe 4. Jahrg. 1,7: 114 (1846). – *Panicum* kraussii - Steud., Syn. Pl. Glum. I: 45 (1854). - *Oplismenus* africanus P. Beauv. var. *capensis* (Hochst.) Stapf in Thiselton-Dyer, Fl. Cap. 7: 417 (1899). - Type: South Africa "ad rivulos in sylvis Knysna“, Krauss s. n., W., Lectotype, M., Isotype.

Oplismenus simplex K. Schum. ex Engler, Sitzungsber. Königl. Preuss. Akad. Wiss., Phys.-Math. Kl. 1: 48 (1894), nom. nud. - *Oplismenus* africanus P. Beauv. var. simplex (K. Schum. ex Engler) Stapf in Thiselton-Dyer, Fl. Cap. 7: 417 (1899). - Type: Siouth Africa: Dohne Mountain, in a wooded Kloot: Galpin 2449, (PRE?), n. v.

Oplismenus bromaoides Baker, J. Linn. Soc. Bot. 21: 452 (1885), non ‘*Panicum* bromoides Lam.’ – *Oplismenus* bakeri Schinz in Dur. & Schinz, Consp. Fl. Afr. V: 771 (1985). – Type: Madagascar: Baron 3213, (K?), n. v.

Oplismenus hirtellus Chippindall, Grasses and Past. of S. Afr.: 362, p.p. (1955), non *Panicum hirtellum* L.

Mainly a delicate plant; Culm (15) to 25 to 35 to (50) cm high. Blades oblong lanceolate to lanceolate, rarely elongated egg-shaped, (0.2) to 0.4 to 0.8 to (1.6) cm wide, (2) to 3 to 7 to (11) cm long. Sheath along the edges thick or loose and long-haired, in the middle rarely loose and long haired. Ligule with a hairy collar, (0.3) to 0.5 to 1 to (1.8) mm long. Inflorescence simply racemose; rachis (2) to 5 to 8 to (13) cm long, bare. Inflorescence branches not present. Spikelets arranged in pairs, directly on the rachis, very rarely up to 4 spikelets together; spikelet pairs are separated from one another, the undermost 1 to 3 to (4) cm. Spikelets (3.7) to 4.5 to (5.6) mm long, lanceolate, always hairless. Lower glume lanceolate, (2.2) to 3.3 to (4.2) mm long, (1.2) to 1.6 to 1.9 mm wide, 5- to (7-) nerved, with awn. Upper glume lanceolate, (2.6) to

3.4 to (4.5) mm long, (1.3) to 1.9 to to (2.9) mm wide, (5-) to 7- to (9-) nerved, with awn. Lower lemmaoblong, (3.3) to 4 to (5.3) mm long, (1.6) to 2.2 to (2.6) mm wide, (5-) to (7-) to 9- to (11-) nerved, with awn.

Pelea I usually missing. Awn robust, redish and bare, becomes sticky when ripe; awn: from Lower glume (5) to 8 to 10 (15) mm long, Upper glume (1) to 1.5 to 2.2 to (5) mm long, and lower lemma0.4 to 0.7 to (2) mm long.

Distribution: Tropical and southern Africa.

Selected Voucher specimens:

Cameroon: Cameroon M. (Johnston s. n.; K). - Kenya: M. Abendare (L. Saroglia 223; FI); Kwale Distr. (R. B. Drummond & J. H. Hemsley 3924; FI). - Liberia: Nimba M. (I.G. Adam 20078; K). - Madagascar: Massif de l'Ankaratra (R. Devary et al. 4567; B); South Betsilo (J. M. Hildebrandt 4003; G); Vallée de la Manambola (H. Humbert 13211; G). - Malawi: Nyassa Hochl., Kyimila (A. Stolz 1181; B); near Lake Kaulime (P. J. Tyrer 954; BR) ; Rumpi Distr., Mwenembe (Chapman 109; BM). - Nigeria: Obuden Plat. (Tuley; K). - Zambia: Nyika Plat. (F . White 2715; BR). – S. Tomé: Vanhulst (A. W. Exell 235; BM). - S. Africa: (Burchell 3159; P); Div. Albany, Grahamstown (F. A. Rogers 27566; Z); Boschberg (MacOwan 1508; Z); Cape of Good Hope, near George (R . Schlechter 2222; FR); Natal, Drakensberg Range (H. Humbert 14886; P); Dlinza For., Eshowe (J. H. Ross 1998; M); Kranskop (R. G. Strey 4813; M); Qudeni For. (Fischer & Schweickerd 116; BR); Swaziland, Pigg's Peak (R. H. Compton 27826; M); Transvaal, Houtbosh (A. Rehmann 5736; .Z); Transvaal, Shilovane (A. Junod 1227; G); Westfalia Estate (J. J. Bos 1139; M); Zoutpansberga. (W. Rauh 3074; M.). - Tanzania: Iringa Distr. Dabage (R. Polhill & S. Paulo 1455; B); Mufindi (S. A. Renvoize & R. A. Abdallah 1929; BR); Bez. Morogoro, Uluguru-Geb. (H. J. Schlieben 3622; BR); Njombe Distr., Mapala (E. Milne-Redhead & P. Taylor 10794; B). - Uganda: West Prov., Bwamba (R. Ross 1097; BM). - Zaire: Elisabethville (H. Humbert. & P. Quarré 16840; P); Parc. Nat. Albert (J. Lebrun 8620; Fl). - Zimbabwe: M'Besa (H. B. Gilliland 1731; 8M); Distr. Melsetter (S. K. Simon & J. F. Ngoni 1340; BM); Vumba M. (R. B. Drummond 5078; BM); Distr. Wedza (H. Wild 6359; BM).

Fig. 28: Area of *O. hirtellus* subsp. *capensis*.

Ecology: In shady and partly shady rainforests and gallery forests.

Sociology: Under Cupressus.

Anthesis: January to December, usually March to July.

Notes: There is a known form from Madagascar that differs somewhat: Spikelets 5.3 mm long, bare, Lower glume pointed end notched in, bottommost side shaft 1 cm long with 8 spikelets, arranged consecutively. Madagascar: Bojer s. n. – This specimen is known as "*Oplismenus* rigidus Boj., ad prior. Trin." A literary description is not known of to the author.

9.4. **subsp. *fasciculatus*** U. Scholz nov. subsp. – Type: Zaire, Ituri, Semliki à l'Est de Beni: H. Humbert 8993, B, Holotype.

> *Oplismenus africanus* P. Beauv., Fl. d'Oware et de Benin 2: 14 (1810, t. p. 1807). – *Panicum* africanum Poir., Encycl. Suppl. IV: 275 (1816). - *Orthopogon* africanus Sweet, Hort. Brit. ed.1: 448 (1827). - Type: Oware et Benin: P. Beauv. s. n., G, lectotype.
>
> *Oplismenus* brasiliensis Raddi, Agrost. Bras.: 40 (1823). - *Panicum* raddianum Steud., Syn. Pl. Glum. I: 45 (1854) - Type: Brazil, CorCovado: Raddi s. n., Fl, Holotype.
>
> *Oplismenus* depauperatus E. Fourn., Mex. Pl. 2: 38 (1886). - Type: Mexico: F. MüIler 2019, NY, Lectotype, Schaffner 207, Galeotti 5847, Syntypi (BR?), n. v.
>
> *Oplismenus* aristulatus Burcham, Contr. U. S. Hatl. Herb. 30: 419 (1948). -Type: New Britain: Burcham 138, US, Holotype.
>
> *Panicum hirtellum* Lam. non L., Tabl. encycl. méth. I: 170 (1791). - *Oplismenus hirtellus* Roem. & Schult., non L. Syst. Veg. II: 481 (1817); Chippendall, L. K. A., Grasses and Pastures of S. Africa: 362, p.p. (1955); Robyns, W., Fl. Agrost. du Congo Belge et du Ruanda-Urundi 2: 147 (1934).
>
> *Hippagrostis hirtella O.* Kuntze non L., Rev. Gen.: 777 (1891).

Ic.: Jacqes-Félix, L., Les Gram. d'Afrique trop. 1: 244, f. 172 (1962). - Koechlin, J., Flore du Gabon 5: 59 (1963). - Robyns, W. F. Agrost. du'Congo Belge et du Ruanda-Urundi 2: 149, f. 33 (1934).

Diagnosis

Lamina foliorum lanceolata vel ovata-l anceolata, 3 - 10 cm longa; inflorescentia 6 - 12 cm longa, racemi erecti, 3 - 8, prope apicem inflorescentiae reducti, basim 0,5 - (1,5) cm longi; 7 - 15 spiculae racemis basalibus in fasciculatis aggregatae.

Perennial, usually robust grass; Culm (20) to 30 to 50 to (100) cm high, hairy or bare. Blades usually oblong lanceolate, sometimes elongated oval, occasionally loosely short-haired, (0.4) to 0.5 to 1.5 to (1.9) cm wide, (2) to 3 to 10 to (12) cm long, midrib more noticeable, side nerves 2 to 4 on both sides, often with cross nerves. Sheath around the edges loose or thick haired, in the middle seldom loosely long haired. Ligule usually with hairy collar, (0.3) to 0.5 to 1.8 mm long. Infloresence grouped together, racemose, rachis (4) to 6 to 12 to (15) cm long, very seldom loose haired. Inflorescence branches 3 to 8, standing straight up, but distanced from one another; the length of the inflorescence branches gets shorter, the higher up one goes, the bottomost is usually no longer than 0.5 (seldom up to 1.5) cm and has (5) to 7 to 15 to (25) spikelets, clustered in a spherical manner to an oblong clustered arrangement. The spacing of the two bottommost inflorescence branches is 1 to 3 to (4) cm. Spikelets are arranged in pairs, however, sometimes indistinct because they are arranged in such a thickly clustered fashion. Spikelets oblong lanceolate, (3) to 3.4 to (4.5) mm long, usually the 3 bottommost glumes are haired. Lower glume oblong, (1.3) to 2.5 to (4.5) mm long, (0.7) to 1.3 to (1.8) mm wide, (3-) to 5- to (7-) nerved, with awn. Upper glume oblong (1.6) to 2.6 to (3.5) mm long, (0.8) to 1.5 to (2.1) mm wide, (5-) to 7-nerved, with awn. Lower lemmaelongated oval, (2.4) to 2.9 to (4.5) mm long, (1.5) to 2 to (2.6) mm wide, (5-) to (7-) to 9-nerved, with awn. Pelea I 2-nerved, occasionally not present. Caryopsis elongated, plano-convex. Awn robust, redish gold, bare, becomes sticky when ripe; awn from the: Lower glume (4) to 5 to 10 to (12) mm long, Upper glume (1) to 1.5 to 2.6 to (4.8) mm long, and lemma 0.4 to 1.1 to (1.9) mm long.

Fig. 29: O. hirtellus subsp. fasciculatus (M. Reekmans 5069, B; Burundi).

Distribution: Tropical regions in the Old and New World.

Selected Voucher specimens:

Argentina: Colonia Benites, Chaco (N. Rojas Acosta 17677; G); A. G. Schulz 7361; G}; Dep. El Dorado, San Pedro (A. Schinini & A. Fernandez 5924; ZT); Corrientes, Dep. General Plaz (T. S. Ibarrola 3735; B); Dep. Mburucuyá, Prov. Corrlentes (T. M. Petersen 2677; G); Guayculec, Zormosa (Jörgensen 3098; B). - Bolivia: La Paz valley (C. Troll 1586; M); Mapiri Reg. near Saramipiuni (O. Buchtien 1; M); Prov. Sara, Dep. Santa Cruz (J; Steinbach 5681; G). - Brazil: Rio das Cortas, Prov. Bahia (Martin 19; M); Santa Catarina (Reitz &, Klein 3106; G); Igarapé, Parimé (P. v. Luetzelburg 21495; M); Minas Gereas Serra do Angico (Y. Mexia 5642; G); Corcovada, Staat Rio (P. v. Luetzelburg 6043; M). – British Guiana: Basin of Rupununi R. (A. C. Smith 2368; G); Georgetown (A. S. Hitchcock 16597; G); El Cayo Distr. (P. H. Gentle 8647; G); Toledo Distr., San Antonio (P. H. Gentle 7551; G); Stann Creek Distr. (P. H. Gentle 8159; G): - Cubà: Vento, Prov. Havana (A. H. Curtiss 593;93; M); Prov. Pimar del Rio (E. L. Ekman 12829; G); Prov. Santa Clara, Colonia Limones Prov. (C. G. Pringle 76; M). - Dominican Republic: Provo. Barahona, Lutto bei Rincôn (M. Fuertes 1282; M). - Ecuador: Guayaquil (Jameson 896; G); Prov. Los Rios, R. Plata (E. Asplund 5316; G). - Grenada: Georges (W. E. Broadway s. n.; PR). - Guatemala: Dep. Peten, Tikal (E. Contreras 418; G). - Haiti: Massif de la Hotte (E. L. Ekman 1149; G). – Hawaii I.: Oahu, Nuuanu Park (A. S. Hitchcock 14057; G); Oahu, M. Tantalus (L. D. Whitney 3897; M). Honduras: Dep. Santa Barbara (C. Thieme 5581; M). Jamaica: St. Andrew (C. D. Adams 8335; FR). - Martinique: (Sieber s. n.; B). - Mexico: Fortin (E. Kerber 316; FR); R. Piedros (Hiaram S. n.; B); Tlapacoyan (C. Troll 199; M); Corodba, State Vera Cruz (A. S. Hitchcock 422; G). - Nicaragua: Dep. Matagalpa (L. *O.* Williams et al. 23893; G). - Panama: Gatun Lake, Canal Zone (A. S. Hitchcock s. n.; G). - Paraguay: Sierra de Amambay (E. Hassler 11992 b; G). - Peru: La Divisora, Huánco (E.

Asplund 12591; B); R. Domingo (J. F. Macbride 4251; G). – Sandwich I.:(M. Gaudichaud s. n.; L). – Surinam: Augustus Falls (B. Maguire 24765; G). - Trinidad: (Z. H. Hart 3304 b; G); Port of Spain (A. S. Hitchcock 601; G). – U. S. A.: Louisiana (Engelmann s. n.; HBG).- Venezuela: Cerro Santa Ana (A. Steyermark & A. Braun 94617; B); Chivacóa (Vareschi & Pannier 2570; M). New Guinea: Bernhard Camp, Idenburg River (L. J. Brass 13719; A); Matafuna Bay (P. F. Stevens 50143; A); Monts Point, Willaumez Penn. (J. R. Croft et al. 41383; A); Morobe Distr., Finschhafen (J. & M. S. Clemens 484; BR).

Ethiopia: Eritrea, Rediti (Baldrati s. n.; FI); Kaffa Prov. Jimma (W. Burger 3634; FI); Mega (R. Corradi 1293; FI); Wolieso, Stoa Provo (H. F. Mooney 7611; Fl). - Angola: (J. Gossweiler 5737; BM); (Nolde 671; BM); Distr. Huilla (Welwitsch 2696; BM); R. Cuango (A. W. Exell & E. A. Mendonca 313; BR); Lunda (Gossweiler 13984; B); Ngongola (Wellen 509; BR). - Annobon: Pico del Centro (F. Melville 163; BM). - Burundi: Nyamagana (J. Lewalle 3422; BR); Bubanza (Reekmans 647; BR); Bururi (M. Reekmans 5069; B); Kanyinya (J. Lewalle 5553; G). – Cap Ver. I.: Sao Antao (A. Chevalier 45434; P) Cote d'Ivoire: Adiopodoumé (W. de Wilde 1114; K); 5 km N from Béréby (R. Oldeman 504; K); Kokondekro (352 A; K); Bassin du

Sassandra et Bassin du Haut Cavally (R. Port~res s. n.; BR); Singrobo (Adjanohoun 317 A; K); Touba (8214; K). – Fernando Po: Moka (A. S. Boughey 56; K); (Vogel 140; K). - Gabon: (M. Thollon 654; P); Eleki (N. Hallé & G. Cours. 6097; P); M. de . Cristal (N. Hallé & J. F. Villiers 4905; P); 10 km SW from Hdjole (N. Hallé 1825; P); Koltang, 30 km E from Libreville (M. G. Gilles 66; p); Mayombe (Le Testus. n.; P); Mouila - Ndèndé (Waltier 6; P). - Ghana: Ankagul (J. B. Hall 3064; P); Ashanti (F. R. Irvine 5080; K); Wacri Tafo (H. E. Box 23; B). - Guinea: (J. G. Adam s. n; P); Vallée du Baffing (H. Pobéguin 1737; P); Kindia (H. Jacques-Félix 2103; P); M. Nimba (R. Schnell 3717; P). - Cameroon: Batanga (M. Dinkl age s. n.; HBG); Eseka (P. Bambs 1317; BR); Douala (A. Meurillon 616; P); Johann-Albrechtshöhe (Staudt 450; G); Nanga (J. Koechlin 7117; P); Sadolkoulay (J. & A. Raynal 12235; B); 10 km S from Ngaoundéré (F. J. Breteler 590; G); 24 km ESE from Nyabesan (J. & A. Raynal 10227; P); Yaoundé Station (Zenker & Staudt 483; K). - Kenya: M. Aberdare (T. Fries 621; BR); M. Kenya (F. White 1355; BM); Nyanza Prov., Kericho Distr. (R. A. Maas Gesteranus 5798; B). - Liberia: West Prov., Boporo Distr. (J. T. Baldwin 12031; K); R. Coss (M. Dinklage 2313; B); Ganta (W. J. Harley 1706; K); Gbarnga (Daniel & Prior 458; P); Nimba (J. G. Adam 20386; K); Sanokwele Distr. (W. J. Harley 1054; K); Vonjama (J. T. Billdwin 9867; K). - Madagascar: N from Maroambihy (H. Humbert 23.368; G). - Malawi: Distr. Rumpi, Nyika Platt (Simon et al. s. n.; BM); Distr. Port Herald (Chapman 2094; BM). - Mocambique: Garuzo (H. B. Gilliland 1807; BM). - Nigeria: Jos Plat. (F. N. Hepper 1071; K); Lagos (O. Olufsen 818; K); Mambilla (M. Oche 75; K); Olokemeji For. Res. (A. Jones et al. 4935; Il); Sapoba (Keay & Onochie 21618; K); Usonigbe (Keay & Onochie 21597; K). - Principe : Terreiro Velho (A. W. Exell 503; BR). - Zambia: 12 km W from Kawabwa, Ntimbacushi Falls (E. A. Robinson 2350; M); Distr. Solwezi, Lunga R. (I. B. Edwards 545; 8M); Victoria Falls (B. K. Simon & R. Hill 2140; P); Banks of Zambesi (F. A. Rogers 207; 13M). – S. Tomé: Lago Amelia (Rose 221; Pl. - Senegal: Stat. Lauma (R. P. Berhaut 2779; 8R); Sikasso (M. Vuillet 506;P). – Sierra Leone: (T. S. Gardner 54; BM); Lester Peak (G. F. Scott Elliott 3854; BM); Njala (F. C. Deighton 1496; BM). - S. Africa: (J. Z. Drege 108; P); Natal, Clavimont (G. Medley Wood 6044; Z); Natal, Durban Prov. (J. Bolus 14648; B); Omcomas (Drege 433 b; Pl. - Tanzania: Korogwe Distr. (H. G. Faulkner 965; B); Mahenge (H. J. Schlieben 1996; G); Morogoro, UI uguru M: (H. J. Schlieben 3797; Z); Usambara (Peter 10027; W). - Taneriffa: (Ventenat s. n.; G). - Togo: Near Gapé (F. J. Breteler 7297; B); Sokodé (F. Schroder 159; K); Anié River by Soutouboua (H. Scholz 102; B); NW Palimé, Klouto (H. Scholz 131; B). - Uganda: (Dümmer 311; Z); Ankole (J. D. Snowden 1420; BM); Distr. Bugichu, Bulecheke (T. D. Maitland 1211; B); Masaka (J. D. Snowden s. n.; BM); Distr. Mengo (H. C. Hawkins 428; BM); Sonso R. (W. J. Eggeling 2287; BR). - People's Republic of Congo: Divenie (J. Koechlin 2204; p); 20 km from Sibiti in the direction of Komono (de Nere 1991; P); Brazzaville (A. Chevalier 27362; P). - Zaire: Bambili (Seret 248; BR); Reserve de Djugu (Smeyers 108; BR); Eala (Staner 1434; G); 8 km SE from d'Elisabethville (A. Schmitz 492; BR); Parc. Nat. Garamba (H. de Saeger 1441; BR); between Iwama and Isandja (C. Everard 2847; BR); Kalehe (Pierlot 2702; BR); 11 km de Lumumbashi (J. J. Symoens 12853; M); Kisantu (Vanderyst 299; B); Idjwi I. in the Lac Kivu (H. Humbert

8360; BR); Lukula (R. Devred 1793; BR); Sao Maluku (H. Breyne 2182; BR); Mwene Distr., Prov. Kasai (Dandoy 74; BR); Parc Nat. Albert (J. Lebrun 9862; BR); Yambata (H. Montchal 103; BR). - Central African Republic: (H. Breyne 1082; BR); Bambari (C. Tisserant 429; BM); Bonar (J. C. Bille 2201; P); Dauzat (J. C. Bille 1951; P); Terr. Mahagi (R. Christiaensen 1129; BR); Nola, Mambére R. (G. J. H. Amshoff 7055; BR); R. Kombala, Ouaka (P. P. Tisserant 2317; P). - Zimbabawe: Chirinda For. (A. A. Obermeyer 2169; BM); 40 km S from Marandellas (B. K. Simon et al. 1825; BM); Distr. Mazoe (M. Bingham 1424; BM).

Fig. 30: Areal of *O. hirtellus* subsp. *fasciculatus*.

Ecology: In shady rainforests, gallery forests, bog forests, secondary forests; in lighted places; in dry forests (Bolivia), Campos (Brazil). On gneiss, quartzite, and sand.

Sociology: Under Agramomum, Tectona, Parkia, Albizzia gummifera, Lantana, Tecla nobilis, Phoenix reclinata; with Conopharyngia holstii and Sapium sp.

Economic impact: Weed in coffee and cocoa bean farms.

Pests: *Cladochytrium replicatrum* J. S. Karling; *Tilletia vittata* (Berk.) Mundkur

Anthesis: January to December; usually March to May and October to December.

Notes:

There are also some known thick-haired forms as following. 1. Culm thick and long haired, blades thick and short haired, and sheaths loose-long haired: Burundi, Bururi: Lewalle 3501, G; Cameroon: Maitland 83, K; Zaire, Leopoldville: Bequaert7384; BR. – 2. Sheaths and

infloresence shafts thick and long haired: Bolivia, Tipuani: *O.* Buchtien 5331; G. – 3. Blades thick and long haired: Cameroon, Buea: Maitland 853; K ; Dohm 4147; K; Ecuador: Heinrichs 734; M. – 4. Culm, sheath, and infloresence shafts haired, inflorescence branches not present or up to 0.2 cm long, number of spikelets 2 to 6: Zaire: Sita 639; P. The form mentioned in 4. and also some plant specimens found in Togo are a in between form of the the european *O. hirtellus* subsp. *undulatifolius*.

9.5. **subsp. *imbecillis*** (R. Br.) U. Scholz nov. stat.

9.5.1. **f. *imbecillis***

Orthopogon imbecillis R. Br., Prod. Fl. Nov. Hall.: 194 (1810). - *Oplismenus imbecillis* (R. Br.) Roem. & Schult., Syst. Veg. II: 487 (1817). - *Panicum* imbecille (R. Br.) Trin., Sp. Gram. Ic. II: t. 191 (1828). – *Oplismenus compositus* (L.) P. Beauv. var. *imbecillis* (R. Br.) F. M. Bailey, Queensland Grasses: 19 (1888). - *Oplismenus setarius* (Lam.) Roem. & Schult. var. *imbecillis* (R. Br.) Benth. ex Hack. in Warb., Bot. Jb. Syst. 13: 259 (1891). – *Oplismenus undulatifolius* (Ard.) Roem. & Schult. var. *imbecillis* (R. Br.) Hack., Govt. Lab. Publ. 25: 82 (1905); Hayata, B., Fl. Mont. Form.: 235 (1908); Hsu, K.-S., Fl. Taiwan 5: 566 (1978); Merrill, E. D., Enum Phil. Flow. Pl. 1: 72 (1925). - Type: Australia: Brown 6133, K, Holotype, n. v.; LE, E, Isotype.

Oplismenus undulatifolius (Ard.) Roem. & Schult. var. lanceolatus Domin, Biblioth. Bot. 85: 329 (1915). - Type: Australia; N. *O.* Queensland: Domin s. n. (PR?), n. v.

Oplismenus undulatifolius (Ard.) Roem. & Schult. var. mollis Domin, Biblioth. Bot. 85: 329 (1915). - Type: Australia: South Queensland: Tambourine Mountains: Domin s. n.; N. S. Wales: Tweed River: Guilfoyle s. n.; Syntypi (PR?), n. v.

Fig. 31: *O. hirtellus* subsp. *imbecillis* (R. Brown 6133, LE; Australia; Type).

Delicate grass: Culm approx. 25 cm high. Blades lanceolate, (0.3) to 0.4 to 0.6 cm wide, 2 to 5 cm long, sparsely haired or hairless. Sheath around the edges short or long haired, bare in the middle. Ligule frayed or short haired in the upper edge, 0.3 to 0.8 mm long. Infloresence uncomplex, racemose, approx. 5 cm long. Rachis bare, inflorescence branches seldom present, the undermost being up to 0.3 cm long. Spikelets in clusters, (2) to 5 to (10) grouped together, oblong, the Lower glume and Upper glume sometimes moderately thickly haired, (2.7) to 3.1 to (3.6) mm long. Lower glume (1.5) to 2.1 to 2.7 mm long, (0.7) to 1 to (1.4) mm wide, 3- to 5-nerved, with awn. Upper glume (1.9) to 2.3 to (2.9) mm long, (1.1) to 1.4 to (1.8) mm wide, 5- to 7-nerved, with awn. Lower lemma(2.4) to 2.9 to (3.4) mm long, (1.3) to 1.9 to (2.2) mm wide, (7-) to 9-nerved, with awn. Awn redish, robust, bare; awn of the: Lower glume (5) to 7 to

(10) mm long, Upper glume (1.7) to 2.3 to (3.3) mm long, and lower lemma(0.4) to 0.7 to(1.5) mm long. Caryopsis elongated oval.

Distribution: Tropical East Asia (especially in the Philippines)

Selected voucher specimens: **Bermuda**: Hamilton I (Taylor 49-1162; G). **Fiji**: Ngau (Smith 7925; L); Ovalan, Lovoni Valley (A. C. Smith 7318; L). - **Indonesia**: Celèbes, Prov. Minahassa (S. H. Koorder 19790; L); Sunda I., Lombok (J. Elbert 1248; L); Palau, M. Luisualumonogui (T. Hosakawa 6877; l); W: Sumbawa, M. Batulanteh (Kostermans 18307; L); Molukken, Ternate (D. R. Pleyte 19; L); Timor, M. Perdido (v. Steenis 18273; L); Borneo, M. Kinabalu (Clemens 40726; G). - **Malaysia**: Sabah, Borneo (Noteboom 1415; L). - **New Guinea**: Morobe Distr. (Clemens 1202; L); Papua, Rambuso (l. J: Brass 2803; L); Subdistr. Popondetta (A. N. Millar 1906; l). - **New Zealand**: Kermandec I. (W. R. Sykes 10/K; l): - **Norfolk Island**.: M. Pitt (R. D. Hoogland 6592; L). - **Philippines**: Bohol (M. Ramos 4297; W); Leyte: M. Jamagdan (G. E. Edana 12050; PNH); Luzon: Mariveles, Prov. Bataan (E. D. Merrill 739; W); Distr. Lepanto, M. Data (E. D. Merrill 4511; W); Rizal Prov., M. Tokduanbanoy (Ramos & Edano 48617; B); Prov. Sorsogon, Irosin (E. D. Merrill 17105; W); Mindanao: Davao (G. E. Edana 11052; PNH); Lake Lanao (Clemens 639; W); Zamboanga del Norte (C. & Ch. Frake 35977; PNH); Tawitawi: Sulu Prov. (Ramos & Edana 44120; W). – **Samoa:** Falealupo (A. Whistler 105; L): - **Society Islands**.: (J. W. Moore 62; L); Taiti (Kastolsky s. n.; LE).

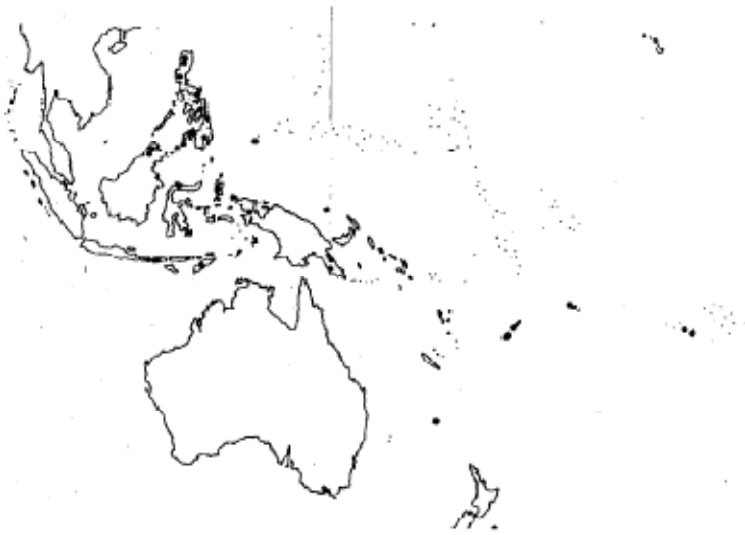


Fig. 32: Distribution of *O. hirtellus* subsp. *imbecillis* f. *imbecillis*.

Common Names: Kinswawa (Wahgi language, East Asia).

9.5.2. f. ***lanceolatus*** U. Scholz **nov. f.**

-Type: Australia: "between Wolumba and Merimbula, S. of Bega", R. Pullen 4039, L, Holotype.

Oplismenus imbecillis (R. Br.) Roem. & Schult. var. morrisonenis Honda, Bot. Mag. Tokyo 38: 190 (1924). – Type: Formosa: Kawakami & Mori 1845; TI, Holotype.

Diagnosis: Lamina foliorum lanceolata (3) - 4 - 7 - (9) cm longa; spiculae saepe breviter et dense pilosae.

Delicate or robust grass; Blades lanceolate, (3) to 4 to 7 to (9) cm long; Spikelets usually short, thick haired.

Distribution: Tropical East Asia (Indonesia – Austrailia).

Selected voucher specimens: **Australia**: (Sieber s. n.; L); Key I. (H. Jensen 112; C); Cape York Penins. (L. J. Brass 19156; G); **Queensland**, Endeavor R. (v. Mueller s. n.; M); North Kennedy (B. Hyland 04151; L); Mossman Distr., Rumula (Mukee 9091; L). – **Fiji I**.: Ovalan, Lovoni (A. S. Smith 7318; W). – **Maluku**: Morotai (H. J. Lam. 3614; L).

Fig. 33: Areal of *O. hirtellus* subsp. *imbecillis* f. lanceolatus.

9.6. subsp. ***japonicus*** (Steud.) U. Scholz, **nov. stat.**

Panicum japonicum Steud., Flora 24: 18 (1846). *Oplismenus japonicus* (Steud.) Honda, Bot. Mag. Tokyo 38: 189 (1924; (Beleg: Japan, Okinawa: Fashiro 214, TI). – *Oplismenus undulatifolius* (Ard.) Roem. & Schult. var. *japonicus* (Steud.) Koidzumi, Bot. Mag. Tokyo 39: 302 (1925); Hsu, K.-S., Fl. Taiwan 5: 566 (1978). – Type: Japan: Göring s. n. (P?), n. v.

Oplismenus coreanus Nakai, Bull. Sci. Nat. Mus. 31: 140 (1952), p.p., nom. illeg.

Panicum burmannii Franchet, A. & Savatier, L., Enum. Pl. Jap. II: 160 (1879), non Retz.

Culm: (10) to 35 to (60) cm high, usually hairy in some grooves. Blades egg-shaped oblong, seldom oblong or oblong-lanceolate, (0.3) to 0.9 to 1.5 to (2.5) cm wide, (2) to 4 to 8 to (12) cm long. Sheath thick or loosely long haired around the edges; usually bare in the middle, sometimes loosely or thickly haired. Ligule with or without hairy collar, 0.4 to 1.2 mm long. Inflorescence uncomplex to grouped, racemose; main shaft (4) to 6 to 11 cm long, usually bare, occasionally hairy; inflorescence branches not present or very short. Spacing between the bottommost inflorescence branches 1 to 3 cm. Spikelets arranged in pairs, located directly on the main shaft or in clusters of 3 to 10 on the short inflorescence branches (up to 10 cm); laceolate, (2.8) to 3.6 to (4.1) m long, fairly thickly haired. Lower glume oblong, (1.8) to 2.5 to (3) mm long, (0.8) to 1.1 to (1.5) mm wide, 3- to 5-nerved, with awn. Upper glume oblong, (2) to 2.5 to (2.9) mm long, (1.1) to 1.4 to (2) mm wide, 5- to 7-nerved, with awn. Lower lemmaoblong, (2.9) to 3.3 to (3.8) mm long, (1.5) to 2 to (2.3) mm wide, 7- to 9-nerved, with awn. Pelea I usually not present. Awn robust, redish, bare, becomes sticky when ripe; awn of the: Lower glume (5) to 7 to 13 to (15) mm long, upper glume 1.8 to 5 to (6) mm, and lower lemma 0.3 to 1.7 mm long.

Distribution: Japan, China, Korea.

Fig. 34: O. hirtellus subsp. japonicus (Takanouchie s. n., B; Japan).

Selected voucher specimens: **China**: Shanhai (Faber s. n.; W); Kiangsi, Lu Shan (H. C. Cheo 289; E); Lokchong (Y. Tsiang 1244; E); Paita (Licent 9649; W); Prov. Shansi, Yao-shan (E. Licent 12786; 101); Shantung Prov., Lung Tung (C. Y. Chiao; E); Yunnan (R. P. Maure 7534; W); Mekong Salween Divide (G. Forrest 14633; W); Yün-shan, Wukang (Handel-Mazzetti 12480; E). - **Japan**: Annori (U. Faurie 6975;W); Kirifuri, Nikko (J. Matsumura 349; TI); Nikko (C. Schröter s. n.; ZT); Kyoto (I. Ohwi s. n.; ZT); Kyushu (A. Takenouchie s. n.; B); Miyanoskata (J. Bisset 2613; E); Honshu, Prov. Sagami (Yo Momiyama 146; TI); Hakone (J. Matsumura 21; 101); Sapporo (U. Faurie 1260; W); Sendai, Honshu (W); Shizuoka (J. Sugimoto s. n.; B); Tokyo (H. Honda s. n.; TI); Tsoyasaki (A. Takenouchi s. n.; B); Yatsuo,

Honshu (So Kirino 381; M); Yokohama (Maximowicz s. n.; W). - Korea: Cheju Do (Taquet 9049; W); Fusan (U. Faurie 815; W).

Common Names: Chizenai-Sara (rippled bamboo), Chidjimi-zasa (Japan).

Ecology: In damp, shady locations; bank of rivers or streams.

Anthesis: February to November, mainly September to October.

Chromosomes: 2n = 54: Tateoka (1967).

9.7. subsp. ***microphyllus*** (Honda) U. Scholz. **nov. stat.**

Oplismenus microphyllus Honda ex Ui, Kishu Shokubutsu Shi: 278 (1929), nom. nud., Honda, J. Fac. Sci. Univ. Tok., Sect. 3, Bot. 3: 274 (1930), descr. – *Oplismenus undulatifolius* (Ard.) Roem. & Schult. var. *microphyllus* (Honda) Ohwi, Bot. Mag. Tokyo 55: 546 (1941); Hsu, K.-S., Fl. Taiwan 5: 566 (1978). - Type: Japan, Honshu, I. Itsukushima: Ogawa 6, TI, Lectotype; Japan, Honshu, in monte Kiyozumiyama: Nakai s. n., TI, Japan, Prov. Kii Nachi: Ui 14, TI,

Syntypes: *Oplismenus* minor Merrill, Phillip. Gov. Lab. Publ. 17: 9 (1904). - Type: Philippinen, Luzon, Mt. Mariveles: Merrill 3203, W, Holotype.

Delicate, small grass; Blades egg-shaped oblong to oblong, 0.3 to 0.9 cm wide, 1.5 to 2 to (4) cm long, bare or covered with a few long, white hairs. Sheath loosely long haired around the edges, in the middle usually bare, sometimes loosely long haired. Ligule usually without a hairy collar or covered with a few short hairs, 0.4 to 0.7 mm long. Inflorescence uncomplexly racemose, 4 to 5 cm long. Inflorescence branches not present. Spikelets solitary or aranged in pairs directly on the main shaft, separated from one another; lanceolate, 2.7 to 3.1 mm long, very sparsely haired. Lower glume oblong, 2.2 mm long, 0.8 to 1.2 mm wide, 3-nerved, with awn. Upper glume oblong, 2.2 mm long, 1.2 to 1.3 mm wide, 5-nerved, with awn. Lower lemmaoblong, 2.6 to 2.9 mm long, 1.5 to 1.9 mm wide, 7-nerved, with awn. Pelea I not present. Awn robust, redish, bare, becomes sticky when ripe; awn of the: Lower glume 6 to 8 mm long, Upper glume 1.6 to 3 mm, and lower lemma0.7 to 1 mm long.

Distribution: East Asia.

Voucher specimens: **Indonesia**: Borneo, M. Kinabalu (J. & M. S. Clemens 40175; HBG). – Japan: Honshu: Itsukushima I. (Ogawa 6; TI); Kiyozumiyama (Nakai s. n.; TI); Prov. Kii Nachi (Ui 14; TI). – **Philippines**: Luzon: Mt. Mariveles (Merill 3203; W).

9.8. subsp. ***psilostachys*** (Honda) U. Scholz, **nov. stat**.

Oplismenus psilostachys Honda, Bot. Mag. Tok. 41: 337 (1927). – Type: Formosa, Buizan-Zyagan: Matuda-Bizi 287; TI, Holotype.

Delicate grass; Blades lanceolate, 0.3 cm wide, 3 to 4 cm long. Sheath long and thickly haired around the edges. Ligule without hairy collar, 0.4 mm long. Inflorescence uncomplex, racemose, 7 cm long, bare, inflorescence branches not present; Spikelets postioned singularly or in pairs in the rachis, lanceolate, 4mm long. Lower glume elongated, 2.8 mm long, 1 mm wide, 3-nerved, with awn. Upper glume elongated, 3.1 mm long, 1.5 mm wide, 5-nerved, with awn. **Lower lemma** elongated, 3.9 mm long, 1.9 mm wide, 7-nerved, with awn. Pelea I not present. Awn robust, redish, bare; awn of the: Lower glume 7 mm, Upper glume 1.6 mm, and lower lemma0.7 mm long.

Distribution: Taiwan.

Voucher specimens: **Taiwan**: Buizan – Zyagan (Matuda 287; TI).

9.9. subsp. *setarius* (Lam.) Mez ex Ekman, Ark. Bot. 13: 33 (1913). –

Panicum setarium Lam., Tabl. Encycl. meth. I: 170 (1791). – *Oplismenus setarius* (Lam.) Roem. & Schult., Syst. Veg. II: 481 (1817); Adams, C. D., Flow. Pl. Jamaica: 185 (1972); Hitchcock, A. S., Contr. U. S. Natl. Herb. 22,3: 126 (1920), North Amer. Fl. 17,4: 308 (1931); Long, R. W. & Lahela, *O.*, Fl. Trop. Florida: 164 (1971); Small, J. K., Man. S. E. Flora: 82 (1933). - *Orthopogon setarius* (Lam.) Spreng., Syst. Veg. I: 306 (1824, t p. 1825). - *Oplismenus compositus* (L.) P. Beauv. var. *setarius* (Lam.) Bailey, Queensland Grasses: 19 (1888). - *Hippagrostis setaria* (Lam.) *O.* Kuntze, Rev. Gen.: 77 (1891). - Type: Richard s. n., P-LAM, Holotype.

Orthopogon hirtellus Nutt., Gen. Am. Pl. I: 55 (1818), non '*Panicum hirtellum* L.' – *Orthopogon* parvifolius Nutt., Gen. Am. Pl. 55, in errata (1818). - *Oplismenus* parvifolius (Nutt.) Kunth, Rev. Gram. I: 45 (1829). *Panicum* nuttallianum Steud., Nomencl. 2. ed. II: 260 (1841). - Type: Florida (PH?), n.v.

Panicum hirtellum Muhlenb.," Descr. ubi.: 100 (1817), non L.

Setaria hirtella Schult., Mant. II: 276 (1824), non '*Panicum hirtellum* L.'.

Ic.: Burkart, A., FI. ilustr. de entre Rios (Arg.) 2: 335 (1969). - Cabrera, A. L., Fl. Prov. Buenos Aires 2: 517, f. 135 (1970). - Fournet, J., Fl. ili. Phanerogam. Guadeloupe: 145 (1978). - Hitchcock, A. S., Contr. U. S. Natl. Herb. 22: 128 f. 22 (1920). - Radford, A. E. & Ahles, H. E.,

Bell, C. R., Man. Vase. Fl. Carolinas: 131 (1968). - Swallen, J. R., Fl. Guatemala 2: 229, f. 72 (1955). - Wiggins, I. L. & Porter, D. M., FI. Galapagos: 861 (1971).

Usually a delicate plant; Culm 15 to 40 cm high. Blades elongated, seldom elongated-lanceolate, (0.3) to 0.5 to 1 to (1.2) cm wide, 2 to 6 to (8) cm long, sparsely haired or bare. Sheath usually only around the edges thick, long, or short-haired, seldom in the middle loosely long-haired. Ligule with hairy collar, (0.4) to 0.6 to 1.1 to (1.5) mm long. Inflorescence usually hairless, (3) to 4 to 8 to (13) cm long, with 3 to 5 to (8) very short (up to 0.3 cm) inflorescence branches. Spikelets grouped together in pairs, clustered in groups of 4 to 10 to (15). The spacing between the two bottommost inflorescence branches is 1 to 2 to (3) cm. Spikelets lanceolate, (2.2) to 2.7 to to (3.3) mm long, moderately thickly haired. Lower glume elongated, (1.4) to 1.9 to (2.2) mm long, (0.7) to 1 to (1.3) mm wide, (3)- to 5- to (7)- nerved, with awn. Upper glume elongated, (1.5) to 2 to (2.4) mm long, (0.9) to 1.2 to (1.6) mm wide, 5- to 7- nerved, with awn. Lower lemmaelongated, (2.1) to 2.6 to (3) mm long, (1.1) to 1.8 to (2.2) mm wide, 7- to 9-nerved, with awn. Pelea I is existent or not present. Awn robust, redish, bare; awn of the: Lower glume (2.7) to 4 to 9 to (10) mm, Upper glume 1 to 2 to (2.6) mm, and lemma (0.2) to 0.4 to 0.7 to (1.5) mm long. Caryopsis: elongated-oval, approx. 2.5 mm long.

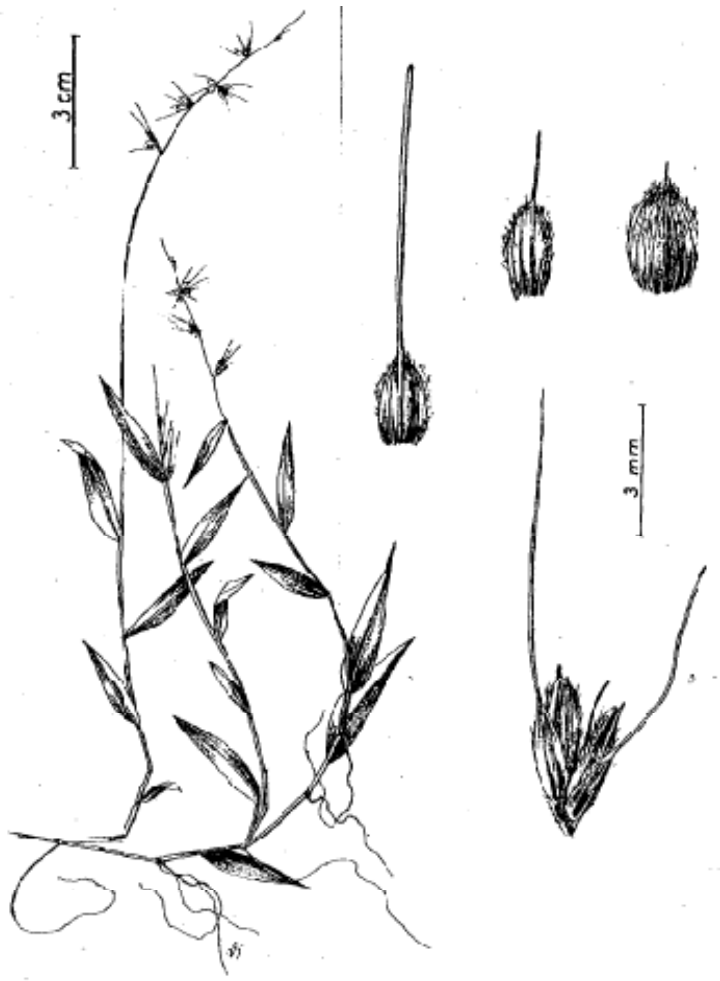


Fig. 35: O. hirtellus subsp. setarius (F. Lincheimer 210, M; U.S.A.).

Distribution: Subtropical and tropical regions of the New World.

Selected voucher specimens: **Argentina**: Prov. Corrientes, Dep. Mburucuyá (T. Myndel Petersen 2678; G); Dep. Mercedes, Colonia Pellegrini (C. Quarin & A. Schinlni 1070; ZT); Isla Martin Garcia (L. R. Parodi 4653; L); San Ignacio (K. Duiroga 47; G). – Barbados I.: Welshman's Hall Gulley (Carter s. n.; CGE). - **Brazil**: (Sellow s. n.; G); Curitiba, Pinheirinho (G. Hatschbach 8917; B); Morro da Caixa (P. R. Reitz 4.569; L); Obidos, Prov. Para (R. Spruce 50; M); Paraopeba (E. P. Herniger 32501; M); South (Camargo 63691; B). - **Cuba**: Campo Florido (Leon 4135; NY); Sierra de Nipe, ,R. Piloto (E. L. Ekman 2091; G); Trinidad M. (A. Gonzales 161; FR); Sierra de Vigne, R. Jimbambay (E. L. Ekman 9871; G). – **Dominican Republic**: (Bertero s. n.; M); Macoris (Taylor 235; NY); Prov. Monte Cristy (E. J. Valeur 482; G); Prov. San Juan (Howard 8741; B). – **French Guiana**: Cayenne (W). - **Guadeloupe**: (Bertero s.n.; G), - **Guatemala**: La Vega (Heyde & Lux 6275; C). - **Haiti**: Anse Galette

(Leonard 3038; NY). - Honduras: Dep. La Paz (Molina 24090; NY). - **Jamaica**: Hordware (Harris 11843; NY); Kingston {A. S. Hitchcock 600; G); Ewarton at Linstead (A. S. Hitchcock 9415; L); Portland(C. D. Adams 11.537; FR). - **Mexico**: Valle de Orizaba (Schaffner 163; W); near Mirador, Prov. Veracruz (Satorius s. n.; FR). - **Paraguay**: Between R. Apa und R. Aquidaban (K. Fiebrig 4231; L); Cordillera de Altos (E. Hassler 3934 a; G); E from Caaguazu (B. Balansa 159 a; L); Dep. Paraguari (Sparre & Vervoost 751; FR); Pilcomayo (E. Hassler 74; G); Yaguason (B. Balansa 2733; L). – **Puerto Rico**: (Poiteau s. n .; G); Cayey (M. Kuhn 2225; G); Jabucoa (P. Sintenis 4953; PR); Mayagües (P. Sintenis 72 b; M); Ponce (A. A. Heller 6303; L). - **Uruguay**: Montevideo (J. Arechavaleta 65; ZT); Dep. Treinta y Tres (Herter 1090; M). – **U.S.A**.: Arkansas: Hulton (B. F. Bush 982; CGE); Florida: Chipola R., Jackson County (Biltmore 2885 a; PR): Jacksonville (A. H. Curtiss 5301; W); St. Johns R. (A. H. Curtiss 3595; FR); Jupiter (A. H. Curtiss s. n.; G); Tallahassee Leon County (V. Nash 2524; G); Georgia: Savannah City Hall, Chatham County (J. Swanberg s. n.; G); Louisiana: (C. W. Short s. n.; PR); New Orleans (C. Baehin 246: G); Missouri: St. Louis (Fista s. n.; L); Ocean Spring (S. M. Tracy 4533; G); Pearl R. County (F. H. Sargent 8310; G); S. Carolina: Cahoun County (Y. F. Logue & J. Bozeman 2133; B); Texas: (F. Lindheimer 210; OXF); Anderson County (I. Palmer 14376; B); Rabb Palm Grove (R. Runyon 3399; M); Rusk County (Vinzent 54; HBG).- **West Indies**: St. Thomas: Signal Hill (Eggers 174; FR).

Fig. 36: Areal of *O. hirtellus* subsp. *setarius*.

Vernacular names: Running mountain grass, wavy-leaf basket grass (USA); Z'erbe à barbes (Martinique).

Ecology: In moist, shady forests, in coppices along inland lakes, in marshy areas and along rivers and streams.

Sociology: Often present with *Erythrodes querceticola* (*Orchidaceae*).

Economic significance: Weed in coffee bean farms.

Anthesis: March to December; usually September to November.

Chromosomes: n = 36: Reeder (1968).

Notes: In west Africa there are few specimens that are most likely coincidental mutations of *O. hirtellus* subsp. *fasciculatus* that appear similar to subsp. *setarius*. These are most likely mutations since it is not reasonable to assume that it is a former flora relationship.

9.10. subsp. ***tsushimensis*** (Honda) U. Scholz, **nov. stat**.

Oplismenus tsushimensis Honda, Feddes Repert. Spec. Nov. Regni Veg. 20: 360 (1924). – Type: Japan, Kyushu, Prov. Tsushima: Hirata 39, TI, Holotype.

Sometimes a robust plant; Culm hairy, occasionally thick and long, 20 to 40 cm long. Blades elongated-eggshape, or more seldom, elogated-lanceolate, (0.5) to 0.8 to 1.5 cm wide, (3) to 4 to 6 to (10) cm long. Sheath loosely or thick and long-haired around the edges and in the middle, rarely hairless in the middle. Ligule with or without a hairy collar, 0.8 to 1.5 mm long. Inflorescence racemose, rachis usually thick, long-haired, 4 to 14 cm long, with short inflorescence branches (up to 0.7 cm long). Spikelets grouped together in pairs, clustered in groups of 4 to 10 on the inflorescence branches. The spacing between the inflorescence branches remains the same the whole height of the plant, usually around 0.2 cm long. Spikelets lanceolate, (3) to 3.2 to (3.7) mm long, always hairy. Lower glume elongated, (1.9) to 2 to (2.3) mm long, (0.9) to 1 to (1.2) mm wide, 3- to 5-nerved, with awn. Upper glume elongated, (1.9) to 2 to (2.6) mm long, (1.2) to 1.4 to (1.6) mm wide, 5- to 7-nerved, with awn. Lower lemmaelongated, (2.7) to 2.9 to (3.4) mm long, (1.6) to 1.9 to (2.2) mm wide, 7- to 9-nerved, with awn. Pelea I usually not present. Awn robust, redish, bare, becomes sticky when ripe; awn of the: Lower glume 6 to 7 to (15) mm long, Upper glume (2) to 2.3 to 2.9 to (4,6) mm long, and lower lemma (0.2) to 0.4 to 1.1 mm long.

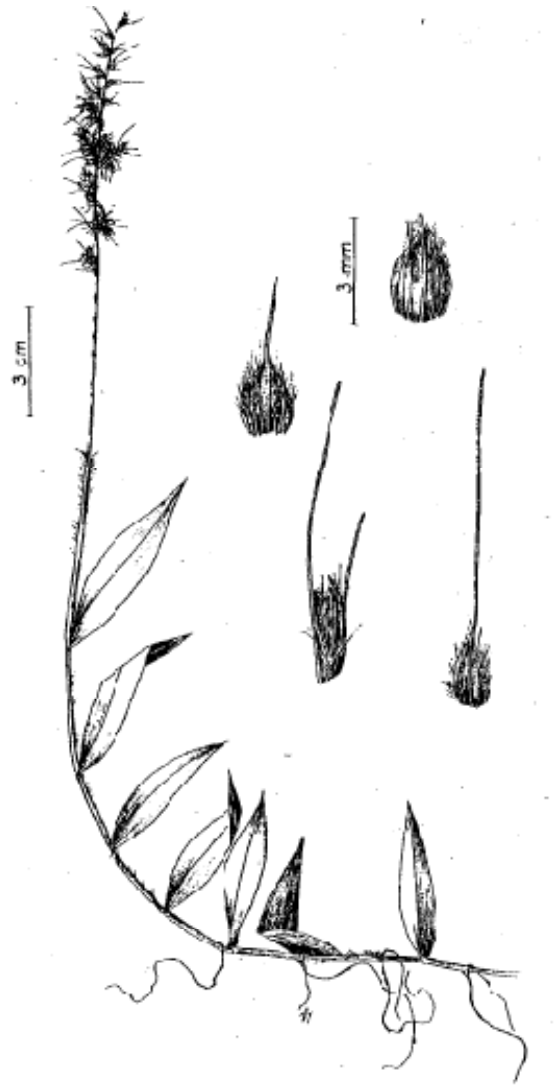


Fig. 37: O. hirtellus subsp. tsushimensis (J. Ohwi 164, B; Japan).

Distribution: East Asia.

Selected voucher specimens: **China**: Kwangsi (Tsang 22884; W). - **Japan**: (Tanaka 16; W); Sendai (Jisiba s. n.; W); Hondo, Ueno Park, Tokyo (J. Ohwi 164; ZT); Tokyo (Matsumura 223; W); Prov. Musashi (Makino 8263; BR).

Anthesis: September to November.

9.11. subsp. ***undulatifolius*** (Ard.) U. Scholz, **nov. stat**.

Panicum undulatifolium Ard., Animad. Sp. alt.: 14 (1764); Ascherson, P. & Graebner, P., Syn. Mitteleur. Fl. 2: 74 (1898); Ettinghausen, E., Beitrag zur Kenntnis der Nervatur der Graminae: 413 (1866). – *Oplismenus undulatifolius* (Ard.) Roem. & Schult., Syst.

Veg. II: 482 (1817); Bor, N. L. in Rechinger K. H., Fl. Iranica: 485 (1970); Conert, H. J., Gramineae. In Conert, H. J., Hamann, U., Schultze-Motel, W., Wagenitz, G. (ed.), Hegi, G., Ill. Fl. von Mitteleuropa 1 (3): 69 (1980); Hsu, K. S., F1. Taiwan 5: 566 (1978); Komarov, V. L., Fl. U.S.S.R. 2: 34 (1934); Lorenzoni, G. G. F1. Veg. Friuli: 113 (1967); Mayer, E., Blütenpfl. im slowenischen Gebiet: 378 (1952); Oberhofer, E., Der insubrische Vegetationskomplex: 141 (1964); Tzvelev, N. N., Poaceae U.S.S.R.: 655 (1976). - *Orthopogon undulatifolius* (Ard.) Spreng., Syst. Veg. I: 306 (1824, t. p. 1825). - *Orthopogon* undulatus Link, Hort. Berol. 1: 202 (1827), nom. superfl. - Type: Arduino s. n., M, Holotype; C, Isotype.

Oplismenus undulatifolius P. Beauv., Ess. Agrost.: 54 (1812), nom amb.

Orthopogon bolosii Vayreda, Cavanillesia 4: 61 (1931), nom. nud. - Type: Spain, Olot: Bolós 5997, W, Holotype.

Oplismenus coreanus Nakai, Bull. Sci. Nat. Mus. 31: 140 (1952), p.p., nom. illeg.

Panicum burmannii auct. non Retz.: Balbis, Misc: Bot. I 8: 80 (1804). - Beleg: Italy, Piemont: Balbis s. n ., C. - Marschall Bieberstein, Fl. Taur. I: 51 (1808).

Panicum hirtellum auct. non L.: All., Fl. Pedemont. 11: 240 (1785); Scop., Del. Florae Faunae insubr. III: 72 (1788), Wulfen ex Jacq., Coll. I: 263 (1787, t. p. 1786). Beleg: Wulfen s. n., W, M.

Ic.: Komarov, V. L., Fl. U.S.S.R. 2: pl. 2, f 10 a-c (1934). - Kiem, J., Ber. Bayer. Bot. Ges. 49: 7 (1978). - Reichenbach, L., Ic. Fl. Germ. I: tb 28, f. 1209 (1834).

Perennial, sometimes delicate plant; Culm (17) to 20 to 37 to (50) cm high. Blades elongated-eggshaped, seldom elongated lanceolate, short-haired, (0.6) to 0.8 to 1.5 to (2.5) cm wide, (2) to 3 to 9 to (12) cm long, very wavy, midrib very noticeable above the base, becoming finer towards the end, side nerves 3 to 4, intermediate nerves 7. Sheath almost always thickly long-haired in the middle and around the edges. Ligule with or without hairy collar, 0.5 to 1 cm long. Inflorescence racemose, almost always thickly long-haired, (3) to 4 to 8 to (18) cm long, with very short (0.5 cm long) or missing inflorescence branches. Spikelets positioned alone or in pairs, arranged in clusters 2 to 7 to (10). Spacing between the two bottommost inflorescence branches (0.5) to 1 to 3 to (6) cm. Spikelets lanceolate, (2.6) to 3.3 to (3.8) mm long, somewhat hairy. Lower glume elongated, (1.5) to 2.1 to (2.7) mm long, (0.7) to 1 to (1.3) mm wide, 3-nerved, with awn. Upper glume elongated, (1.5) to 2.2 to (2.7) mm long, (1) to 1.4 to (1.7) mm wide, 5-nerved, with awn. Lower lemmaelongated, (2.2) to 3 to (3.6) mm long, (1.5) to 1.9 to (2.2) mm wide, 7- to (9)- nerved, with awn. Palea I almost always not present. Awn robust, redish-yellow, hairless, becomes sticky when ripe; awn of the: Lower glume (4) to 7 to 11 to

(13) mm, Upper glume (2) to 2.4 to 3.8 to (5) mm, and lower lemma(0.2) to 0.4 to 0.8 to (1.3) mm long. Caryopsis: elongated oval.

Fig. 38: O. hirtellus subsp. undulatifolius (Hausmann s. n., B; Italien).

Distribution: Southern Switzerland, northern Italy, U.D.S.S.R., Iran, Turkey, India, China, Japan. – Temperate-subtropical zone.

Selected voucher specimens:

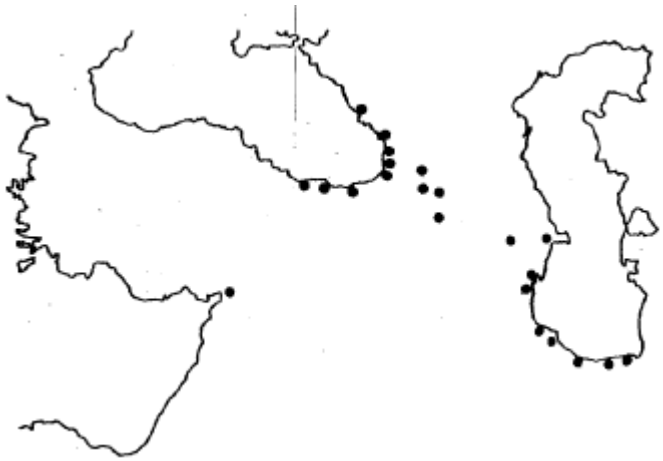
China: Hunan Prov., Ma-Ling-Tung (C. S. Fan &Y. Y. Li 464; G) Kweichow, Kwangsi (Y. Tsiang 648 b; W). - **Iran**: Asterbad, Bender Ges. (P. Sintenis 1492; G); Bandar-e-Pahlavi (J. & A. Bornmüller 8335; B); North (Butse s. n.; W). - **Italy**: South Tyrol: Bozen, Kaiserau (Hausmann s. n.; B); (C. v. Hepperger s. n.; W); (Lauter 100; FR); Rodlerau (Hausmann s. n.; B); Valsugana (Faichini s. n.; ZT); Niederlanaer Au by Meran (J. Vetter s. n.; W); Vallée d'Aosta (E. Thomas s. n.; W); Vallesia (Hagenbach s. n.; M); Aquilegia (Putterlick s. n.; W); Cadro (Siegfried s. n.; Z); near Chiavenna, Prov. Sondrio (SDt. Lager s. n.; G); Gardasee (Pittoni s. n.; W); Karfreit (Correns s. n.; M); Gargiano (P. Bigo 770; B); Grantola (Franzoni s. n.; W); Luganersee, St. Margherita (S. Vautier s. n.; G).; Prov. de Novare (L. Terretaz s. n.; G); Lago d'Orta, Piemonte (A. F. Negri s. n.; ZT); Pallanza (A. W. Peipers s. n.; FR); Pavia (G. Sieber-Gyti s. n.; ZT); M. Bracco, Valle du Po (B); Staragora by Görz (I. Glowacki s. n.; B); Stresa, Lago Maggiore (C. Bicknell; B); Montello (P. A. Sanadorz 45; IT); Prov. Torino, Ivrea (Vaccari 1402; Z); area around Turin (Reichenbach s. n.; W); Friaul, Udine (Tommasini s. n.; W); Veneta (R. Pampanini s. n.; G); Veneta, St. Maria di Teletto (Pampanini s. n.; Z). – **Japan**: Kiusiu (G); Musashi, Tokyo (J. Palacky s. n.; PR); Tokyo (K. Onuma s. n.; ZT); Umgaisha ob. Nikko (C. Schröter s. n.; ZT). - **Yugoslavia**: Dalmatlen (FR). **Korea**: Cheju Do (Taquet s. n.; G). - **Nepal**: Mugu Karnali Valley (O. Polunin et al. 5240; E). - **Switzerland**: Jardin de Genève (G); Agnuzzo, Luganersee (A. Becherer s. n.; G); Arcegno (P. Aellen s. n.; B); Bellinzona (Mittelholzer s. n.; ZT); Bignasco (G. Kohler s. n.; G); Brusino Arsizio (E. Baumann s. n.; Z); Riva, San Vittale (G. Kummer s. n.; ZT); Cassarate Canyon, Sonvico (W. Koch 54/80; IT);

Gordola (Müller-Argau s. n.; ZT); Gudo (D. Rapin s. n.; CGE); Between Locarno and Gordola (E. Fisek s. n.; ZT); Locarno, Madonna del Sasso (St. Arnold 53; Z); Lugano (L. Mari s. n.; Z); Betwwen Lugano and Agno (Cornaz s. n.; Z); Val Maggio (Muret s. n.; Z); Malcantone (E. Streuli 129; ZT); Moesa R. (J. L. Terretaz s. n.; G); Arasio by Montagnola(E. Berger 136; ZT); Musano (Z); Ponte Brolla (M. Rikli s. n.; ZT); Ponte Tresa (F. v. Tavel s. n.; ZT); Sementina (L. Favrat s. n.; ZT); Graubünden: Calania, Misox (G. Walser s. n.; Z); Valle Erono (H. Seitter Sargans s. n.; ZT); Gano (G. Walser s. n.; ZT); San Vittore (H. Seitter Sargans s. n.; ZT); Sorte (H. Kunz s. n.; ZT). - **Turkey**: Amanus

Fig. 39: Distribution of *O. hirtellus* subsp. *undulatifolius*.

M., Kizil-Dagh, Col de Selderin (M. P. Delbès 39; G); Behizè Lazistan (B. Balansa 1547; G); Giresun (P. Zurse 4133; G); Trabzon (Handel-Mazzetti 215; W). – **U.D.S.S.R.**: Alazan (Reichenbach s. n.; W); Kaukasus, Gagra (M. Rikli s. n.; W); Jurjewo (G. Woronow 1146; W); Prov. Baku, Distr. Lenkoran (N. Pastuchov 404 b; HBG).

Fig. 40: European distribution of *O. hirtellus* subsp. *undulatifolius*.



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Caucasian distribution of subsp. undulatiformis

Vernacular names Welligblättriger Geradbart (wavy-leaved straight barb), welligblättrige Grannenhirse (wavy-leaved millet awn).

Ecology: In shady chestnut and moist alden forests; between cobblestones (seldom); 0 to 1000 m.

Sociology: Companion plants: *Brachypodium sylvaticum, Vinca minor, Salvia glutinosa, Hedera helix, Asplenium sp., Adianthum nigrum, Corylus avellana, Viburnum opulus, Acer campestre, Ulmus campestris, Ostrya carpinifolia, Pinus sylvestris, Picea excelsa.*

Anthesis: East Asia: February to November, usually July; Europe: July to November, usually September.

Chromosomes: (Data may refer to specimens of *O. hirtellus* subsp. *japonicus*)

2n = 54: Gould & Soderstrom (1974); Koshla & Mehra (1973); Tateoka (1965), (1967).

n = 27: Koshla (1972).

2n = 90: Davidse & Pohl (1974).

13. **Taxonomic divisions and geography of the genus – Reorganization and discussion**

13.1. General and introductory remarks

The genus *Oplismenus* was divided into two sections, according to the position of the awns, as Schlechtendahl (1861-62) had suggested, in *Oplismenus* sect. *Oplismenus* and in sect. *Scabriseta* Schlecht.

Oplismenus or *Orthopogon* has 160 valid species names and another 56 that belong in this group, but are currently under different generic names. Of this number, 63 are homotypical enough to be automatically added in. Another 74 are ruled out of the genus as *nomina excludenda*, leaving a remaining 79 species names that can in most cases be assigned through investigation of their types.

In most operating conservatories only a few species are represented or recognized. It is always good to remember that we are discussing an especially polymorphic taxon whose boundaries and definition are merely a matter of man's invention. Ascherson & Graebner (1898) write this in regards to *O. undulatifolius*: "Most likely only a subspecies or strain of *Panicum compositum* L., which is widespread in the tropics." Likewise, Hitchcock (1909) writes the following about *O. hirtellus* (syn. *O. setarius* (Lam.) P. Beauv.) only to mention two examples: "It is quite possible that the specimen here included may be referred to distinct species. The type of *P. setarium* Lam. at Paris resembles Wrights 1543. The blades are short and the spikelets globose and few flowered. Wright 751 and Curtiss 268 and 593 have larger and longer blades and spikes, but some of the other specimens are intermediate." – The large similarities between *O. compositus* on one side and *O. undulatifolius* and *O. hirtellus* on the other are especially large. The taxa do, however, differentiate themselves through the positioning of their inflorescence and the frequent absence of the awn on the lower lemmawith *O. compositus*. Beyond that the arrangement of the spikelets must be taken into account. With *O. hirtellus* they are more or less heavily clustered, while with *O. compositus* they are positioned roughly in rows (s. a. Kap. 7.2.). Stapf (1934) notices a relationship in *O. hirtellus* between sturdy growth and spikelet size, and also between the length of the awns and the length and number of inflorescence branches on the inflorescence. He also draws upon the species Lamark refers to as *Panicum loliaceum* attributed its spectrum to Herbarbogen f. robustus. Such correlations are not always a given (i.e. in South America).

The polymorphism of the species most likely misled many authors to come up with new species. – After a critical review of an extensive gathering of all of the last three century's described or named taxa that can be included in the genus *Oplismenus* the author has come to the conclusion that there are 27 taxa that can be systematically and taxonomically noticed as being different and various classes that they can be ordered into also. The relatedness between these is represented in Fig. 42 and Fig. 43.

Fig. 42: Relationships - *Oplismenus* sect. *Scabriseta*.

Fig. 43: Relationships - *Oplismenus* sect. *Oplismenus*.

If one were to make a taxonomic classification for the individual continents, the individual genera for America, Africa, and Europe are relatively easy to keep separate. However, when the worldwide areal of the genus is contemplated the individual taxa in most cases are not so easily separated. Davey & Clayton (1977) come to the same conclusion in their mathematical analysis of the genus. It therefore appears necessary that the most described species be repositioned in the taxonomical classification of species. This process will be described more fully later in the text. The geographical differentiation is mostly carried out through the formation of subspecies. In East Asia, however, a different set of criterion must be used to fully establish the taxonomical classification. Here it is most likely a successive species definition similar to the one described by Grant (1976), in which the individual classifications remained the same. These connect links or intermediaries must lie between the taxonomical elements, seeing that the traits used to

differentiate the taxa become partly broken up or replaced with a somewhat modified combination. Grant opposes taxonomical species that are either a biologically founded or an evolutionary species, as claimed by Simpson (1961). In order to be able to establish biological species or types in the genus *Oplismenus* cross trials had to be performed on living plant material; this is, however, outside the scope of this work and will be left to later studies. As previously mentioned from Grant, the term "biological species" only allows reference to two-parented organisms, while single-parent organisms are better referred to as "evolutionary species". The definition of an evolutionary species states that a part of the population reproduces separate from the whole and fills its own ecological niche, or rather that it has its "own evolutionary functions".

Because it is most likely an apomixisical reproduction method that is present in the genus *Oplismenus*, one could also speak of evolutionary species or types, as long as no intermediary types show a commingling of the population. Even then, however, caution is necessary. For example, if one considers the distribution of *O. undulatifolius* in the European region it is possible to assume that no comingling with other populations is possible, seeing that the nearest related source is found in the Caucasus, where similar conditions as in the European region exist. In contrast, in the East Asian and Indian regions a comingling with other species or types is possible. It follows, therefore, that the European taxon is only constant in its morphological characteristics because of its isolated distribution and also, therefore, exhibits no evolutionary structure of its own.

Type	Europe	Asia - Australia	Africa	America
O. aemulus		var. aemulus var. densiflorus var. flaccidus		
O. affinis				var. affinis var. humboldtianus
O. burmannii		var. burmannii var. lanatus	var. burmannii var. lanatus	var. burmannii
O. compositus		var. compositus var. rariflorus	var. compositus var. sylvaticus	var. compositus var. rariflorus
O. hirtellus	subsp. undulatifolius	subsp. acuminatus subsp. imbecillis subsp. japonicus subsp. microphyllus subsp. psilostachys subsp. tsushimensis subsp. undaltifolius	subsp. capensis subsp. fasciculatus subsp. hirtellus	subsp. fasciculatus subsp. hirtellus subsp. setarius

Tab. 2: Geographical distribution of the taxa.

13.2. Remarks and grouping of the distributional regions

When the special diversity of the genus *Oplismenus* with reference to the geographical diversity is investigated, one comes to the conclusion that no one continent comes to the forefront as especially preferential.

The genus is distributed in all tropical and many subtropical areas and in the Mediterranean region. Its areal is described by Holub & Jisarék (1968) as austrotropical-pen-meridional.

In Europe only one species, *O. hirtellus*, is present in the form of the subspecies *O. hirtellus* subsp. *undulatifolius*.

In the Asian-Australian region one finds four species: *O. aemulus* , *O. burmanii*, *O. compositus*, and *O. hirtellus*, along with 14 subspecies or varieties (Tab. 2).

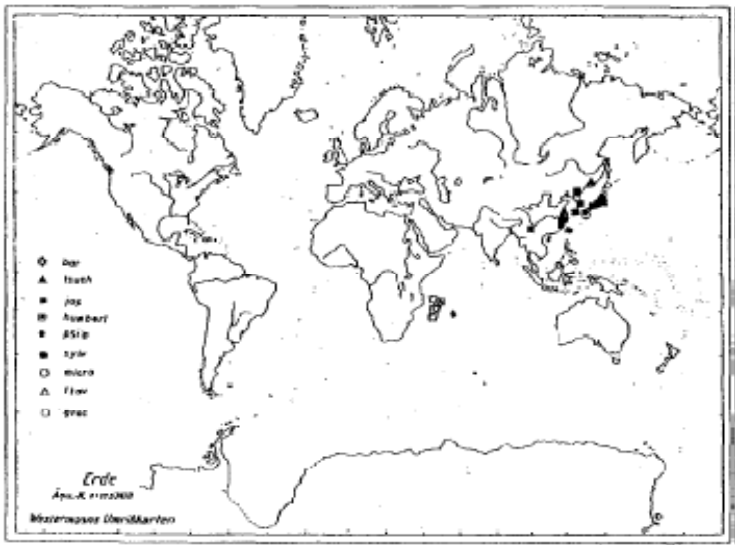

Fig. 44: Taxa with small areas.

In Africa (including Madagascar) seven species are present: *O.* baronii, *O. burmanii*, *O. compositus*, *O. flavicomus*, *O. gracillimus*, *O. hirtellus*, and *O.* I, along with seven subspecies or varieties (Tab. 2).

In America four species are present: *O. affinis*, *O. burmanii*, *O. compositus*, and *O. hirtellus*, along with eight subspecies or varieties (Tab. 2).

With respect to the special variety, the Asian-Australian region is especially distinguished with 14 taxa. Whether this is the center of evolution for the genus or if the multiplicity of species and varieties is something secondary caused by the varied climate zones that border each other so closely, is indeterminable. Of the 27 taxa that are recognized here, 9 have a large areal and 8 a mid-size one (usually a mixed areal). The taxa shown in Fig. 44 have a small, often only dot-sized areal.

13.3. The species of *Oplismenus* sect. *Scabriseta*

Four of the six species of *Oplismenus* sect. *Scabriseta* are endemics from Madagascar that are noticeably characterized through clearly defined features, whose development is traceable to their isolated island homes.

Another form of *Oplismenus* sect. *Scabriseta* is *O. affinis*, located solely in America, has an inflorescence that is thick and long haired on all parts and approximated inflorescence branches; the two outermost glumes and often also the bottommost lemma are either pointed or blunt on the ends. This is a feature that is not present in any other taxon with such frequency. The species is separated into two varieties, those that are present in the same areal and differentiate themselves through the spikelet length and a different form of glume teething. There are, however, a whole array of crossovers and exceptions so that a higher ranking taxonomic ranking is not needed. An intermediary form between *O. affinis* and *O. burmanii* that is often attributed to *O. affinis* is found in Haiti. It is a sparsely haired plant that features distinct notched glumes (Haiti: M. la Cidre: Leonard 7542, MO).

The species of the section *Scabriseta* that is the most widespread is *O. burmanii*. It is because of its distinct, generally constant characteristics that is so easy to identify and presents accordingly few difficulties to taxonomically classify. Two taxa recognized by the author through their varied hairiness are *O. burmanii* var. *lanatus* and var. multisetus. *O. burmanii* var. *lanatus* is only present in Java; its spikelets are long, thick, and silver-haired, which is very similar to the hairing of *O. affinis*. The glumes are, however, not like the aforementioned species', being notched on the end. Nevertheless the variety appears to be a link between the two species.

The connection from the generally clear defined *Oplismenus* sect. *Scabriseta* to sect. *Oplismenus* generates a form that is described by Hooker f. in Trimen (1900) as the species *O. thwaitesii*. Bor (1960) names the species but has the view that it most likely is only a variety of *O. burmanii*. Because of the study of the types the following characteristics were noticed: Blades 3 cm long, inflorescence branches 1.5 cm long, spikelets 2.6 mm long, arranged in rows of 6; Lower glume has an awn, Upper glume is pointed, and lower lemmahas no awn. The awn is greenish, robust, and teethed. It is especially easy to notice using the awn arrangement that we are dealing with a bastard between *O. burmanii* and *O. compositus*. The occurrence of hybrids or a tendency towards hybridization between these two species is shown also through the following sources: Java, Batavia: Schiffner 1520, L; Buitenzorg: Winterbotton s. n.; K; West Java: Preyer s. n.; B. In these sources there are 2.5 to 3 cm long inflorescence branches, spikelets arranged in rows, sparsely toothed awns, and toothless lemma. Another source (India: Heifer 558) has delicate and whitish, but toothless awns.

13.4. The species of *Oplismenus* sect. *Oplismenus*

Oplismenus sect. *Oplismenus* using the new taxonomic arrangement contains 3 species, namely *O. hirtellus*, *O. compositus*, and *O. aemulus* . All three species contain within in them multiple ranges that other authors have separated into different species. A grouping into subspecies is unsustainable seeing that numerous crossover and intermediary forms exist, making each species classification synthetic or man-made and therefore not very meaningful. Because the species classification process in the genus *Oplismenus*, that is *Oplismenus* sect. *Oplismenus*, is

not finished but rather full swing, the grouping represented here appears partly artificial seeing that also between the remaining species now and again crossover forms arise. Nevertheless, the taxonomic classification represented here is still meaningful since most of all the plants can be distinctly classified and also since there is an allowance built in for geographical differences.

13.4.1. *Oplismenus hirtellus*

The most important species in *Oplismenus* sect. *Oplismenus* is *O. hirtellus*. The name, however, is used by various authors to designate differing ranges of plants. On one side it is accepted that only specimens with short inflorescence branches be included while the specimens with long inflorescence branches are referred to as *O. loliaceus* (Lam.) P. Beauv., and on the other side both long and short side-shafted versions are included. On the American continents the taxon with large inflorescence branches is referred to as *O. hirtellus*, and the taxon with short inflorescence branches is denoted using the name *O. setarius*. Actually there are three differentiating forms. One must be able to decide which of the species names is to be used to classify a specimen. The type material from *Panicum hirtellum* L. was investigated as a microfiche in the Linné herbarium. Using this source one finds a version with distinct long inflorescence branches. We can then conclude that *Panicum loliaceum* Lam. is only a synonym for *Panicum hirtellum* L. If we were to take the short side shafted version that comes mainly from Africa and separate it taxonomically from the long side shafted version, name changes would be needed. The long side shafted version is distinctly set apart by the name *O. hirtellus* (L.); the short side shafted version receives a name newly conceived by the author: *O. hirtellus* subsp. *fasciculatus*. This taxon is a basic member of the species *O. hirtellus*, as many other versions branch off of it, including the above mentioned *O. loliaceus*, which is from now on will be referred to as *O. hirtellus* subsp. *hirtellus*. Also branching off of *O. hirtellus* is the taxon *O. hirtellus* subsp. *setarius*, which is only present in Africa in small quantities but has its main presence on the American landmass.

The type of *O. hirtellus* subsp. *fasciculatus* is distinguished through its short inflorescence branches (the bottommost being 0.5 to 1.5 cm long) and clustered spikelet arrangement. On the bottommost side shaft there are (7) to 15 spikelets. The inflorescence shaft and the sheath surface are usually hairless. The outer glumes are 5- to 7-nerved; the bottom lemma is 9-nerved. *O. hirtellus* subsp. *fasciculatus* comes predominantly from and is very common in tropical Africa. On the other hand, in South America the predominate form is *O. hirtellus* subsp. *hirtellus*, which is distinct with its longer inflorescence branches and different spikelet arrangement. In Asia *O. hirtellus* subsp. *fasciculatus* is seldom found with such characteristics as mentioned above. One can trace multiple development pathways of this subspecies, namely in the direction of: 1) *O. hirtellus* subsp. *japonicus*, 2) *O. hirtellus* subsp. *capensis*, 3) *O. hirtellus* subsp. *setarius*, and 4) *O. hirtellus* subsp. *hirtellus*.

Let's consider next the development pathway to *O. hirtellus* subsp. *japonicus*. This subspecies is found in the tropical regions of East Asia and is set apart by its short or nonexistent inflorescence branches, diminished number of spikelets (2 to 6), and often its diminished number of nerves (3/5/7) in the area belonging to the glumes. In some rare cases one of these characteristics can be found in *O. hirtellus* subsp. *fasciculatus* on the African continent – there is, therefore, no possible distinct separation that can be made. *O. hirtellus* subsp. *japonicus* is not very consistent in its characteristics. Developmentally it is most likely a crossover form.

As shown in Fig. 21 there are multiple forms that come from the developmental link between *O. hirtellus* subsp. and *O. hirtellus* subsp. *japonicus*, the most important being the herein newly formed *O. hirtellus* subsp. *undulatifolius*. This taxon, whose main distribution is in north Italy and the subtropical area the Black and Caspian seas, exhibits in these geographical areas a strong, consistent pattern of characteristics. The inflorescence shaft, sheath surface, and also the sheath edges are always thickly long haired. The inflorescence branches are very short or nonexistent. The spikelets are clustered in groups of 2 to 5, and an individual spikelet measures (2.6) to 3.3 to (3.8) mm long; the outer glumes are always 3- to 5-nerved and the bottom lemma is 7-nerved.

In the examination of this plant range *O. undulatifolius* has always been overlooked; the typical features of the European material are disappearing and in their place distinct characteristics of *O. hirtellus* subsp. *japonicus* have emerged. According my investigation *O. undulatifolius* is found in the East Asian region with the typical characteristics only when totally isolated, usually, however, one or more of the characteristics are mutated and the plants show a tendency to *O. hirtellus* subsp. *japonicus*. Examples of this can be found in the following sources: India, Suala: Duthie 10136, W (Nervature of the glumes: gl I: 5, g II: 7, l I: 9; bottommost side shaft 1 cm long); Iran, Andavar: Wendelbo & Assadi 14566; E (Plant robust, spikelets 3.7 mm long inflorescence branches 0.7 cm long, main shaft and sheath surface hairless).

Several African specimens that resemble *O. hirtellus* subsp. *undulatifolius* with many similar features descend most likely from a chance mutation, and are, therefore, converging forms seeing that such a mixture of an African and European population appears to me to be highly unlikely. The source: Italy: Lange s. n., features a 2.5 cm long side shaft, while all other characteristics and all further inflorescences clearly resemble *O. hirtellus* subsp. *undulatifolius*. It follows, therefore, that also the characteristic of "side shaft length" varies and is not a good indicator of taxonomical separation.

A discrepancy regarding nomenclature of this taxon is referred to by Smith (1979), who did not view the combination founded in *Panicum undulatifolium* Ard. with *Oplismenus* or *Orthopogon* as valid, because in the work of Ardino the binary nomenclature was not consistently used. Wilmott (1935) mentions that the binary Nomenclature was used only unclearly by Ardino in

the first edition of the work. In the second edition from 1764, where *Panicum undulatifolium* is described, this relationship is correct.

From *O. hirtellus* subsp. *japonicus* another taxon is derived, this one found only in East Asia: *O. hirtellus* subsp. *tsushimensis*. It is found only in Japan and is distinguished from *O. hirtellus* subp. *japonicus* through the strong approximation of its inflorescence branches and spikelet clustering. Thereby the inflorescence functions almost like a homogeneous spike or compact raceme. Crossover forms toward *O. hirtellus* subsp. *japonicus* are also encountered. On the inflorescence shaft, an otherwise *O. hirtellus* subsp. *tsushimensis* conforming plant, the spacing between the two bottommost spikelet clusters measures 1cm (Japan, Nikko: Tateoka s. n.; E).

A third complex that deviates from *O. hirtellus* subsp. *japonicus* contains three new taxa introduced by the author: *O. hirtellus* subp. *imbecillis*, *O. hirtellus* subp. *microphyllus*, and *O. hirtellus* subp. *psilostachys*. These taxonomic classifications were necessary since the taxa posess different morphological characteristics from the above mentioned subspecies, but are nonetheless related to them through crossover forms. In the case of *O. hirtellus* subp. *imbecillis* there is a geographic distinction with a center on the Philippines, while meanwhile this is not possible with the other two taxa, seeing that outside of the specimen types no known sources exist.

O. hirtellus subsp. *psilostachys* resemble *O. hirtellus* subp. *imbecillis* in habitus but differentiates itself through its 4mm long spikelets. This is another example that especially large spikelets are not always necessarily coupled together with strong growth.

O. hirtellus subsp. *imbecillis* is set apart by its especially delicate habitus, small lanceolate blades, and fewer inflorescences. However, a group of *O. hirtellus* subp. imbecillis, mainly from Australia, are somewhat more robust and have longer, similarly strong lanceolate blades and mainly shortly thick-haired spikelets.

O. hirtellus subsp. *microphyllus*, a rare taxon, is distinguished by its very small blades (none being longer than 2 cm) and spikelets that are arranged on the inflorescence shaft either alone or in pairs. It is possible that *O. hirtellus* subp. *microphyllus* is either only a distressed form of *O. hirtellus* subp. *imbecillis* or it is simply a very young taxon. Between these two closely related subspecies intermediate forms are found, which possess one or the other distinguishing features, but as a whole do not allow for a distinct special or sub-special separation: (Malaysia, Sarawak: Burtt 8339, E; Philippines, Luzon: Ramos & Edano 45004, G; Japan, Sagami: Mizushima 10107, C).

We will now trace the second developmental line of *O. hirtellus* subsp. *capensis*. The taxon, which must have been formed as a result of geographical differences, is found mainly in the subtropical areas of South Africa. Outside of that it, can also be found in Madagascar, tropical central Africa, and sporadically in West Africa, where it mixes with *O. hirtellus* subsp.

fasciculatus. *O. hirtellus* subsp. *capensis* is characterized by its always hairless ligules, nonexistent inflorescence branches, and hairless, 3.7 to 5.6 mm long spikelets that are arranged either alone or in pairs on the main shaft. If these features were consistent in overlapping areals, then it would be enough for a special separation. This is, however, not the case and that is why it appears most likely to be a sub-species with geographical differences. Intermediary forms are also frequently found; for example, the following sources: South Africa: Luxton 414, Mo; Natal: Harrison 428, M; Cap. Prov.: Drege s. n., G; Duiwelskloof: Bos 1139, B; Mozambique, Beira: Torre 4018, BM; Zaire, Lac Kivu: Humbert 7425, P; Gabon, Franceville: Descoings 6584, P; u. a. m.

The intermediate forms are usually recognizable by their numerous spikelets, singular, longer inflorescence branches, or thicker haired ligules.

This developmental line is traceable from Madagascar by way of Mauritius to India, where a mutated form *O. hirtellus* subsp. *capensis* is found. This form is known as *O. hirtellus* subsp. *acuminatus*. Common also to this subspecies are large and only rarely hairy spikelets and greatly diminished inflorescence branches. In contrast to *O. hirtellus* subsp. *capensis* the number of spikelets in the bottom part of the inflorescence is usually 5 to 7 per cluster. This areal classification of South Africa to India is noteworthy, as it is supported by Wegner's continental drift theory.

We will now discuss the developmental branch of *O. hirtellus* subsp. *hirtellus*. This taxon is distinguished by its usually strong growth, longer inflorescence branches, and thick, multi-rowed, consecutively arranged spikelets. In Africa as well as in America there are intermediary forms in the direction of *O. hirtellus* subsp. *fasciculatus*: Bolivia, Santa Cruz: Steinbach 7010, G; Martinique, M. Parnasse: Hahn 147, G. Sometimes there are also intermediary forms found between *O. hirtellus* subsp. *hirtellus* and subsp. *capensis*: Zimbabwe, Umtali: Crook 880, M; Madagascar: Vignier and Humbert 1530, B: inflorescence branches 1 cm long, spikelets hairless and arranged in rows of six, ligules hairless.

Another taxon, this one widespread in America, *O. hirtellus* subsp. *setarius* should be viewed as a fourth developmental line. These are delicate plants with very short inflorescence branches and clustered spikelets that are mostly approx. 2.7 mm long, bunched together in groups of 4 to 10 to (15). The American version is partly identified as being *O. undulatifolius*. *O. hirtellus* subsp. *setarius* differentiates itself from this taxon by having no hair on the inflorescence shaft and sheath surface, the nervature of its glumes (Gl I: 5, Gl II: 7, and L I: 9), and larger spikelet clusters. However a specimen was found in the Dominican Republic that distinctly resembles *O. hirtellus* subsp. *undulatifolius*: Gl I 3- to 5-nerved, inflorescence shaft thickly haired: Ritter s. n., W. It appears to be a mutation in the direction of *O. hirtellus* subsp. *undulatifolius*. One could, however, also assume that such taxa can develop in multiple places. The presence of *O. hirtellus* subsp. *setarius* in West Africa with unique feature similarities with the American plant

also supports this view: Benin: Cotonou: Froment 1052; BR; Cameroon, Dehane: Dinklage 377, HBG. – With the close relations and the few criteria we, therefore, come to the conclusion that a polyphyletic developmental path of the species or subspecies is not to be ruled out.

13.4.2. *Oplismenus compositus*

We turn now to the world's second most distributed species, *O. compositus*. This species distinguishes itself from *O. hirtellus* with the development of its especially longer inflorescence branches (up to 10 cm) and the nonexistence of an awn on the lemma I. There are four distinct varieties: *O. compositus* var. *compositus*, var. rariflorus, and var. *sylvaticus*. *O. compositus* was mentioned up to this point for only its main Asian distribution. It could, however, be possible that it is also present in America. This is also how *O.* rariflorus was described. However, as previously mentioned, it is also distributed throughout Asia. Both taxa distinguish themselves through the length of their spikelets and their differing habitus.

The third taxon we need to discuss is *O. compositus* var. *sylvaticus*. It is found only in Mauritius and sets itself apart with shorter inflorescence branches (the bottommost is 2.5 to 3 cm long) and more compactly positioned spikelet pairs than are found in the other two varieties. This taxon also resembles *O. hirtellus* subsp. *hirtellus*, but differs mainly by not having an awn on the lemma I. In spite of this, this taxon appears to be a connecting link between both species, justifying in this case a special separation. In all the remaining areas of distribution the species are easy to identify, making it advisable to keep this classification, in the which I concur with the opinion of Davey and Clayton (1977).

13.4.3.

Oplismenus aemulus

The third species in this section is *O. aemulus* , is very similar to *O. compositus* and also appears to be a connecting link to *O. hirtellus*. This species, however, is very different and needs remain in separate taxa from *O. compositus* var. *sylvaticus*. Because of the large variability this species, it must be divided in three varieties, namely *O. aemulus* var. *aemulus* , var. *flaccidus*, and var. *densiflorus*. Accordingly, quintessentially the same views as Domin (1915) are followed here. He used the variety classification "pilosus" for *O. aemulus* , which is distinct from the form referred to by the author as *O. aemulus* var. *densiflorus*, which is only found in New Guinea. However, the author is unfamiliar with this "pilosus", as referred to by Domin.

O. *aemulus* var. *aemulus* is distinguished by its distinct inflorescence branches (0.5 to 3.5 cm long), upon which 2.8 to 3.2 mm large spikelets are arranged consecutively, either in pairs or frequently alone. The bottom outer lemma usually has no awn and the whole inflorescence is thickly haired. In contrast, *O. aemulus* var. *flaccidus* has hairless inflorescence shafts and inflorescence branches, as well as usually only sparsely haired spikelets. The species *O. aemulus* and *O. flaccidus* are mentioned in many studies as synonyms for *O.* imbecillis. However, they distinctly distinguish themselves through the length of their inflorescence branches and their presence of awns. Sometimes, though, intermediary forms are found; their Habitus is delicate, their blades are small and lanceolate and their lower lemmahas no awn: New Guinea, Papua: Carr 11848, L; Australia, N. S. Wales: Pullen 4039, G.

The third variety in this range is *O. aemulus* var. *densiflorus* from New Guinea. In this taxon the inflorescence branches of the inflorescence are strongly approximated and also long haired like the main shaft. The awns on the three outermost glumes are, however, the most distinct of all the taxa. The awn of the Upper glumes 1.5 to 3.5 mm long and the awn of the Upper glume is 0.2 to (1.1) mm long; the bottom lemma has no awn. There is a unique population found in Africa that is very similar to *O. aemulus* var. *densiflorus*. The inflorescence branches are also approximated, the spikelets are small (2.6 mm long), and has rather short awns: Africa: Richard s. n.; Zaire: Hens 157.

13.5. A comparison of the taxa in tropical and extra-tropical areals

We will now investigate whether the taxa of the genus in the tropical regions are morphologically different from those of the extra-tropical regions. The boundaries of the tropical areas are depicted in Fig. 45, as defined by Küchler (1961) according to climate and vegetation maps. When one compares the boundaries depicted with specific *Oplismenus* taxa, then it becomes apparent that the taxa mentioned in Tab. 3 as "Tropical Taxa" have a purely tropical distribution.

Fig. 45: Boundaries of the tropical regions according to Küchler (1961).

Fig. 46: Glaciation of the Alps according to Gams (1936). Black areas: Areas that have remained free of ice.

The taxa with a purely subtropical areal include *O. hirtellus* subp. *japonicus*, subsp. *tsushimenis*, and subsp. *undulatifolius*. In contrast, the taxa in Tab. 3B have a focus of distribution in a tropical areal but have specimens in subtropical areals or vice versa.

The variability of the taxa is quite large in the tropical as well as the subtropical regions for the four listed characteristics. A tendency for the subtropical taxa to have short or nonexistent inflorescence branches is easy to note in this table. This tendency is also present here and there throughout the tropical taxa (*O. hirtellus* subsp. *microphyllus*, subsp. imbecillis). Through this investigation we are able to derive that one can in no way say that in the subtropical regions the taxa are mainly delicate, small bladed, and small awned - meaning that these taxa are no more than "trouble case" plants that grow in the tropics under better ecological and climatic conditions, as Schlectendahl (1861-62) in connection with culture experiments suggested.

A:	Tropical taxa											Subtropical Taxa		
	aff.	humb.	baron.	burm.	lanat.	rarifl.	sylv.	flavio.	grac.	micro.	psilost.	jap.	tsush.	und.
Habitus	s-k	s	s	s	s	s-n	k	n	s-n	s	s	n	n-k	s-n
Undermost side shaft (cm)	0.5 - 1.5	0.5 - 1.5	1.5	0.5 - 1.5	0.5 - 1.2	1.5 - 5.0	2.5 - 3.0	1.5 - 2.0	5.0 - 6.0	-	-	0 - 0.5	0 - 0.5	0 - 0.5
Spikelets (mm)	3.5 - 4.0	3 - 3.3	2.7 - 3.0	2.8	3.0 - 3.5	2.6 - 3.2	2.4 - 4.1	3.8 - 4.0	1.5 - 1.8	2.7 - 3.1	4	3.6	3.2	3.3
Blade length (cm)	3.0 - 5.0	3.0 - 5.0	1.5 - 2.5	3.0 - 7.0	3.0 - 7.0	4.0 - 8.0	4.0 - 8.0	6.5 - 10	5.0 - 7.0	1.5 - 2	3.0 - 4.0	4.0 - 8.0	4.0 - 6.0	3.0 - 9.0

B:	Taxa with a tropical focus								Taxa with a subtropical focus		
	aem.	densifl.	flacc.	comp.	hirt.	fasc.	imb.		acum.	cap.	set.
Habitus	s - n	s - n	s - n	n - k	n - k	n	s		n	s - n	s - n
Undermost side shaft (cm)	1.5 - 2.5	1.5 - 2.5	0.5 - 3.0	6.0 - 10.0	1.0 - 3.0	0.5 - 1	-		-	-	0 - 0.3
Spikelets (mm)	2.8 - 3.2	2.8 - 3.2	2.4 - 3.1	3.6	3.6	3.4	3.1		4.3	4.5	2.7
Blade length (cm)	3.0 - 8.0	3.0 - 8.0	5.0 - 7.0	4.0 - 9.0	5.0 - 12.0	3.0 - 10.0	2.0 - 5.0		3.0 - 8.0	3.0 - 7.0	2.0 - 6.0

Tab. 3: Comparison between the tropical and subtropical taxa.

13.6. The disjunct areal of *O. hirtellus* subsp. *undulatifolius*

The taxa in the genus *Oplismenus*, outside of *O. hirtellus* subsp. *undulatifolius*, all have a more or less continuous areal. The boundaries of both tropical and subtropical areals are fluidic and indicate a slow migration to larger regions. In contrast, the disjunct areal of *O. hirtellus* subsp.

undulatifolius is of note (Fig. 39). This taxon is found more or less only in subtropical regions of Eurasia. Its focus of distribution is in the southern parts of Switzerland and northern Italy (Fig. 40). The region contains discovery locations in the valleys of the Maritime Alps (Aosta), in Ticino and Graubünden, in South Tyrol near Bozen and Meran, around Lake Garda, in the area around the Po River, and in the East Italian area near Friaul. Literary records report specimen finds on Istria (Schlosser & Farcas 1869). It appears that Degen (1936) investigated the original discovery locations and discovered that nowadays the taxon is not present at any of the given locations. The sources from the South Tyrol area are from the beginning of the century and it was no longer clear, whether the subspecies was extinct or not. Kiem (1974) found evidence that spoke towards the species continued existence. He found that the most of original areas of growth had suffered some sort of city building, but he could report (1978) to have found an area of recent growth near Burgstall.

The southern European map depicting the taxon's distribution was authored using data from another map made by Pampini (1903) and written entries from Becherer (1966). Outside of this defined areal, some specimens of *O. hirtellus* subsp. *undulatifolius* were found by Vayreda (1931) in northern Spain, Olot, Prov. Gerona and Becherer (1966) in the Swiss canton Geneva, Chancy, northern part of the Bouchet forest. Both specimens are most likely not from natural distribution. Becherer (1966) reports that in 1963 and 1964 multiple smaller growth colonies were found in the areas mentioned above, and that these plants could not naturally be found there, seeing that these areas are frequented by Genevoean botanists and they would have long ago discovered these colonies.

In Quatre Flores de France P. Fourier (1961) mentions the presence of the taxon on the Italian Riviera. In France, however, it has not been found.

O. hirtellus subsp. *undulatifolius* has another relatively well defined areal in the Caucasus Mountains with distributions in Turkey (near Rize and the Amanus mountains) and in northern Iran as well (Fig. 41). The distribution data for this area was filled in by a map authored by Grossheim (1939). Outside of these areas specimens of this subspecies have only been found in India, China, and Japan. These finds, however, do not make up a separate areal, but are rather isolated cases. The eastern open-end of this areal overlaps with the areal of *O. hirtellus* subsp. *japonicus*.

The following remarks are aimed towards explaining the disjuncted areal belonging to *O. hirtellus* subsp. *undulatifolius*. The European areal is neither a tropical nor subtropical area, so there must be weighty reasons why a single taxon of a genus that normally grows only in tropical and subtropical regions is found here. Accordingly, two possible hypotheses can be conceived: 1) *O. hirtellus* subsp. *undulatifolius* is a Tertiary Relict, which are sometimes present in the Alps in other relationship circles. 2) The taxon migrated or was brought here after the Ice Age and established itself in places with a suitable climate.

Next, we will define the term "Tertiary Relict" and identify patterns of distribution of such relicts. Before the Ice Age, Central Europe had a subtropical ocean climate (Wettstein 1896; Brockman-Jerosch (1926). This is proven by the fact that many fossil finds nowadays are only of tropical and subtropical species. As the climate began to worsen, many of these warm-weather species went extinct or retreated to areas with a more temperate climate. The flora of the Alps underwent an important change. Based on Gams (1936), the glacation of the Alps is pictured in Fig. 46. This map shows that only a few areas, especially those on the southern boundary of Alps remained free of glaciers. According to Szafer (1975) and Pitschmann & Reisigl (1959) a plant is referred to as a Tertiary Relict only when it can be proven that the species survived the Ice Age in the same areas where it is found today.

Braun-Blanquet (1923) gives some arguments for the tertiary beginnings of a few species. The species are systematically isolated, therefore there are no crossover forms in this specific area with any related species. Tertiary Relicts are very ecologically adapted but are rather one-sided. They have lost the abilities to broaden their areal and variety, leading to a dividing up of the areal. Oftentimes these conditions lead to a disjuncted areal. Wettstein (1896) brings to our attention that Tertiary plants are very fragmentarily distributed and usually consist of only one species. In some areas, seeing that there was no Ice Age since this initial Tertiary adaptation, an unbroken developmental chain has been possible (i.e., in the regions of East Asia), and many different taxa have come into existence. Engler (1879) and Gams (1936) now see a relationship between the European Tertiary Relict and the Colchian regions (Caucasus), Himalaya, and Japan. Their connecting links, however, were broken by the Ice Age so that nowadays only the Tertiary plant is found in these same areas where the species originally sought refuge from the worsening climate. Wettstein (1896) viewed certain specimens that grow in the Alps along side other species as evidence of this Tertiary adaptation. The plants related closest to them are found in tropical areas.

Before we test *O. hirtellus* subsp. *undulatifolius* according to these criteria, a general description and investigation of the Insubric climate of its European areal will be given. This area contains both Mediterranean and oceanic zones. The amount precipitation this area receives is considerably higher than most parts of Europe and especially more than the Central Mediterranean region. Hofer (1967) reports an average precipitation amount of 1300 to 2000 mm per year. Braun-Blanquet (1961) reports 950 to 1100 mm precipitation per year for the morainal region around Ivrea and 2000 mm for Ticino (in extreme cases, even up to 2500 mm). Brockman-Jerosch (1913) reports 1700 mm precipitation per year for Locarno and Pitschmann & Reisigl (1965) report 1441 mm for the Lake Como and 1500 to 2000 mm for Lake Lugano. According to their data the area around Lake Garda also receives high amounts of precipitation. Also the average temperature for July in Lugano is reported as being 21.5 °C, and the yearly average as 11.4 °C. As is apparent, in this area there are mild winters coupled with high amounts of precipitation. There is also a low level of both cloudiness and fog. Hofer (1967) reports that Locarno has the highest actual and relative amount of sunshine for all of Switzerland. He states that good climate in southern Switzerland is due to the shielding provided by the Alps from cold air masses from

the east and north and the inability of these same cold air masses to form there due to the relief-dependant air circulation.

One could also assume that *O. hirtellus* subsp. *undulatifolius* grows in places in Europe that have a nearly subtropical mini-climate. If this were the case, a distribution according to purely ecological criteria would also seem logical. In order to discover the possible beginning point of the Tertiary Relict, we will compare the taxon with a map authored by Szafer (1975) that details ecological tertiary areas of refuge. Upon viewing this map it is clear that the only area of refuge on the European continent is on the Balkan Peninsula. Other areas, these being outside of Europe, include the Caucasus, between the Black and Caspian Seas, in Central Asia, and in East Asia. Additionally, Wettstein (1896) lists other refuge areas in northern Spain and in the lowlands around the Alps.

O. hirtellus subsp. *undulatifolius* meets some of the requirements out lined by Braun-Blanquet (1923) for a plant to be termed a Tertiary Relict: No related taxa are found on the European continent and its characteristics vary little, which points toward an older range of plants. Also, the previously mentioned ecological specialization and adaptation are present, since larger populations of the subspecies are found only in damp, wet forested areas. The amount of precipitation must be very high. – The ability to enlarge its areal, however, has not completely disappeared; Becherer (1966) gives report of the discovery of new specimens in a forest near Geneva which were observed over several years and showed an increase in population. Also in South Tyrol have other such new discoveries been made. How intact the northeastern Spanish areal is today is determinable. Far and wide, though, the areal and the taxon itself are largely nonexpanding and possible candidates to be termed a Tertiary Relict.

In Fig. 46 (from Gams 1936) the zones that remained free of ice are pictured on the northern and southern boundaries of the Alps. The glaciers that entirely covered both the Ticino and South Tyrol valleys are easily recognized. It follows then that the two modern areas which are the main places of distribution for *O. hirtellus* subsp. *undulatifolius* were, according to Gams, entirely covered with glacial ice. The glacation of the area around Lake Garda is depicted by Pitschmann & Reisigl (1959). Here, also, there remain only a few, small square kilometer sized areas free of the glacial ice, even when Pitschmann (1965) declares the areas around Bresciano and Bergamo in the Alps as having permanently remained free of ice. According to these findings one must either wholly reject or at least strongly doubt the hypothesis that *O. hirtellus* subsp. *undulatifolius* is a Tertiary Relict. If we use the definition given by Szafer, the taxon is not actually a Tertiary Relict, since the historical areal does not coincide with the modern. There is also just as little evidence to suggest that the population migrated out of its original area of distribution into areas of refuge from the worsening climate, and then afterwards returned to its modern area of distribution. In this case there would surely be leftover populations located in the Tertiary refuge areas (as suggested by Szafer (1975)), i.e. on the Balkan Peninsula; which is not the case.

It is more likely then that the present-day areal traces back to a post Ice Age migration of the taxon, which came out of East Asia, passed through the ecologically favorable areas of the Caucasus, and found root in northern Italy. It should, however, be made clear that the question cannot be totally settled due to a few of the above mentioned facts (isolated locations in the ecological system, disjunt areal, and ecological specialization), which all speak in favor of the taxon being termed a Tertiary Relict. Seeing that there have been no direct studies on samples of pollen finds conducted, the above mentioned ideas connected to dealing with the investigation of this question must suffice.

14. Taxa dubia

Hekaterosaehne elatior Steud., Syn. Pl. Glum. I: 118 (1854). - Type: New Zealand; n. v. Notes: According to the original description, this is most likely not an *Oplismenus* species.

Oplismenus compositus (l.) P. Beauv. var. brachyphyllus Trin., Ic. Spec. Gram.: Tb. 190 b (1828). – Type: No entry.. Notes: According to the depiction by Trinius, it is most likely a shortly branched Form of *O. compositus* var. *rariflorus*.

Oplismenus gracilis Schlecht., Linnaea 24: 649 (1851). - *Panicum* ischnocaulon Steud., Syn. Pl. Glum. I: 45 (1854). - Type: cult. "ab hortulano Halensi cl. Wolfhagen accepimus". Notes: Possibly a species of *Oplismenus* sect. *Scabriseta*. It distinguishes itself form all other species with its 1-nerved glumes. The awn of the Lower glume should only be 3.5 mm long, and the awn on the Upper glume, in contrast, 9 mm long. Eventually there will be a switch between the glumes.

Oplismenus setarius (Lam.) Roem. & Schult. f. sterilis F. Brown, Bernice P. Bishop Mus. Bull. 84: 68 (1931). – Type: Marquesas, Hivaoa, Feani: F. Brown 1034; BISH, Holotype, n. v. - Marquesas, Hivaoa, Atuona: F.. Brown 841, BISH, Paratype. - Marquesas, Nukuhiva, Taipi Vai: F. Brown 593, BISH, Paratype. Notes: Because these are sterile plants, it is impossible to distinctly classify them. F. Brown 841 probably does not belong in the genus *Oplismenus* due to it differing ligule. F. Brown 593 possibly belongs to *O. hirtellus* f. *lanceolatus* due to its vegetal characteristics and areas of distribution.

Orthopogon cubensis Spreng., Syst. Veg. I: 307 (1824, t. p. 1825). - Echinochloa cubensis (Spreng.) Schult., Mant. II: 596 (1824). - *Oplismenus* cubensis (Spreng.) Kunth, Rev. Gram. I: 45 (1829). - *Panicum* cubense (Spreng.) Steud., Nomencl. Bot. 2. ed. II: 255 (1841). - Type: Cuba n. v. Notes: = *O. hirtellus* (l.) P. Beauv., fide Hitchcock & Chase (1951), without Typical investigation.

Orthopogon trichoides Link, Hort. Berol. I: 203 (1827). - Type: cult. "habitat Indis orientalis?"; n. v. Notes: Most likely a culture variant of *O. hirtellus* subsp. *undulatifolius*.

Panicum brevisetum (Ness ex Steud.) Steud., Syn. Pl. Glum. I: 46 (1854). - *Oplismenus* brevisetus Nees ex Steud., Syn. PI. Glum. I: 46 (1854), pro syn. - Type: Guarea: Cuming s. n., in Herb. Lindley (CGE?). Notes: According to the original description, this is possibly *O. affinis*.

Panicum elatius L. f., Suppl.: 107 (1781). – *Oplismenus* elatior (L. f.) P. Beauv., Ess. Agrost.: 54 (1812). - Type: Malabaria; n. v. Notes: According to the original description, this is ver similar to *O. compositus*

Panicum incanum Schum. & Thonn., Beskr. Guin. Pl.: 60 (1827). - Type: Guinea: Thonning; n. v., C. Notes: It could be a studied sterile source specimen from the Thonning Herbarium, C, whose classification was not possible.

Sorghum saccharatum Host, Gram. Austr. IV: 48 (1809). Notes: = *O. undulatifolius*, fide Kew Index.

15. Species excludendae

Oplismenus abortivus auct. ex Roem. & Schult., Syst. Veg. II: 808 (1817). - Vetiveria ziganoides (L.) Nash; fide Chase & Niles (1962).

Oplismenus abortivus (R. Br.) Desv., Opusc.: 82 (1931). = Vetiveria sp.; fide Stapf (1934).

Oplismenus angustifolius E. Fourn., Mex. Pl. 2: 40 (1886). = Echinochloa sp.

Oplismenus anomalus Mez ex Peter, Feddes Repert. Spec. Nov. Regni Veg ., Beih. 40,1 A: 200 (1938). - Type: "D. *O.* Afrika, Konde: Rungew", Stolz 1272, n. v. (B, destr.?) = Chloachne oplimenoides (Hack.) Stapf ex Robyns; fide Clayton (1972).

Oplismenus benthamii (Steud.) Coredem., Fl. Ile Réunion: 118 (1895). = Alloteropis paniculata (Benth.) Stapf; fide Clayton (1972), als "*Panicum* benthamii Steud.".

Oplismenus colonus (L.) H.B.K., Nov. Gen. et Spec.: 89 (1816). = Echinochloa colona (l.) Link; fide Gould et al. (1972).

Oplismenus crus-corvi (L.) Dumort., Obs. Belg.: 138, 151 (1823). = Echinochloa sp.; fide Chase & Niles (1962).

Oplismenus crus-galli (L.) Dumort., Obs. Belg.: 138 (1823). = Echinochloa crus-galli (L.) P. Beauv.; fide Gould et al. (1972).

Oplismenus crus-pavonis H.B.K., Nov. Gen. et Spec. I: 88 (1816). - Type: "crescit in aricis calidissimis Provinciae Cumanensis prope Bordones - Venezuela." = Echinochloa crus-pavonis (H.B.K.) Schult., fide Gould et a1. (1972).

Oplismenus cuspidatus Kunth, Rev. Gram. I: 45 (1829). = Echinochloa sp.; fide Chase & Niles (1962).

Oplismenus daltonii (Parl. ex Webb.) Schmidt, Beitr. Fl. Cap. Ver. Ins.: 136 (1852) = Echinochloa colona (L.) Link; fide Chase & Niles (1962) .

Opl ismenus discolor (Trin.) Kunth, Rev. Gram. I: 45 (1829). = *Panicum* sp.; fide Chase & Niles (1962).

Oplismenus dubius Kunth, Rev. Gram. I: 44 (1829). = Echinochloa crus-galli (1.) P. Beauv.

Oplismenus echinatus Kunth, Rev. Gram. I: 45 (1829). = Echinochloa sp.

Oplismenus erianthos (Poir.) Kunth, Rev. Gram. I: 45 (1829). = Anthaenantia villosa (Michx.) P. Beauv.; fide Hitchcock & Chase (1917).

Oplismenus fasciculatus (Lam.) Roem. & Schult., Syst. Veg. II: 487 (1817). = Coridochloa cimcina (L.) Nees; fide Chase & Niles (1962).

Oplismenus festucaceus Mez, Notizbl. Bot. Gart. Berlin-Dahlem 7: 54 (1917). - Type: "Madagascar, in silva Amboh mitombo", Forsyth-Major 209; B. = Poecilostachys baronis Stapf.

Oplismenus festucoides (Nees) Kunth, Enum. Pl. I: 146 (1830). = Chaetium festucoides Nees; fide Chase & Niles (1962).

Oplismenus forsteri Kunth, Rev. Gram. I: 45 (1829). = Echinochloa sp.

Oplismenus frumentaceus Kunth, Rev. Gram. I: 45 (1829). = Echinochloa crus-galli (L.) P. Beauv. var. frumentacea (Roxb.) W. F. Wight; fide Gould et al. (1972).

Oplismenus helvolus (L.) P. Beauv., Ess. Agrost.: 54 (1812). = Chaetochloa sp.; fide Niles & Chase (1925).

Oplismenus hildebrandtii Mez, Feddes Repert. Spec. Nov. Regni Veg. 17: 83 (1921). - Type: Madagascar: Hildebrandt 3759, B. = Poecilostachys hildebrandtii Hack.

Oplismenus hirsutus (Roxb.) Koen. ex Schult., Mant. II: 271 (1824). = *Panicum* javanicum Poir.; fide Hooker (1897) .

Oplismenus hirtus Heyne ex Roem. & Schult., Syst. Veg. II: 484 (1817). - Type: "In India orlentalis", B. Heyne s. n. = Echinochloa hirta Schult.

Oplismenus hispidulus (Retz.) Kunth, Rev. Gram. I: 44 (1829). - Type: Ind. or.: Koenig (BM?). = Echinochloa hispidula (Retz.) Keng; fide Chase & Niles (1962).

Oplismenus hispidus (Muhl.) Wood., Class-Book, ed. 2: 604 (1847). = Echinochloa walteri (Pursh) Heller; fide Gould et al. (1972).

Oplismenus holciformis H.B.K., Nov. Gen. et Spec. I: 88 (1816). - Type: "crescit in humidis montanis prope Cinapecuaro", Mexico: Humboldt & Bonpland 4362 (P?). = Echinochloa holciformis (H.B.K.) Chase; fide Chase & Niles (1962).

Oplismenus hookeri Parl., Ottova Riun. Sc. Ital.: 586 (1846). = Echinochloa sp.

Oplismenus intermedius (Vahl ex Hornem.) Kunth, Rev. Gram. I: 45 (1829). = Echinochloa sp.

Oplismenus jamaicensis Kunth, Enum. Pl. I: 147 (1833). = Echinochloa crus-pavonis (H.B.K.) Schult.; fide Gould et al. (1972).

Oplismenus javanicus Roem. & Schult., Syst. Veg. II: 891 (1817). = *Panicum* javanicum Poir.

Oplismenus lanceolatus (Retz.) Kunth, Rev. Gram. I: 45 (1829). - Type: "Ind. or." Koenig (BM?). = Echinochloa lanceolata (Retz.) P. Beauv.

Oplismenus lappagoides Speg., Anal. Mus. Nac. Buenos Aires 3,2: 7 (1903). = Pseudechinolaena polystachya (H.B.K.) Stapf; fide Cabrera (1970).

Oplismenus limosus K. B. Presl, Rel. Haenk. I: 321 (1830). - Typus: "In insula Luzon", Haenke s. n., PR. = Echinochloa crus-galli (L.) P. Beauv.

Oplismenus longisetus (Torr.) Kunth, Rev. Gram. I: 45 (1829). = Echinochloa walteri (Pursh) Heller; fide Gould et al. (1972).

Oplismenus magellanicus Roem. & Schult., Syst. Veg. II: 485 (1817). = Centosteca latifolia (Osb.) Trin.; fide, Manod de Froideville (1971).

Oplismenus margaritaceus (Link) Kunth, Rev. Gram. I: 44 (1829). = Echinochloa sp.; fide Chase & Niles (1962).

Oplismenus minarum Nees, Agrost. Bras.: 268 (1829). - Type: "Brasilia, Paranàn, Villa Ricca, prov. Rio Negro"; M.= Ichnanthus minarum (Nees) Doell.

Oplismenus muricatus (Michx.) Kunth, Rev. Gram. I: 44 (1829). = Echinochloa muricata (P. Beauv.) Fern.; fide Gould et al. (1972).

Oplismenus muticus R. A. Philippi, Anal. Univ. Chil. 93: 714 (1896). - Type:, "In praedia Mansel (prov. O'Higgins) orn. Nathanis. Miers Cox legi". = Echinochloa colona (L.) Link; fide Cabrera (1970).

Oplismenus nossibensis Mez, Notizbl. Bot. Gart. Berlin-Dahlem 7: 53 (1917). - Type: Madagascar, Nossibé: Hildebrandt 3354, B. = Cyphochlaena madagascariensis Hack.

Oplismenus oplismenoides Speg., Anal. Mus. Buenos Aires 9: 7 (1903). = Pseudechinolaena polystachya (H.B.K.) Stapf; fide Cabrera (1970).

Oplismenus penicillatus (Nees) Kunth, Rev. Gram. I: 45 (1829).= *Panicum* penicillatum Nees; fide Chase & Niles (1962).

Oplismenus pictus Kunth, Enum Pl. I: 144 (1830). = Echinochloa crus-galli (L.) P. Beauv.

Oplismenus polystachyus H.B.K., Nov. Gen. et Spec. I: 88 (1816). = Echinochloa polystachya (H.B.K.) Rojas; fide Chase & Niles (1962).

Oplismenus prostratus Edgew., J. Linn. Soc. Bot. 6: 195 (1862). = *Panicum* setigerum Retz.; fide Hooker (1897) .

Oplismenus pseudocolonus (Roth) Kunth, Rev. Gram. I: 44 (1829). = Echinochloa colona (L.) Link; fide Kew Index.

Oplismenus pseudoundulatlfolius (Roem. & Schult.) Kunth, Rev. Gram. I: 44 (1829). = *Panicum* pseudoundulatiofolium Roem. & Schult.; fide Kew Index.

Oplismenus repens K. B. Presl, Rel. Haenk: I: 321 (1830). - Type: Mexico: Haenke s. n. PR. = Echinochloa colona (L.) Link.

Oplismenus sabulicolus (Nees) Kunth, Enum Pl. I: 145 (1833). - Type: "In arenosis Parae. Sieber". = Echinochloa crus-pavonis (H.B.K.) Schult.; fide Gould et al. (1972).

Oplismenus scaber (Lam.) Kunth, Rev. Gram. I: 44 (1829). = Echinochloa crus-galli (L.) Link; fide Hooker (1897) .

Oplismenus secundus K. B. Presl, Rel. Haenk. I: 322 (1830). - Type: "In Peruviae montanis huanoccensibus", Haenke, PR, n. v. = Ichnanthus minarum (Nees) Doell.; fide Chase & Niles (1962).

Oplismenus semialatus Desv., Opusc.: 81 (1831). = Axonopus semialatus Hook. f.; fide Kew Index.

Oplismenus spectabilis (Nees) Kunth, Enum Pl. I: 145 (1833) = Echinochloa spectabilis (Nees) Link.

Oplismenus stagni nus (Retz.) Kunth, Rev. Gram. I: 44 (1829). = Echinochloa stagnina (Retz.) P. Beauv.; fide Chase & Niles (1952).

Oplismenus strictus Schult., Mant. II: 272 (1824). = Arundinella Wallichii Nees ex Steud.

Oplismenus tenuis K. B. Presl, Rel. Haenk. I: 319 (1830). – Type: Mexico, Haenke, PR. = Ichnanthus tenuis (K. B. Presl) Hitchcock; fide Chase & Niles (1962).

Oplismenus tomentosus Schult., Mant. II: 272 (1824). Setaria verticillata·P. Beauv., fide Kew Index.

Oplismenus volkensii (Pilger) Mez ex Peter, Feddes Repert. Spec. Nov. Regni Veg., Beih. 40,1 A: 222 (1938). - Type: East Afrika, Kilimanjaro: Volkens 1278, B. = Achritochaete volkensii Pilger.

Oplismenus walteri (Muhl.) Kunth, Rev. Gram. I: 45 (1829). = *Panicum* hemitomon Schult.; fide Chase & Niles (1962).

Oplismenus zelayensis H.B.K., Nov. Gen. et Spec. I: 89 (1816). = Echinochloa crus-galli (L.) P. Beauv. var. zelayensis (H.B.K.) Hitchcock; fide Abrams (1953).

Orthopogon abortivus (R. Br.) Spreng., Syst. Veg. I: 306 (1824 t. p. 1825). = Chamaeraphis spinescens Poir.; fide Chase & Niles (1962).

Orthopogon agrostoides Trev. ex Steud., Nomencl. 2. ed. II: 234, pro syn. = Arundinella brasiliensis Raddi; fide Kew Index.

Orthopogon crus-galli (L.) Spreng., Syst. Veg. I: 307 (1824 t. p. 1825). = Echinochloa crus-galli (L.) P. Beauv.; fide Gould et al. (1972).

Orthopogon dichotomus Llanos, Fragm.: 38 (1851) = Echinochloa colona (L.) Link; fide Chase & Niles (1962).

Orthopogon echinatus Spreng., Syst. Veg. I: 307 (1824 t. p. 1825). = Echinochloa sp.

Orthopogon hirsutus Spreng. ex Steud., Nomencl. 2. ed. II: 234 (1841), pro syn. = Echinochloa spectabilis (Nees) Link; fide Chase & Niles (1962).

Orthopogon hispidus (Muhl.) Spreng., Syst. Veg. I: 307 (1824 t. p. 1825). = Echinochloa walteri (Pursh) Heller; fide Chase & Niles (1962).

Orthopogon halciformis (H.B.K.) Spreng., Syst. Veg. I: 307 (1824 t. p. 1825). = Echinochloa holciformis (H.B.K.) Chase; fide Chase & Niles (1962).

Orthopogon retzii Spreng. Syst. Veg. I: 307 (1824 t. p. 1825). = Echinochloa hispidula (Retz.) Keng; fide Chase & Niles (1962).

Orthopogon sqarrosus Spreng., Syst. Veg; I: 307 (1824 t. p. 1825). = Chamaeraphis spinescens Poir., fide Chase & Niles (1962).

Orthopogon stagninus (Retz.) Spreng., Syst. Veg. I: 307 (1824 t. p. 1825). = Echinochloa stagnina (Reti.) P. Beauv.; fide Chase & Niles (1962).

Orthopogon subverticillatus Llanos, Fragm.: 38 (1831). Echinochloa sp.; fide Chase & Niles (1962).

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17. Summary

In the previous monograph, the genus *Oplismenus* was discussed morphologically, anatomically, systematically, and areal-geographically using historical sources and self-performed study.

The genus was newly divided into two sections with 9 species and 18 infraspecific taxa.

There were a whole row of status changes that took place and 3 additional taxa were described: *O. hirtellus* subsp. *fasciculatus*, *O. hirtellus* subsp. *imbecillis* f. lanceolatus, and *O. aemulus* ver. *densiflorus*.

Epidermal investigation and chemical analysis of the sticky secretion of the awns (*Oplismenus* sect. *Oplismenus*) completed the morphological-systematical conclusions. These secretions could possibly belong to the family of Triterpenes.

It was attempted to explain the areal of the disjunctly distributed *O. hirtellus* subsp. *undulatifolius*; its origins as a Tertiary Relict were also discussed, but came to no suitable conclusion.

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19. Index

Oplismenus africanus P. Beauv.
Oplismenus africanus var. *capensis* Stapf
Oplismenus africanus var. simplex Stapf
Oplismenus albus Roem. & Schult.
Oplismenus angustifolius E. Fourn.
Oplismenus anomalus Mez
Oplismenus aristulatus Burcham
Oplismenus bakeri Schinz
Oplismenus baronii Camus
Oplismenus benthamii Cordem.
Oplismenus brasiliensis Raddi
Oplismenus brevisetus Nees ex Steud.
Oplismenus bromoides Baker
Oplismenus bromoides P. Beauv.
Oplismenus burmannii Mez
Oplismenus burmannii P. Beauv.
Oplismenus burmannii var. *burmannii*
Oplismenus burmannii var. intermedius Honda
Oplismenus burmannii var. *lanatus* Baker
Oplismenus burmannii var. multisetus U. Scholz
Oplismenus burmannii f. cristatus Hier. in Peter
Oplismenus burmannii Thwaites
Oplismenus capensis Hochst.
Oplismenus chondrosioides E. Fourn.
Oplismenus colonus H. B. K.
Oplismenus compositus Bauer
Oplismenus compositus P. Beauv.
Oplismenus compositus var. brachyphyllus Trin.
Oplismenus compositus var. *compositus*
Oplismenus compositus var. *imbecillis* Bailey
Oplismenus compositus var. intermedius Ohwi
Oplismenus compositus var. lasiorhachis Hack.
Oplismenus compositus var. *loliaceus* Hack.
Oplismenus compositus var. owatarii Ohwii
Oplismenus compositus var. patens Ohwii
Oplismenus compositus var. rariflorus U. Scho1z
Oplismenus compositus var. *setarius* Bailey
Oplismenus compositus var. *sylvaticus* U. Scholz
Oplismenus compositus f. glabratus F. Brown
Oplismenus compositus f. pubescens F. Brown

Oplismenus coreanus Nakai
Oplismenus cristatus K. B. Presl
Oplismenus crus-corvi Dumort.
Oplismenus crus-galli Dumort.
Oplismenus crus-pavonis H. B. K.
Oplismenus cubensis Kunth
cuspidatus Kunth
daltonii Schmidt
de*compositus* Nees
depauperatus E. Fourn.
discolor Kunth
dubius Kunth
echinatus Kunth
elatior P. Beauv.
erianthos Kunth
fasciculatus Roem. & Schult.
festucaceus Mez
festucoides Kunth
flaccidus Roem. & Schult.
flavicomus Mez
foliaceus P. Beauv.
formosanus Honda
forsteri Kunth
frumentaceus Kunth
gracilis Schlecht.
gracillimus Mez
helvolus P. Beauv.
hildebrandtii Mez
hirsutus Keon. ex Schult.
hirtellus P. Beauv.
subsp. *acuminatus* U. Scholz
subsp. *capensis* Mez ex U. Scholz
subsp. *fasciculatus* U. Scholz
subsp. *hirtellus*
subsp. *imbecillis* U. Scholz
subp. *japonicus* U. Scholz
subsp. *loliaceus* Mez
subsp. *microphyllus* U. Scholz
subsp. *psilostachys* U. Scholz
subsp. *setarius* Mez ex Ekman

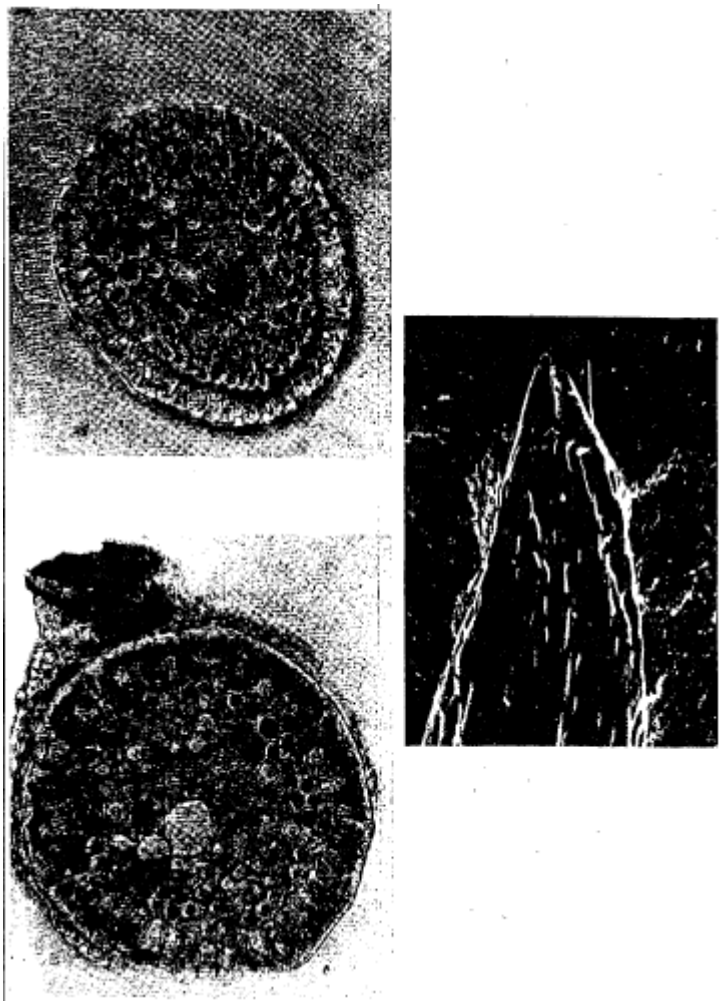
subsp. *tsushimensis* U. Scholz
subsp. undulatiofolius U. Scholz
var. *acuminatus* Mez
f. foliaceus Stehle
f. imbecillis
f. lanceolatus U. Scholz
hirtellus Roem. & Schult.
hirtiflorus K. B. Presl
hirtus Heyne ex Roem. & Schult.
hispidulus Kunth
hispidus Wood.
holciformis H. B. K.
hookeri Parl.
humbertianus Camus
humboldtianus Nees
var. genuinus E. Fourn.
var. muticus E. Fourn.
var. nudicaulis Vasey
imbecillis Roem. & Schult.
var. morrisonensis Honda
indicus Roem. & Schult.
intermedius Kunth
jacquinii Kunth
jamaicensis Kunth
japonicus Honda
javanicus Klotzsch ex Schlecht.
javanicus Roem. & Schult.
junghuhnii Boerlage
lanceolatus Kunth
lappagoides Speg.
latifolius Haenke ex Steud.
liebmannii E. Fourn.
limosus K. B. Presl
loliaceus P. Beauv.
longisetus Kunth
magellanicus Roem. & Schult.
margaritaceus Kunth
microphyllus Honda
minarum Nees
minor Merrill

mollissimus Hochst. ex Steud.
multisetus Hochst. ex A. Rich.
muricatus Kunth
muticus Philippi
nossibensis Mez
oahuaensis Nees & Mez ex Steud.
oplismenoides Speg.
owatarii Honda
parvifol ius Kunth
patens Honda
penicillatus Kunth
pictus Kunth
polliniifolius Honda
polystachyus H. B. K.
pratensis Schult.
preslii Kunth
prostratus Edgew.
pseudocolonus Kunth
pseudo*undulatifolius* Kunth
psilostachys Honda
rariflorus K. B. Presl
repens K. B. Presl
sabulicolus Kunth
scaber Kunth
secundus K. B. Presl
semialatus Desv.
setarius Roem. & Schult.
var. *aemulus* Bailey
var. *imbecillis* Benth.
f. sterilis F. Brown
simplex K. Schum. ex Engler
spectabilis Kunth
stagninus Kunth
strictus Schult.
sylvaticus Roem. & Schult.
tenuis K. B. Presl
thiebautii E. Fourn.
thwaitesii Hook. f.
tomentosus Schult.
tsushimensis Honda

undulatifolius P. Beauv.
undulatifolius Roem. & Schult.
var. elongatus Honda ex Nakai
var. *imbecillis* Hack
var. *japonicus* Koidzumi
var. lanceolatus Domin
var. *microphyllus* Ohwi
var. mollis Domin
velutinus Schult.
volkensii Mez
walteri Kunth
zelayensis H. B. K.
Orthopogon
abortivus Spreng.
aemulus R. Br.
africanus Sweet
agrostoides Trev. ex Steud.
albus Nees ex Steud.
bolosii Vayreda
bromoides Loud.
burmannii R. Br.
var. glabrescens Buse
var. *lanatus* Buse
compositus R. Br.
var. glabrescens Buse
crus-galli Spreng.
cubensis Spreng.
dichotomus Llanos
echinatus Spreng.
flaccidus R. Br.
gonyrrhizus Miq.
hirsutus Spreng. ex Steud.
hirtellus R. Br.
hirtellus Nutt.
hispidus Spreng.
holciformis Spreng.
imbecillis R. Br.
junghuhnii Nees ex Steud.
loliaceus Spreng.
longeracemosus Miq.

parvifolius Nutt.
pratensis Spreng.
remotus Trin.
retzii Spreng.
setarius Spreng.
sqarrosus Spreng.
stagninus Spreng.
subverticillatus Llanos
sylvaticus Miq.
trichoides Link
undulatifolius Spreng.
undulatus Link
velutinus Spreng.
Panicum
acuminatissimum Steud.
aemulum Steud.
africanum Poir.
album Poir.
arlstatum Retz.
balfourii Baker
barbifultum Hochst. ex Schlecht.
bidentatum Steud.
bidentulum Steud.
brevisetum Steud.
bromoides Lam.
burmannii Balb.
burmannii Marschall Bieb.
burmannii Retz.
certificandum Steud.
composito-proximum Rottl. ex Willd.
compositum L.
compositum Rottl. ex Steud.
cristatum Steud.
cubense Steud.
elatius L. f.
flaccidum Steud.
foliaceum Steud.
francoi Steud.
gonyrrhizum Steud.
hirtellum All.

hirtellum Burm. f.
hirtellurm Host
hirtellum Lam.
hirtellum L.
hirtellum Muhl.
hirtellum Scop.
hirtellum Wulfen ex Jacq.
imbecille Trin.
incanum Schum. & Thonn.
ischnocauloh Steud.
japonicum Steud.
kraussii Steud.
lappaceum Willd. ex Spreng.
loliaceum Lam.
longeracemosum Steud.
multisetum Hochst. ex A. Rich.
nuttallianum Steud.
oahuaense Steud.
parciflorum Steud.
peninsularum Steud.
pratense Steud.
raddianum Steud.
sanctae-marthae Steud.
schultesii Steud.
setarium Lam.
sylvaticum Lam.
undatum Steud.
undulatifolium Ard.
velutinump. F. N. Meyer
Pollinia undata Spreng.
Setaria hirtella Schult.
Sorghum saccharatum Host

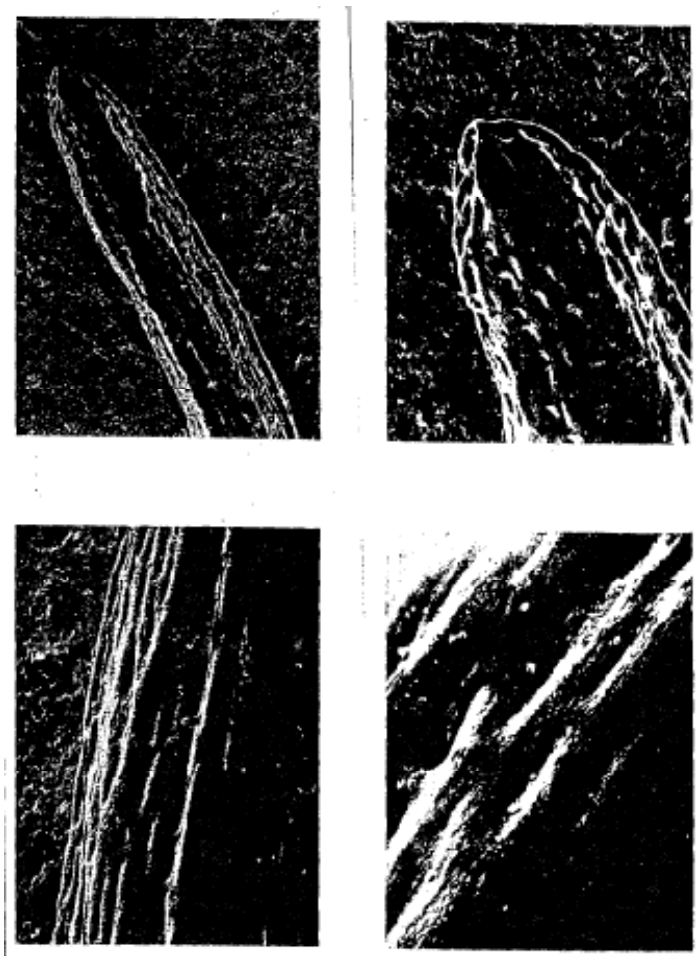


Panel 1: Anatomy and form of an imperforate awn.

Fig. 1: In the spikelet's blooming phase (650 x; Ø 30 µm).

Fig. 2: At the time of ripeness (650 x; Ø 30 µm).

Fig. 3: Point of awn with denticles (REM, 750 x).



Panel 2: Top side of an imperforate awn.

Fig. 1: REM: 300 x.

Fig. 2: REM: 750 x.

Fig. 3: REM: 1000 x.

Fig. 4: REM: 2500 x.

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