

First record of the invasive species *Rottboellia cochinchinensis* (Poaceae, Andropogoneae) in the South Region of Brazil

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Abstract: *Rottboellia cochinchinensis* is an aggressive invasive species native to Asia. This species is known worldwide for invading crops and disturbed habitats in tropical and subtropical regions. In Brazil, *R. cochinchinensis* had its southernmost record in São Paulo state; however, in this study we expand its distribution to Santa Catarina state, in the South Region of Brazil, based on the discovery of a population in Blumenau municipality. These new records are ca. 440 km distant from the nearest known population, in São Paulo municipality, São Paulo state, Brazil.

Key words: distribution extension; Neotropics; new record; Poales; South America

Rottboellia L.f. (Poaceae, Andropogoneae) is a small genus of grasses including five species, all of them native to the Old World tropics (Sun and Phillips 2006). Although originally native to southern Asia, *R. cochinchinensis* (Lour.) Clayton (Loureiro 1790: 51; Clayton 1981: 817–818) is considered, nowadays, an invasive weed known for causing significant agricultural losses in tropical and subtropical regions (Holm 1977), especially in maize (Bridgemohan and Brathwaite 1989), soy (Griffin 1991; Lejeune et al. 1994), and sugarcane (Lencse and Griffin 1991; Millhollon 1992) cultivations. Additionally, this species is an aggressive invader of disturbed areas (Bridgemohan et al. 1991; Wipff and Rector 1993) and has reportedly allelopathic and phytotoxic effects on other plants and also possesses stiff irritating trichomes on the leaf sheaths (Wipff and Rector 1993; Meksawat and Pornprom 2010). Thus, all these attributes make this species listed among the world's most problematic weeds (Millhollon and Burner 1993).

It is believed that *R. cochinchinensis* was introduced and started spreading around the New World at the beginning of 20th century (Valverde 2004), where this species found several contributing factors, including improved climatic conditions, human dispersal of seeds, favourable agronomic practices and absence of co-evolved natural enemies (Ellison and Evans, 1992). *Rottboellia cochinchinensis* has arrived to the Americas through the United States, where it was firstly reported, with the expansion of newly occupied areas around railroads (Hall and Patterson 1992). The species spread from Colombia to Brazil in 1961 through the seeds accidentally mixed with rice seeds (Millhollon and Burner 1993). Currently, this species continues to expand its distribution in Brazil, probably through contamination of crop seeds, farm machinery, birds, rodents, and water (Millhollon 1980; Aison et al. 1984; Freshwater et al. 1986).

During intensified field work effort in the area we discovered a population of *R. cochinchinensis* in Blumenau municipality, Santa Catarina state, southern Brazil. These plants were found along a roadside, growing spontaneously among other typically ruderal plants.

We revised the collections of *Rottboellia* at ASE, C, EFC, FLOR, FURB, GB, HBR, JOI, MBM and UPCB herbaria (acronyms according to Thiers 2016). The references used to identify this species in order to confirm the new occurrence were Veldkamp et al. (1986), Clayton and Renvoize (1999) and Sun and Phillips (2006). The generic classification follows Soreng et al. (2015).

Rottboellia cochinchinensis (Figure 1) is an erect annual grass that can grow up to 3 m, characterised by having thick roots emerging from the base of the culm; leaf blades and sheaths with siliceous tuberculate hairs that can irritate the human skin; inflorescence in cylindrical terminal and axillary racemes 3–15 cm

long, usually subtended by an inflated leaf sheet; rachis fragile, inflated, releasing in cylindrical diaspores composed by an internode segment fused to the internode, one sterile pedicellate spikelet,

and one fertile sessile spikelet (Clayton et al. 2006). Synonyms of *R. cochinchinensis* include *R. exaltata* L.f. (Linné 1782: 114) and *Stegosia cochinchinensis* Lour. (Loureiro 1790: 51).

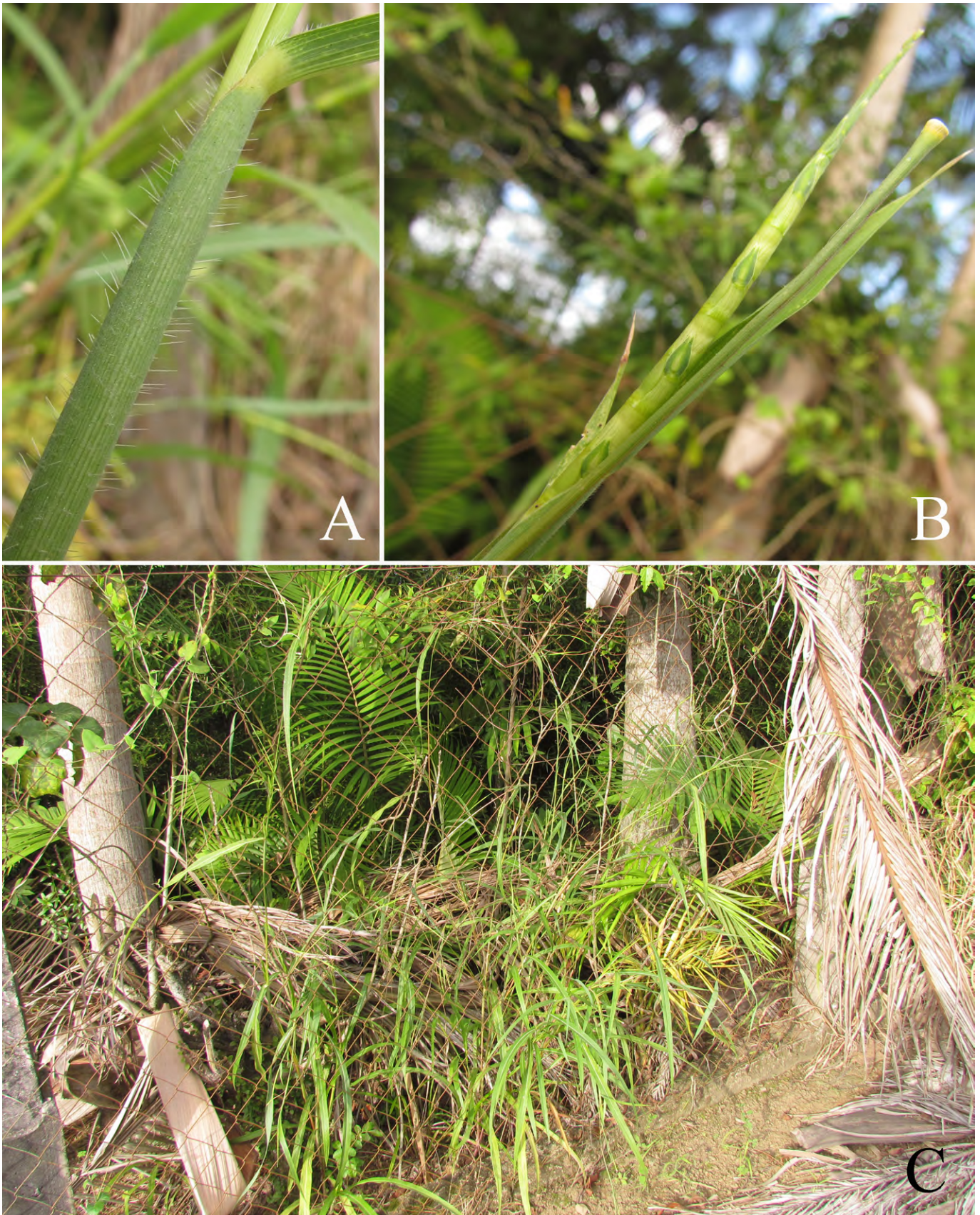


Figure 1. *Rottboellia cochinchinensis*. **A:** Sheath trichomes. **B:** Inflorescence. **C:** Habit.

In the Americas, *R. cochinchinensis* is known to occur in 27 countries, from U.S.A. to Argentina (CABI 2016). In South America it occurs in the following countries: Argentina, Bolivia, Brazil, Colombia, Ecuador, Peru, Suriname and Venezuela (CABI 2016). In Brazil, this species was hitherto recorded in the states of Amazonas, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Rio de Janeiro, Roraima, and São Paulo (Filgueiras and Valls 2015). Previously, the southernmost occurrence record of *R. cochinchinensis* in Brazil was in São Paulo municipality, São Paulo state. However, we recently (April 2015) discovered a population of this species (Figure 1) in Blumenau municipality, eastern of Santa Catarina state (Figure 2). This is the first record of this species in the South Region of Brazil, corresponding to a distribution expansion of ca. 440 km.

In Brazil, and in much of its distributional range, this species is seen as an aggressive invader of important crops such as corn, beans, soybeans, rice, peanuts and specially sugarcane that are causing major economic losses, because it is very resistant to various controlling methods, their seeds are produced in large quantities, between 2,200 and 16,500 per plant (Hall and Patterson 1992) and can remain dormant in the soil for up to four years (Lorenzi 2000). Since it is a highly competitive

species with economically important crops, much research has been conducted on its physiology, genetics and ecology, in order to find ways to control or eradicate it (Pamplona and Mercado 1981; Lencse and Griffin, 1991; Freitas et al. 2004; Silva et al. 2009; Monquero et al. 2012).

This new record is relevant for the invasive character of *R. cochinchinensis*, and calls attention to the potential expansion in Santa Catarina of this important agricultural pest, which certainly would be able to, once installed, cause serious economic losses. Nevertheless, despite its “destructive potential” regarding the agricultural aspect, there is still no record of biological invasion in natural environments caused by this species in Brazil.

Material examined

Rottboellia cochinchinensis—BRAZIL. SANTA CATARINA: Blumenau: Rua Bahia, on the roadside, 26°52'56.60"S, 049°10'37.20"W, 1 April 2015, L.A. Funez 4170 (C, FURB). SENEGAL. ZIGUINCHOR: near Diouloulou, in disturbed stand of *Eleis guineense*, roadside, 11 September 1994, Laegaard et al. 16896 (C). ETHIOPIA. GOJJAM REGION: ca. 120 km from Chagni on the road toward Gubba, patch of *Acacia* woodland in small depression in otherwise *Combretum–Terminalia* dominated

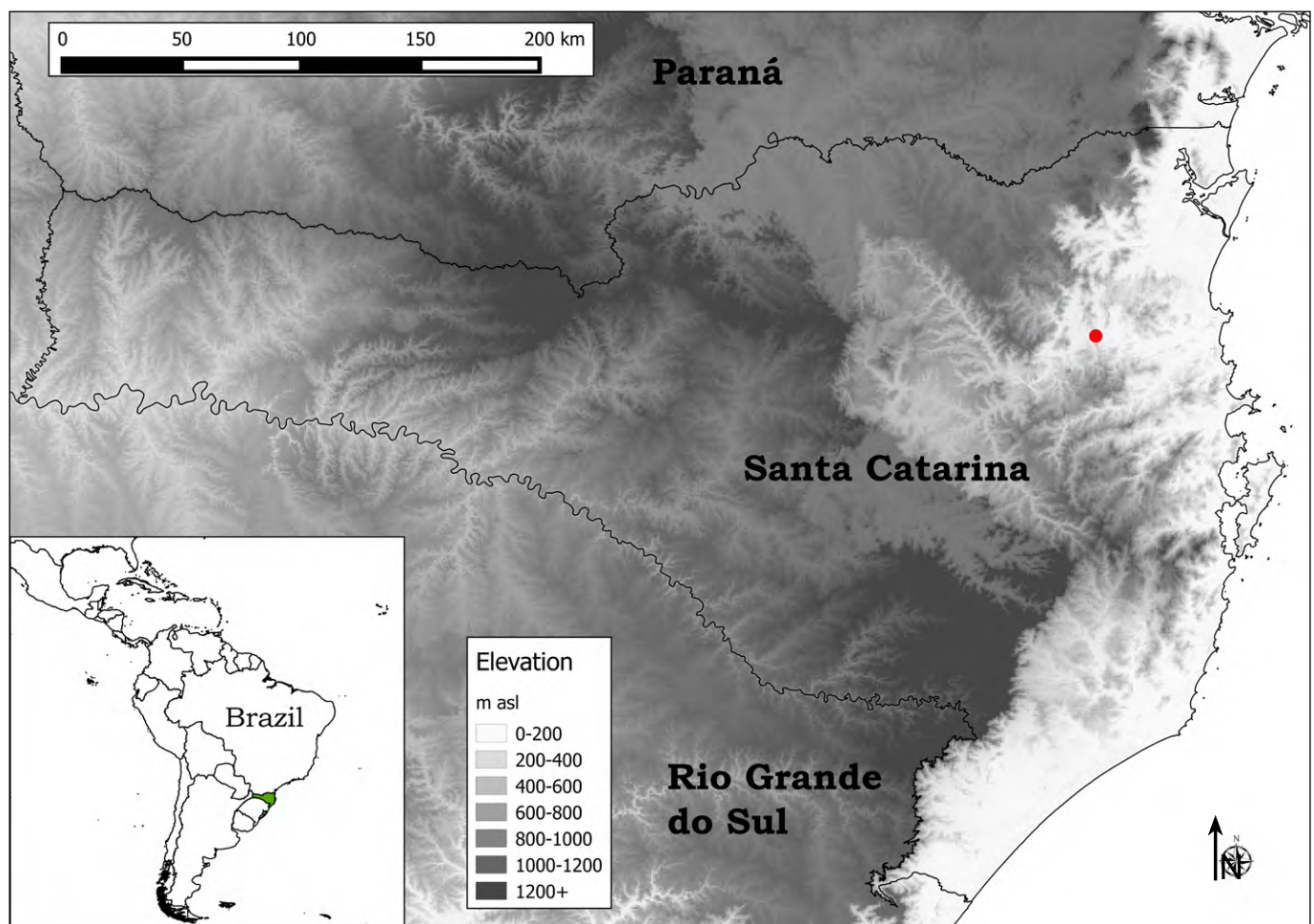


Figure 2. Location of the discovered population of *Rottboellia cochinchinensis* in Blumenau, Santa Catarina, Brazil.

vegetation, 11 October 1996, I. Friis 7711 (C). SOUTH SUDDAN. Imatong Mountains and surroundings, Hilieu (Kiliu), southeast of Bachelor Street, in cultivation, 4 December 1983, Lund 202 (C).

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LITERATURE CITED

- Aison, S., M.K. Johnson and T.R. Harger. 1984. Role of birds in dispersal of itchgrass (*Rottboellia exaltata* L.) seeds in the southeastern USA. *Protection Ecology* 6: 307–313.
- Bridgemohan, P. and R.A.I. Brathwaite. 1989. Weed management strategies for the control of *Rottboellia cochinchinensis* in maize in Trinidad. *Weed Research* 29(6): 433–440.
- Bridgemohan, P., R.A.I. Brathwaite and C.R. McDavid. 1991. Seed survival and patterns of seedling emergence studies of *Rottboellia cochinchinensis* (Lour.) W.D. Clayton in cultivated soils. *Weed Research* 31(5): 265–272.
- CABI. 2016. Invasive Species Compendium. Accessed at <http://www.cabi.org/isc/datasheet/47782>, 16 July 2016.
- Clayton, W.D. 1981. Notes on the tribe Andropogoneae (Gramineae). *Kew Bulletin* 35(4): 813–818.
- Clayton, W.D. and S.A. Renvoize. 1999. *Genera Graminum — Grasses of the World*. Kew: Royal Botanical Garden. 389 pp.
- Clayton, W.D., M.S. Vorontsova, K.T. Harman and H. Williamson. 2006. *GrassBase — The Online World Grass Flora*. Accessed at <http://www.kew.org/data/grasses-db.html>, 16 July 2016.
- Filgueiras, T.S. and J.F.M. Valls. 2015. *Rottboellia*; in: Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. Accessed at <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/fb105951>, 16 July 2016.
- Freitas, S.P., A.R. Oliveira, S.J. Freitas, and L.M.S. Soares. 2004. Controle químico de *Rottboellia exaltata* em cana-de-açúcar. *Planta Daninha* 22(3): 461–466. doi: 10.1590/s0100-83582004000300017
- Freshwater, I.T., A.J. Benson and T.F. Hall. 1986. Itchgrass *Rottboellia cochinchinensis*—the Burdekin infestation and legislative control program. *Proceedings of the Australian Society of Sugar Cane Technologists* 8: 155–160.
- Griffin, J.L. 1991. Itchgrass (*Rottboellia cochinchinensis*) control options in soybean (*Glycine max*). *Weed Technology* 5(2): 426–429.
- Hall, D.W. and D.T. Patterson. 1992. Itchgrass: stop the trains. *Weed Technology* 6: 239–241.
- Holm, L.G., D.L. Plucknett, J.V. Pancho and J.P. Herberger. 1977. *The world's worst weeds. Distribution and biology*. Honolulu: University Press of Hawaii. 609 pp.
- Lejeune, K.R., J.L. Griffin, D.B. Reynolds and A.M. Saxton. 1994. Itchgrass (*Rottboellia cochinchinensis*) interference in soybean (*Glycine max*). *Weed technology* 8(4): 733–737.
- Lencse, R.J. and J.L. Griffin. 1991. Itchgrass (*Rottboellia cochinchinensis*) interference in sugarcane (*Saccharum* sp.). *Weed Technology* 5: 396–399.
- Linné, C. von. 1782. *Supplementum Plantarum Systematis Vegetabilium*. Braunschweig: Orphanotropei. 467 pp. doi: 10.5962/bhl.title.555
- Lorenzi, H. 2000. *Plantas daninhas do Brasil: terrestres, aquáticas, parasitas e tóxicas*. 3rd ed. Nova Odessa: Instituto Plantarum. 640 pp.
- Loureiro, J. de. 1790. *Flora Cochinchinensis*. Vol. 1. Lisbon: Ulyssipione. 353 pp. doi: 10.5962/bhl.title.560
- Meksawat, S. and T. Pornprom. 2010. Allelopathic effect of itchgrass (*Rottboellia cochinchinensis*) on seed germination and plant growth. *Weed Biology and Management* 10(1): 16–24. doi: 10.1111/j.1445-6664.2010.00362.x
- Millhollon, R.W. 1980. Itchgrass — a weed of world-wide concern. *Sugar Journal* 43(7): 16.
- Millhollon, R.W. 1992. Effect of itchgrass (*Rottboellia cochinchinensis*) interference on growth and yield of sugarcane (*Saccharum* spp. hybrids). *Weed Science* 90(1): 48–53.
- Millhollon, R.W. and D.M. Burner. 1993. Itchgrass (*Rottboellia cochinchinensis*) biotypes in world populations. *Weed Science* 41(3): 379–387.
- Monquero, P.A., N. Hijano, I. Orzari, R.S. Sabbagand A.C.S. Hirata. 2012. Profundidade de sementeira, pH, textura e manejo da cobertura do solo na emergência de plântulas de *Rottboellia exaltata*. *Ciências Agrárias* 33(1): 2799–2812.
- Pamplona, P.P. and B.L. Mercado. 1981. Ecotypes of *Rottboellia exaltata* L.f. in the Philippines I. Characteristics and dormancy of seeds. *Philippine Agriculturist* 64(1): 59–66.
- Silva, C.E.B., M.C. Parreira, P.L.C.A. Alves, and M.C.M.D. Pavani. 2009. Aspectos germinativos de capim-camalote (*Rottboellia cochinchinensis*). *Planta Daninha* 27(2): 273–281. doi: <http://dx.doi.org/10.1590/s0100-83582009000200009>
- Soreng, R.J., P.M. Peterson, K. Romaschenko, G. Davidse, F.O. Zuloaga, E.J. Judziewicz, T.S. Filgueiras, J.I. Davis and O. Morrone. 2015. A worldwide phylogenetic classification of the Poaceae (Gramineae). *Journal of Systematics and Evolution* 53(2): 117–137. doi: <http://dx.doi.org/10.1111/jse.12150>
- Sun, B. and S.M. Phillips. 2006. *Rottboellia*; pp. 644–645, in: Z. Wu, P.H. Raven and D. Hong (eds.). *Flora of China*. Vol. 22. Beijing: Science Press; and St. Louis: Missouri Botanical Garden.
- Thiers, B. 2016. *Index Herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. Accessed at <http://sweetgum.nybg.org/science/ih>, 16 July 2016.
- Valverde, B.E. 2004. Progress on *Rottboellia cochinchinensis* management; pp. 67–79, in: R. Labrada (ed.). *Weed Management for Developing Countries*. Rome: FAO Plant Production and Protection Paper.
- Veldkamp, J.F., R. de Koning and M.S.M. Sosef. 1986. Generic delimitation of *Rottboellia* and related genera (Gramineae). *Blumea* 31(2): 281–307.
- Wipff, J.K. and B.S. Rector. 1993. *Rottboellia cochinchinensis* (Poaceae: Andropogoneae) new to Texas. *Sida* 15(3): 419–424.

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