Investigation note

Distribution and density of *Rottboellia cochinchinensis* (Lour.) Clayton in the state of Morelos

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Abstract

In Mexico, an increase in the introduction and dissemination of quarantined weeds can be observed, which can cause million-dollar economic damage to agriculture, as new crop control measures are required. The objective of the study was to determine the distribution and population density of *Rottboellia cochinchinensis* (hairy grass) in the state of Morelos and thus know the time of greatest spread with references to environmental conditions and thereby assess the most appropriate time to control or eradicate the hairy grass, before it can reproduce. The study was conducted from January 1 to December 31, 2015, in the agricultural areas of the 33 municipalities of the state of Morelos, where they were sampled to identify the presence of *R. cochinchinensis*. Once the existence of hairy grass in the municipalities was identified, each month the municipalities with presence were monitored to determine population density. The municipalities with the densest population were Jantetelco, Jonacatepec, Tepalcingo and Xochitepec. The highest population density occurred in the months of July and August after observing the highest rainfall, so it is important to apply control technique on *Rottboellia cochinchinensis* before the period mentioned between the months of May and June.

Keywords: *Rottboellia cochinchinensis*, quarantines, weeds.

Reception date: September 2019
Acceptance date: October 2019

There is currently an increase in trade and transport between countries, which has led to an increase in the introduction and dissemination of exotic plants, in some cases unintentionally. An exotic plant can be considered quarantine because of its history as a pest and because of the biotic and abiotic conditions that favor its establishment. Each pest has certain temperature, humidity, soil and altitude requirements, which, if not met, hinder or impede its establishment in a new territory (Labrada, 2015).

In Mexico, an increase in quarantined weeds caused by foreign trade can be observed. This type of weeds can cause millionaire economic damages to agriculture, by requiring new combat measures in crops or other environments (Delgado *et al*., 2008).

Hairy grass (*Rottboellia cochinchinensis* (Lour.) Clayton) initially known as *R. exaltata* L., is an annual grass of self-pollination, erect and is classified as a quarantined weed widely distributed in the states adjacent to the Gulf of Mexico (Campeche, Tabasco and Veracruz) are found in rice, cotton, corn, sorghum and sugarcane crops, as well as in pastures and tropical plantations (mangoes, citrus, papaya) (Alves *et al*., 2003; Esqueda, 2005; Silva *et al*., 2009; Sánchez-Ken *et al*., 2012; Bundit *et al*., 2014; León *et al*., 2015). In Mexico, this species was first collected in the area of Escarcega, Campeche, in 1982 (Esqueda, 2005).

In the state of Morelos, the presence of *R. cochinchinensis* has been detected (Sánchez-Ken and Cerros-Tlatilpa, 2016). This species is considered one of the 12 worst weeds that infest sugarcane in the world and is classified as harmful by the United States Department of Agriculture (Alves *et al*., 2003).

It can cause yield losses of 20 to 70%, depending on the crop that affects (Contreras-Ramos *et al*., 2013). The use of herbicides has been a primary factor in the eradication of this species; however, the wrong time of application has allowed hairy grass to continue to spread, thus affecting important crops (sugar cane, corn and sorghum) in the state of Morelos.

Therefore, the objective of the study was to determine the distribution and population density of *R. cochinchinensis* (hairy grass) in the state of Morelos and thus know the time of greatest spread with reference to environmental conditions and thereby determine the most appropriate time to control or eradicate hairy grass, before it can reproduce.

The study was conducted from January 1 to December 31, 2015, in the agricultural areas of the municipalities of the state of Morelos, which is geographically located in the southern central part of Mexico at 19° 08’ north latitude, 18° 19’ south latitude, 98° 38’ east longitude and 99° 20’ west longitude, with an area of 4 892.7 km^2. The state of Morelos has altitudes from 720 to 5 432 m, where the subhumid warm climate predominates (INEGI, 2013).

The 33 municipalities of the state of Morelos were sampled to identify the presence of *R. cochinchinensis*; the identification was made based on the Southern Weed Science Society Weed Identification Guide (Elmore, 1990). For the sampling, 40 farms (≈1000 m^2 each place) were selected per municipality where it was expected to find the presence of hairy grass, which were close to agricultural crops and where it grew without being affected by the farmers.

On each site, a zig-zag route was carried out that covered most of the surface, where 12 random points were selected for sampling. The population density was quantified with a metal quadrant of 50 x 50 cm (0.25 m^2), and the number of *R. cochinchinensis* plants present inside the quadrant was counted and then extrapolated to plants per m^2 (Trujillo *et al*., 2013).

Each month the farms sampled in the municipalities with presence were monitored to determine population density. The data obtained were concentrated in a spreadsheet in the Excel® program, where the number of individuals of *R. cochinchinensis* present per month and municipality was recorded, as well as an average for the entire year. The average temperature and precipitation of the municipalities where the quarantined weed was found was obtained from the pluviometric stations belonging to the National Meteorological Service network and the National Water Commission.

In 19 of the 33 municipalities of the state of Morelos, *R. cochinchinensis* was found. The highest population during the year was observed in the municipalities of Jantetelco, Jonacatepec, Tepalcingo and Xochitepec, which had a density of 172 to 184 plants m^{-2} and the average temperature presented was 27 to 24 °C, thus as a precipitation between 1 624 to 1 017 mm (Figure 1). In turn, the lowest density was registered in the municipalities of Ayala, Cuautla, Tetecala and Yecapixtla, with a population density of between 104 and 112 plants m^{-2}; it should be noted that it has been determined that *R. cochinchinensis*, even at densities of 55 plants m^{-2}, can reduce the yield of corn cultivation by up to 47% (Strahan *et al*., 2000; León *et al*., 2015).

Figure 1 shows the distribution of *R. cochinchinensis* in the municipalities of the state of Morelos. It can be seen that this species is adapted to environmental conditions where subhumid hot climates predominate, with average temperatures of 21.5 °C. León *et al*. (2015) indicate that the base temperature for *R. cochinchinensis* germinates is 20 °C and that, at lower temperatures, this species does not spread. It should be noted that the municipalities with the highest population density of *R. cochinchinensis* border the Puebla, so it may have spread due to the flow of agricultural machinery, water, as well as animals, from Veracruz to Puebla and from there to Morelos (Esqueda, 2005).

Figure 1. Population distribution and density of *R. cochinchinensis* in the state of Morelos (18° 44' 51" north latitude, 99° 04' 13" west longitude). The municipalities in color indicate the presence and numbers the average population density during the year (plants m^{-2}) in each municipality.

As for population density (Figure 2), from January to March a density was observed that was maintained in a range of 32 to 40 plants per m^2, since the absence of moisture affected its propagation. The low population at the beginning of the year was probably due to the fact that weeds that emerged in October presented resistance to drought (Bolfrey-Arku *et al*., 2011). In April there were increases in population density, coinciding with the first rains of the storm.

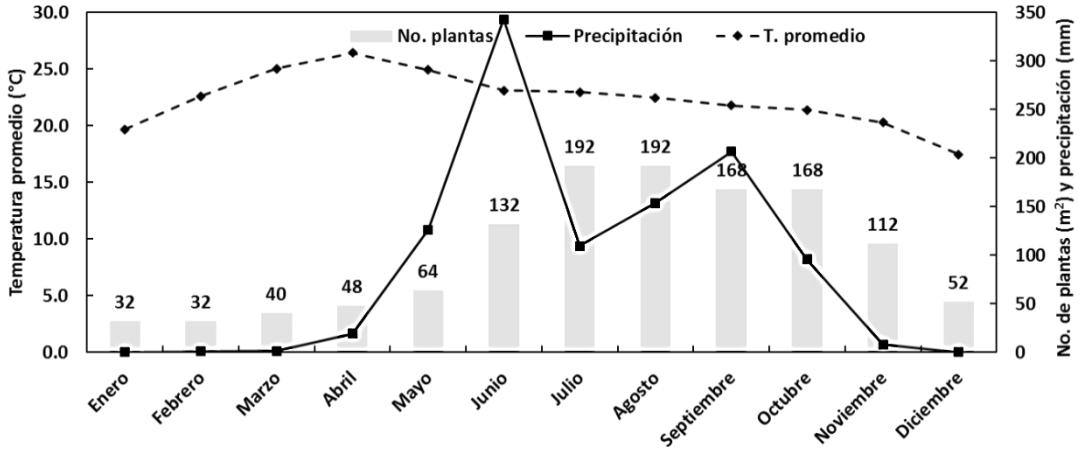

Figure 2. Average monthly population density of *R. cochinchinensis* in the environmental conditions (precipitation and temperature) of the state of Morelos.

The highest rainfall occurred in June, this favored the highest density in July, which remained until October, where precipitation began to decrease. The low humidity and temperature during the months of November and December caused a reduction in population densities. On the other hand, *R. cochinchinensis* populations developed at temperatures that ranged from 20 to 26 °C from January to November, with optimal temperatures for hairy grass (21.8 °C) to spread, as indicated by Silva *et al*. (2009); Bolfrey-Arku *et al*. (2011); León *et al*. (2015).

Conclusions

The municipalities of the state of Morelos with the densest population were Jantetelco, Jonacatepec, Tepalcingo and Xochitepec. The highest population density occurred in the months of July and August after the highest rainfall was observed, so it is important to apply control technique on *Rottboellia cochinchinensis* before the period mentioned between the months of May and June.

Cited literature

Alves, P. L.; Bachega, M. F.; Moro, J. R.; Lemos, M. V. F.; Alves, E. C. C.; Silva, M. A. S. and Moro, F. V. 2003. Identification and characterization of different accessions of itchgrass (*Rottboellia cochinchinensis*). Weed Science. 51(2):177-180. DOI: 10.1614/0043-1745(2003)051[0177:IACODA]2.0.CO;2.

Bolfrey-Arku, G. E. K.; Chauhan, B. S. and Johnson, D. E. 2011. Seed germination ecology of itchgrass (*Rottboellia cochinchinensis*). Weed Sci. 59(2):182-187. DOI: 10.1614/WS-D-10-00095.1.

Bundit, A.; Auvuvhanon, A. and Pornprom, T. 2014. Classification of population structure for allelopathic properties in itchgrass (*Rottboellia cochinchinensis*). Agrivita. 36(3):249-259.

Contreras-Ramos, S. M.; Rodríguez-Campos, J.; Saucedo-García, A.; Cruz-Ortega, R.; Macías-Rubalcava, M. L.; Hernández-Bautista, B. E.; Dendooven, L.; Esqueda-Esquivel, V. A. and Anaya, A. L. 2013. Mutual effects of *Rottboellia cochinchinensis* and maize grown together at different densities. Agron. J. 105(6):1545-1554.

Delgado, M.; Ortiz, D. A. y Zambrano, A. 2008. Población de *Rottboellia cochichinensis* (Lour.) W. D. Clayton con resistencia cruzada al foramsulfuron + iodosulfuron. Agronomía Tropical. 58(2):175-180.

Elmore, D. C. 1990. Weed identification guide. Southern Weed Sciences Society. Champaign, IL. 250 p.

Esqueda, E. V. A. 2005. Efecto de herbicidas sobre plantas y semillas de *Rottboellia cochinchinensis* (Lour.) W. Clayton, en caña de azúcar. Agron. Mesoam. 16(1):45-50. DOI: 10.15517/am.v16i1.5181.

INEGI. 2013. Perspectiva estadística Morelos. Instituto Nacional de Estadística y Geografía. México, DF. 93 p.

Labrada, R. 2015. Revisión de la lista de malezas cuarentenadas de Ecuador. Revista La Técnica. 15(2):58-68. http://revistas.utm.edu.ec/index.php/latecnica/article/view/553/427.

León, R. G.; Izquierdo, J. and González-Adujar, J. L. 2015. Characterization and modeling of itchgrass (*Rottboellia cochinchinensis*) biphasic seedling emergence patterns in the tropics. Weed Sci. 63(3): 623-630. DOI: 10.1614/WS-D-14-00172.1.

Sánchez-Ken, J. G. y Cerros-Tlatilpa, R. 2016. Listado florístico de la familia Poaceae del estado de Morelos, México. Acta Botánica Mexicana. 116(3): 65-105. http://www.scielo.org.mx/pdf/abm/n116/2448-7589-abm-116-00065.pdf.

Sánchez-Ken, J. G.; Zita, P. G. de los A. y Mendoza, C. M. 2012. Catálogo de las gramíneas malezas nativas e introducidas de México. Primera Edición. SAGARPA, ASOMECIMA, AC, UNAM, CONACOFI. 433 p. https://www.researchgate.net/profile/GabrielSanchez-Ken/publication/256496385_Catalogo_de_malezas_gramineas_nativas_e_introducidas_de_Mexico/links/02e7e5231f0711998a000000/Catalogo-de-malezas-gramineas-nativas-e-introducida s-de-Mexico.pdf.

Silva, C. E. B.; Parreira M. C.; Alves, P. L. y Pavani, M. C. 2009. Aspectos germinativos de capim-camaote (*Rottboellia cochinchinensis*). Planta Daninha. 27(2):273-281. DOI: 10.1590/S0100-83582009000200009.

Strahan, R. E., Griffin, J. L., Reynolds, D. B. and Miller, D. K. 2000. Interference between *Rottboellia cochinchinensis* and *Zea mays*. Weed Sci. 48(2):205-211. DOI: 10.1614/0043-1745(2000)048[0205:IBRCAZ]2.0.CO;2.

Trujillo, A. F. J.; Arias, R. R.; Sánchez, A. H. M. y Ramírez, Del A. M. 2013. Manual operativo de la campaña contra malezas reglamentadas. SAGARPA. SENASICA, 30 p. https://www.gob.mx/cms/uploads/attachment/file/108116 /Manual_Operativo.p.