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Cyperus canus J. Presl & C. Presl – a traditional source of fiber, its uses, products and cultural significances among ethnic communities of Central America

The genus *Cyperus* L. (Cyperaceae) includes between 750 and 950 species (mostly annuals and perennials), the exact number depends on the accepted generic or unresolved names (Larridon et al., 2011, *The Plant List*, 2013). Most species of *Cyperus* are predominantly aquatic to sub-aquatic in habitat (marshes, swamps, bogs, lakes, ponds, fens and grassland) and are characterised by their distinct hollow, circular or triangular stems with distinct ridges and furrows predominantly present in the tropics, sub-tropics, temperate and the sub-temperate regions (Adams, 1994; Tucker, 1983, 1994). The genus is found in close association and ecological assemblages with different species of grasses (e.g. *Scleria secans* (L.) Urb., *Echinochloa colona* (L.) Link, *Pennisetum purpureum* Schumach., *Urochloa platyphylla* (Munro ex C. Wright) R. D. Webster and *Zea mays* L.). Both families have close evolutionary affinities. The species within the genus vary greatly in height from 3–5 cm at one end of the spectrum, to as high as over 4 or 5 m on the other.

The plants usually thrive well in water less than 1 m in depth (Adams, 1994; Tucker, 1983, 1994). The hollow stems usually bear the slender leaves towards the base of the plant, compactly arranged on a whorl at the apex of the floral items (Castro-Ramírez et al., 1991; Castro-Ramírez, 1994). The flowers vary in color between greenish to pale whitish or greenish white, flowers are mostly anemophilous (wild pollinated) and flowers are aggregated in different clusters between the leaves at the apex. The aggre-

gation of the flowers on the apex of the stem is arranged in the form of an umbrella (Standley, 1931; Castro-Ramírez et al., 1991; Castro-Ramírez, 1994). *Cyperus* species have cosmopolitan distribution, some of these are considered as noxious weeds, while a large number of others have different agricultural, horticultural, medicinal, pharmaceutical and industrial uses (Jansen, 1993, 1998; Magaña-Alejandro et al., 2014).

The most emblematic species of the genus by its historical and utilitarian context is *C. papyrus* L., a plant used by the ancient Egyptians to make paper. Other species of economic importance are: *C. articulatus* L., *C. canus* J. Presl. & C. Presl., *C. esculentus* L. and *C. rotundus* L. (Standley, Steyermark, 1958; Eshbaugh, 1983; Tucker, 1983, 1994). In Central America, *C. canus* is a plant widely used by the indigenous communities of Mexico, Guatemala, El Salvador, Honduras and Nicaragua for the principal elaboration of mats (*'petates'*) (Cajas et al., 2009). Secondarily for other objects such as baby carrier, briefcases, folders and occasionally hats; also for all types of moorings, as a cords or ropes. At home it is used to start fire in the kitchen (Ludlow-Wiechers, Diego-Pérez, 2002; Cajas et al., 2009; Magaña-Alejandro et al., 2014). The stems of this plant are used as an excellent fiber for weaving, in making high quality ropes and also for producing blowers, backpacks, hats and sandals used commonly by the local people (Castro-Ramírez et al., 1991; Castro-Ramírez, 1994; Cajas et al., 2009). The fibers are also applied by local people to make handicrafts such as baskets and bags. It is also used in preparing traditional food products of Guatemala mostly for tying up sausages and food bags (*'pita'*) (Fig. 2 – Appendix).

C. canus appears in the local culture historically, as mentioned in the Popol Vuh. This plant is commonly used in districts of Alta Verapaz, Chimaltenango, Escuintla, Guatemala, Quiché, Sacatepéquez, Santa Rosa, Retalhuleu and Zacapa (Castro-Ramírez et al., 1991; Adams, 1994; Castro-Ramírez, 1994; Cajas et al., 2009). The use and traditional knowledge of *C. canus* among the indigenous communities of Central America have been transferred through successive generations as part of the local tradition and culture. However, these traditional activities are now being slowly abandoned; since the plant products are being replaced by modern chemistry-based synthetic products (Hardy Nelson, 1986; Jansen, 1993, 1998; Roquas, 1994). In this study we describe the uses and production processes of some of the most important products made from *C. canus*.

Systematics and distribution

Class: Equisetopsida C. Agardh

Subclass: Magnoliidae Novák ex Takht.

Superorder: Lilianae Takht.

Order: Poales Small

Family: Cyperaceae Juss.

Genus: *Cyperus* L.

Species: *Cyperus canus* J. Presl. & C. Presl.

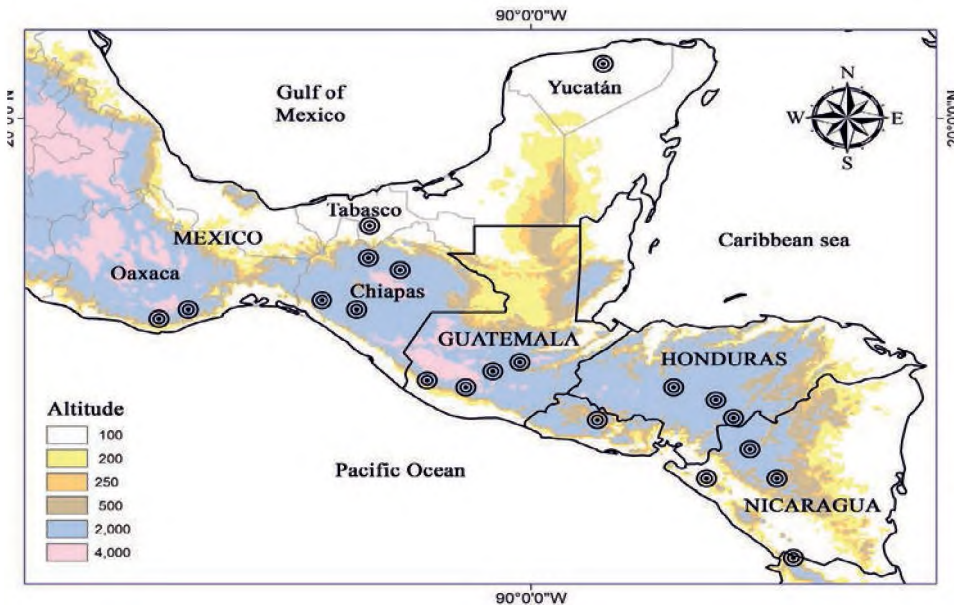


Fig. 1. Distribution of *Cyperus canus* in Central America (based on herbarium records of *Tropicos*, 2015)

C. canus (Fig. 3 – Appendix 1) was collected by Haenke in ‘regno Mexicano’ (currently Mexico) and described by Presl and Presl in 1828 in the work *Reliquiae Haenkeanae* (Reliq. Haenk.) 1(3): 179. This species is a native plant of tropical America, distributed from southern Mexico and Guatemala to Colombia (Fig. 3 – Appendix 1). It grows along the shores of lakes, streams and marshy places and is sometimes found on rocks, at altitudes of 200–1500 m a.m.s.l. (Standley, 1931; Castro-Ramírez et al., 1991; Castro-Ramírez, 1994). However, it is quite rare to find the plants in the wild since locals treat them as a common weed (Fig. 4 – Appendix 1).

Common names of *Cyperus canus* (Tule)

The species is commonly referred to as ‘tule’. The word originated from the Nahuatl word ‘tullin’ or ‘tolin’ and is commonly used to mean herbs growing in the lakes and marshy creeks, that are applied in the manufacture of chairs, baskets, mats, and several other handicrafts (Castro-Ramírez et al., 1991; Castro-Ramírez, 1994). However, according to Del Paso y Troncoso (1986), the word ‘tullin’ corresponds to the generic name used for several species of Cyperaceae, Typhaceae, Poaceae and Pontederiaceae (Ludlow-Wiechers, Diego-Pérez, 2002). From this perspective, Martínez (1979) associated the name ‘tule’ to several different species, such as: *C. articulatus* L., *C. tenerrimus* J. Presl & C. Presl., *C. canus*, *Pontederia cordata* L., *Schoenoplectus americanus* (Pers.) Volkart ex Schinz & R. Keller, *S. validus* (Vahl) Á. Löve & Löve, *Typha dominicensis* Pers., and *T. latifolia* L. The plant *C. canus* is called ‘sak’ in local Mayan language

due to the similarity of the stems to sugar cane (Diego-Pérez, 2010). It is also known in Spanish as ‘*tule negro*’, ‘*tule de petate*’ (González-Mayorga, 2009), ‘*junquillo*’, ‘*sivate*’, ‘*cafiita*’; and ‘*say*’ in Q’eqchi’ language (Standley, Steyermark, 1958).

Harvesting process of tule

In Central America the harvesting season of tule stems starts after the blooming period (otherwise these are not well dried). The stems are all cut down and after harvest is completed, the separation of the stems is conducted depending on the quality of the harvested stem. The decayed or rotten stems are discarded and only the healthy ones are carefully scrutinised and selected for use downstream (González-Mayorga, 2009). The harvest period is from February to May, tiller plants produce 75–200 stems per plant, in each crop growing up to 400–500 plants, but in the drying step, 400 stems are equivalent to one-pound weight.

Preparation of tule

The selected stems are placed under the sun for proper drying depending upon the criteria of the producer and based on local customs. It takes 4–5 days for drying in Salvador, but even for 8 days in Guatemala. Once dried, stems are classified according to the length of the rods since the longest stems enable the producers to develop high quality parts without flaws in the quality of the fibers. The classified stem is properly stored in high and dry places for thorough ventilation and also for protection against insects. They are usually wrapped in nylon bags and under proper storage conditions can be successfully stored for a year or so. The triangular shape of the stem helps in producing three strands of fibers that are extracted using an indigenous tool known as ‘*güiscoyal*’ in Guatemala. This is locally made from palms (*Bactris* sp.) or by using specific parts of bone as part of the traditional knowledge and technology used in the production process. In Salvador, the tool used is called ‘*rajador*’. In both cases these tools are made by the same craftsmen or artisans (González-Mayorga, 2009). In Guatemala, the central portion of the stem is known as the ‘*heart of tule*’ or ‘*gut of tule*’ (Spanish: *corazón del tule* or *tripa de tule*) or ‘*cibaque*’. In Salvador, it is called ‘*rope or heart of tule*’ (Spanish: *mecate o corazón de tule*). This fiber is also used in the manufacture of handbags, sandals, blowers, hats, side bags, sacks etc.

Fiber crafts

Basketry is one of the oldest human activities from the dawn of human civilisation across the planet and constitutes an indispensable part of the daily tasks of several indigenous communities (e.g. Maya and Chontal Maya people in Mexico, Q’eqchi’, Xinca, Poqomchi’, ch’orti’ and Kaqchikel people in Guatemala). Local women historically have developed exceptional skills and knowledge over several generations in the art

of basketry and related textiles trades by judicious use of locally available resources. They have been solely responsible for transferring this traditional knowledge of manufacturing different basketry products to their future generations (Bustos, 1994). One of the most commonly and historically known traditional local products made from *C. canus* is the ‘petate’. In Central America (Mesoamerica), the Mayas used basketry for making different ceremonial utensils and for their daily use, that is demonstrated in the codices, steles and ceramics; where different products such as blowers, belts, baskets and mats were presented (Cajas et al., 2009).

Mats ‘petates’

Tab. 1. Comparative analysis of use and prices of different craftswomen using tule in preparing traditional fiber-based products and handicrafts

Craftswomen	Comments	Uses	Prices
Carmen Chocooj	People only buy stems for mooring food	Mooring tamale ‘tamales’	140 stems or strands (US\$ 3.93) 4–5 stems or strands (US\$ 0.66)
Elisa Cú	Tule blowers do not sell much because it is comparatively costlier than the plastic blowers	Blowers and ropes for mooring candles	Blowers (US\$ 1.31)
Eulalia Teyul	Young generations do not practice this activity since they are not interested in learning this traditional craft. She makes 6 blowers per day (5 am – 6 pm); and a mat of 60×40 cm (3 hours), 2×1.25–1.30 m (1 day), 5×1.25–1.30 m (3 days)	Mats and blowers	25 stems for a blower (US\$ 1.31), Mats of 60×40 cm (US\$ 1.31), 2×1.25–1.30 m (US\$ 1.97), 5×1.25–1.30 m (US\$ 2.62)

For the preparation of a mat (depending on size) ~80–210 stem barks of *C. canus* are commonly used depending on the target size or dimension of the finished mat. Generally, weaving is conducted on the floor, on the other ‘petate’, bed sheet or nylon material. In some cases it is also done directly on the dirt floor. The bark is initially extended in a vertical arrangement and afterwards the interweaving of the barks are made on a horizontal direction one after another. As the work proceeds, more stems are added vertically and interwoven horizontally; leaving a fraction non-interlaced to make a moored that finally serves as the basic frame or contour (Fig. 5 – Appendix 1).

Blowers or fans

The blower or fan is generally prepared by using ~25 stems of *C. canus* that are carefully selected, having equal length and flexible consistency to facilitate the interlacing process. Alternatively, water is repeatedly applied to appropriately soften the stems to

make them more manageable and easy for the trade. The process of weaving starts by mooring a stem in half on the wooden benches; where 6–10 stems are placed, next doubled in half and are then woven together. As they get interweaving other stems are added until the blower takes the shape. Before making the middle blower, the base is made because it is the point of attachment of the 25 stems, then the base or gripper will be thick and resistant to movement (Fig. 6 – Appendix 1). We conducted personal interviews with women artisans in Alta Verapaz, Guatemala, and we share some interesting facts about the production and costs of *C. canus* crafts (Tab. 1).

Market scenario of the tule products

Studies of the situation of tule fiber artisans in Central America (Mesoamerica) indicate recurrent problems in the ethnic communities studied across different countries. Although there is a demand for traditional tule fiber-based handicrafts and products in the local and regional markets, as well as with foreign tourists, the economic conditions of the artisans are deplorable since this is a poorly organised sector. As a result traditional artisans and craftsmen and women are heavily dependent on middlemen who have better knowledge of the markets, gross product prices and the distribution systems. These middlemen make the most of the existing system retaining greater share of the profit to themselves compared to the artisans and craftsmen and women. Based on a case study on tule artisans from Guatemala, Lemus Herrera et al. (2009) observed the importance of gender equity in the community development programs; particularly in areas where women do majority of crafts work for their livelihoods and barter. In these rural areas majority of development programs unfortunately exclude women due to cultural practices in which most power is exercised and enjoyed by men in the traditional societies. The researchers therefore suggested that it will be important to improve the quality of life of local indigenous womenfolk by empowering them in their communities and societies.

Another case study from Central America that is worth mentioning is that of the Masatepe municipality from Nicaragua (Santana et al., 2004). In this community too, the indigenous fiber-based crafts work on tule for preparation of mats and related products are conducted mostly by women (86%). Their average weekly pay varies between \$US 22–29 (300–400 Córdobas). Several of the local fibre products are regularly exported to Costa Rica, Mexico, the US and the European Union. This is an unorganised cottage industry sector and hence exact data for the trade is not available or published. However, based on general estimates it could be mentioned that the trade is quite small in scale compared to other organised production sectors in Central America. The price of mat generated with one or two bunches of tule (each constituting on average ~150 leaves of *Cyperus canus*) is ~US\$ 22 (300 Córdobas). Monthly production is between 6–12 medium size mats, single, without decoration with pricing of

US\$ 4–11 (50–150 Córdoba) each. The best quality mats with drawings and decorations vary in price range between US\$ 11–22 (150–300 Córdoba) each. However, the latter is made in smaller quantities only, around 6 mats per workshop unit (Santana et al., 2004).

In general, tule artisans in Central America need consultancies in terms of education, training, empowerment and funding to help them develop into an organised sector for earning better economic return for their traditional artisan work and craftsmanship. This will allow them to slowly establish an efficient and effective production system in terms of better technology, diversification and improving the quality of their products based on current market demands, better product distribution network and financial management.

References

- Adams, C.D. (1994). *Cyperus* (Cyperaceae). In: G. Davidse, M. Sousa Sánchez, A.O. Chater, F. Chiang-Cabrera (eds.), *Flora Mesoamericana*, 6: *Alismataceae a Cyperaceae* Universidad Nacional Autónoma de México. México: Missouri Botanical Garden & The Natural History Museum (London), 423–440. [In Spanish]
- Bustos, M.L. (1994). Basketry and feminine world. *Historia Crítica*, 9, 29–35. [In Spanish]
- Cajas, A., Cano, M., Guirola, C. (2009). *Basketry and matting in Mesoamérica*. Asociación Flaar Mesoamérica. http://www.wide-format-printers.org/FLAAR_report_covers/705573_Guatemalan_basketry_fibers_copan_baja_verapaz_etnohistory.pdf
- Castro-Ramírez, A.E. (1994). Olcuatitan and its petate activity. *América Indígena*, 1–2, 257–278. [In Spanish]
- Castro-Ramírez, A.E., Hernández-Xolocotzi, E., Aguirre-Rivera, J.R., Engleman, E.M. (1991). Process of domestication and use of *Cyperus canus* by Chontales Nacajuca, Tabasco. *Agrociencia (Ser. Fitociencia)*, 2, 7–20. [In Spanish]
- Del Paso y Troncoso, F. (1986). Studies on the history of medicine in Mexico. *Anales del Museo Nacional de Mexico*, 3(35), 138–235.
- Diego-Pérez, N. (2010). A case study: The Cyperaceae of Yucatan. In: R. Durán-García, M. Méndez-González (eds.), *Biodiversity and human development in Yucatan*. Mérida, Yucatán: Cicy, Ppdmam, Conabio, Seduma, 1–496.
- Eshbaugh, W.H. (1983). The Useful Plants of Central America. *Economic Botany*, 37, 68–68.
- González-Mayorga, K.E. (2009). *Aplicación de la fibra de tule (Cyperus canus), teñidas con el tinte extraído de la mora (Maclura tinctoria) al diseño de 3 bolsos de playa*. <http://webquery.ujmd.edu.sv/siab/bvirtual/BIBLIOTECA%20VIRTUAL/TESIS/03/DPA/ADTESGA0001333.pdf>
- Hardy Nelson, S.C. (1986). *Plantas comunes de Honduras*. Tegucigalpa: Editorial Universitaria. [In Spanish]
- Jansen, K. (1993). Coffee and forms of production in Honduras. *Revista centroamericana de economía*, 14, 58–96. [In Spanish]
- Jansen, K. (1998). *Political ecology, mountain agriculture, and knowledge in Honduras*. Amsterdam: Thela Publishers.
- Larridon, I., Reynders, M., Huygh, W., Bauters, K., Van De Putte, K., Muthama Muasya, A., Boeckx, P., Goetghebeur, P. (2011). Affinities in *C₃* *Cyperus* lineages (Cyperaceae) revealed using molecular phy-

- logenetic data and carbon isotope analysis. *Botanical Journal of the Linnean Society*, 167, 19–46. DOI: 10.1111/j.1095-8339.2011.01160.x
- Lemus Herrera, L.B., Martínez, J., Girón Hernández, J.L. (2009). *Caracterización organizativa, producción y comercialización de Artesanías de tule (Cyperus canus) que realiza el grupo de Mujeres artesanas del municipio de San Juan Tecuaco, Departamento de Santa Rosa, Guatemala*. Universidad de San Carlos Guatemala, Guatemala. <http://digi.usac.edu.gt/bvirtual/informes/puieg/INF-2009-059.pdf> [In Spanish]
- Ludlow-Wiechers, B., Diego-Pérez, N. (2002). Utilidad e importancia histórica y cultural de las Cyperaceae. *Etnobiología*, 2(1), 90–102. [In Spanish]
- Magaña-Alejandro, M.A., Mendoza, M.S., Rodríguez, M.I.M. (2014). Use of medicinal plants by the villagers of Tapotzingo, Nacajuca, Tabasco, Mexico. *European Scientific Journal*, 3, 67–73.
- Martínez, M. (1979). Catalog of common and scientific names of Mexican plants. México: Fondo de Cultura Económica.
- Roquas, E. (1994). *Las petateras producen más que artesanía: la economía del tule y del petate*. Universidad Nacional Autónoma de Honduras. Documentos de Trabajo No. 8. Tegucigalpa: Poscae-Unah. [In Spanish]
- Santana, R., Montagnini, F., Louman, B., Villalobos, R., Gómez, M. (2004). La industria de artesanías de Masaya y Masatepe, Nicaragua: demanda por materia prima de bosques tropicales. *Recursos Naturales y Ambiente*, 42, 77–85. [In Spanish]
- Standley, P.C. (1931). The Cyperaceae of Central America. *Field Museum of Natural History, Botanical series*, 8, 237–292.
- Standley, P.C., Steyermark, J. (1958). Cyperaceae, En Flora of Guatemala. *Fieldiana: Botany*, 24(1), 90–196.
- The Plant List*. (2013). *A working list of all plant species* (version 1.1). <http://www.theplantlist.org>
- Tropicos*. (2015). *Missouri Botanical Garden*. <http://www.tropicos.org/Name/9904590>
- Tucker, G.C. (1983). The taxonomy of *Cyperus* (Cyperaceae) in Costa Rica and Panama. *Systematic Botany Monographs*, 2, 1–85.
- Tucker, G.C. (1994). Revision of the Mexican species of *Cyperus* (Cyperaceae). *Systematic Botany Monographs*, 43, 1–213.



Fig. 2. Different products and crafts made with tulle; A – blower, B – a plastic blower for comparison; processed fiber strands: C-D – ropes for tying up sausages, E – ropes for tying up tamales, F – ropes for hanging candles, G – ropes for tying up food bags, H – finished high quality mats (Photo. E. M6)

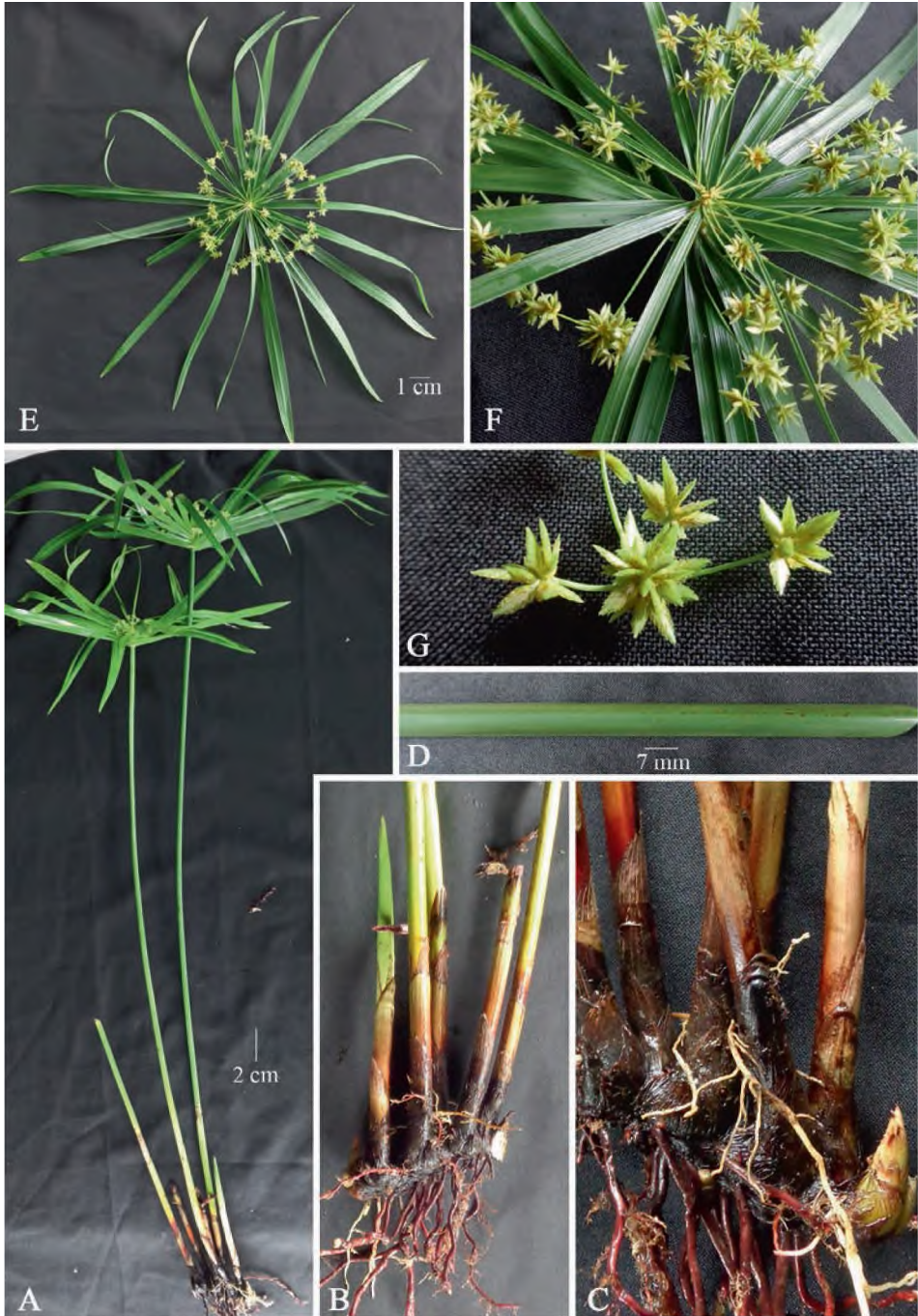


Fig. 3. *Cyperus canus* J. Presl & C. Presl; A – plant habit, B–C – young stems, D – mature stems, E – leaves and inflorescence, F – inflorescence enlarged, G – flowers (Photo. E. M6)



Fig. 4. *Cyperus canus* J. Presl & C. Presl; A – plants growing in a field crop of corn, B – juvenile plants, C – plants growing in sub-aquatic habitat, D – plants mixed with corn (Photo. E. M6)



Fig. 5. Production of mats '*petates*' with tulle; A-E – selection and preparation of stem barks, F–G – stem barks of different dimensions, H–I – interlacing process of the stems, J – finished mats (Photo. E. M6)



Fig. 6. Production of a blower or fan with tulle; A – selections of stems, B – traditional operating wooden bench, C – stems moored to the wooden bench, D-F – interlacing process with the stems, G – middle blower, H-I – finished blower (Photo. E. M6)

Cyperus canus J. Presl & C. Presl – tradycyjne źródło błonnika, zastosowanie, produkty i znaczenie kulturowe wśród społeczności etnicznych

Streszczenie

Rodzaj *Cyperus* L. (Cyperaceae) obejmuje od 750 do 950 gatunków. Występuje w ścisłym powiązaniu z ekologicznymi ugrupowaniami różnych gatunków traw. Gatunki z rodzaju *Cyperus* posiadają rozmieszczenie kosmopolityczne. Niektóre z nich są uważane za szkodliwe chwasty uprawowe, jednak duża ich liczba znalazła zastosowanie w rolnictwie, ogrodnictwie oraz w przemyśle farmaceutycznym. *Cyperus canus* J. Presl & C. Presl (Cyperaceae) jest rośliną naturalną dla tropikalnej Ameryki, rosnącą od południowego Meksyku oraz Gwatemali do Kolumbii. Gatunek ten występuje wzdłuż brzegów jezior, strumieni i bagien, a czasami na skałach, na wysokości 200–1500 m n.p.m. W naturalnym środowisku jest rośliną dość rzadko spotykaną, ponieważ traktowany jest jako tępy chwast. W Ameryce Środkowej *C. canus* jest rośliną powszechnie stosowaną do produkcji dywanów, nosidełek dla dzieci, portfeli, teczek, kapeluszy i lin. W Gwatemali, pędy tego gatunku są używane do wyplatania koszy i torebek, do produktów codziennego użytku (śpiworów, sandałów, wachlarzy) oraz przygotowywania tradycyjnych potraw. W artykule tym opisano zastosowanie i procesy produkcji niektórych ważnych wyrobów wykonywanych z dzikorosnącego *C. canus*.

Słowa kluczowe: Central America, *Cyperus canus*, stem, practical use

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