# WEED SCIENCE







## WEED SCIENCE

Published six times a year by the Weed Science Society of America

#### William K. Vencill, Editor

The Weed Science Society of America publishes original research and scholarship in the form of peer-reviewed articles in three international journals. Weed Science is focused on understanding "why" phenomena occur in agricultural crops. As such, it focuses on fundamental research directly related to all aspects of weed science in agricultural systems. Weed Technology focuses on understanding "how" weeds are managed. As such, it is focused on more applied aspects concerning the management of weeds in agricultural systems. Invasive Plant Science and Management is a broad-based journal that focuses not only on fundamental and applied research on invasive plant biology, ecology, management, and restoration of invaded non-crop areas, but also on the many other aspects relevant to invasive species, including educational activities, policy issues, and case study reports. Topics for Weed Science include the biology and ecology of weeds in agricultural, forestry, aquatic, turf, recreational, rights-of-ways, and other settings; genetics of weeds and herbicide resistance; chemistry, biochemistry, physiology and molecular action of herbicides and plant growth regulators used to manage undesirable vegetation, and herbicide resistance; ecology of cropping and non-cropping systems as it relates to weed management; biological and ecological aspects of weed control tools including biological agents, herbicide resistant crops, etc.; effects of weed management on soil, air, and water. Symposia papers and reviews are accepted. Consult the editor for additional information.

#### **Associate Editors (Assignment Year)**

Muthukumar V Bagavathiannan, Texas A&M, College Station, TX 77843 (2015)

Ian Burke, Washington State University, Pullman, WA 99164 (2019)

Carlene Chase, Horticultural Sciences Department, University of Florida, Gainesville, FL 32611 (2016)

**Bhagirath Singh Chauhan,** Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Queensland, Australia (2014)

Sharon Clay, South Dakota State University Plant Science Department, Brookings, SD 57007 (2002)

Franck E. Davan, USDA-ARS-NPURU, National Center for Natural Products Research, University, MS 38677 (2003)

Timothy Grey, Department of Crop and Soil Science, University of Georgia, Tifton, GA 31793 (2009)

Erin Haramoto, University of Kentucky, Lexington, KY 40506 (2020)

Prashant Jha, Iowa State University, Ames, IA 50011 (2017)

Mithila Jugulam, Kansas State University, Manhattan, KS 66506 (2019)

Vipan Kumar, Kansas State University, Hays, KS 67601 (2020)

Ramon Leon, Department of Crop and Soil Sciences, North Carolina State University, Raleigh, NC 27695 (2016)

Sara Martin, Ag Canada, Ottawa, Canada (2018)

Vijay Nandula, Mississippi State University, Delta Research & Extension Center, Stoneville, MS 38776 (2008)

Chris Preston, Australian Weed Management, University of Adelaide, PMB1, Glen Osmond, SA 5064, Australia (2003)

Dean Riechers, Department of Crop Sciences, University of Illinois, Urbana, IL 61801 (2011)

Hilary Sandler, University of Massachusetts-Amherst Cranberry Station, East Wareham, MA 02538 (2008)

Debalin Sarangi, University of Wyoming, Powell, WY 82435 (2020)

Steven Seefeldt, USDA-ARS, University of Alaska, Fairbanks, AK 99775 (2011)

Patrick J. Tranel, Department of Crop Sciences, University of Illinois, 360 ERML, Urbana, IL 61801 (2002)

Te-Ming Paul Tseng, Mississippi State University, Mississippi State, MS 39762 (2019)

Martin M. Williams II, USDA-ARS Global Change and Photosynthesis Research, Urbana, IL 61801 (2008)

Chenxi Wu, Crop Science Division, Plant Biotechnology - Research & Development, Bayer U.S., Chesterfield, MO 63017 (2019)

Tracy Candelaria, Managing Editor

#### Officers of the Weed Science Society of America

http://wssa.net/society/bod/

Weed Science (ISSN 0043-1745) is an official publication of the Weed Science Society of America, 12011 Tejon Street, Suite 700, Westminster, CO 80234 (720-977-7940). It contains refereed papers describing the results of research that elucidates the nature of phenomena relating to all aspects of weeds and their control. It is published bimonthly, one volume per year, six issues per year beginning in January.

Membership includes online access to *Weed Science, Weed Technology, Invasive Plant Science and Management,* and the online *WSSA Newsletter.* Dues should be sent to WSSA, 12011 Tejon Street, Suite 700, Westminster, CO 80234 no later than December 1 of each year. Membership in the society is on a calendar-year basis only.

New subscriptions and renewals begin with the first issue of the current volume. Please visit the *Weed Science* subscription page at https://www.cambridge.org/core/journals/weed-science/subscribe; Email: subscriptions\_newyork@cambridge.org in USA, journals@cambridge.org outside USA.

Weed Science publishes six times a year in January, March, May, July, September, and November. Annual institutional electronic subscription rates: US \$443.00; UK £308.00.

Please use Editorial Manager to access manuscript submissions (http://www.editorialmanager.com/ws). Authors are asked to pay \$65 per page as a portion of the cost of publication, plus an additional processing charge of \$55 per manuscript if none of the authors are WSSA members. The Editor can make exceptions in advance when justified.

The Weed Science Society of America fully subscribes to the belief that progress in science depends upon the sharing of ideas, information, and materials among qualified investigators. Authors of papers published in *Weed Science* are therefore encouraged, whenever practicable and when state and federal laws permit, to share genotypically unique, propagative materials they might possess with other workers in the area who request such materials for the purpose of scientific research.

Weed Science published by the Weed Science Society of America.
Copyright 2021 by the Weed Science Society of America.
All rights reserved. Reproduction in part or whole prohibited.

#### On the Cover:

Image of a seed shatter phenology study on *Amaranthus* spp. See the two articles from Schwartz-Lazaro et al. in this issue for seed-shattering studies on grasses and broadleaf weed species. Photo by Dr. Lovreet Shergill.



### Volume 69 Number 1 January 2021

#### **EDITORIAL** Editorial for Weed Science, Volume 69. William K, Vencill 1 **REVIEW** Managing herbicide resistance in China. Xiangying Liu, Austin Merchant, Shihai Xiang, Tao Zong, Xuquo Zhou and Lianyang Bai..... 1 **RESEARCH ARTICLES** Herbicide symptomology and the mechanism of action of methiozolin. *Chad Brabham, Philipp Johnen.* Janneke Hendriks, Michael Betz, Alexandra Zimmermann, Jarrad Gollihue, William Serson, Chase Kempinski and Michael Barrett..... 18 Under pressure: maternal effects promote drought tolerance in progeny seed of Palmer amaranth (Amaranthus palmeri). Maor Matzrafi, O. Adewale Osipitan, Sara Ohadi and Mohsen B. Mesgaran...... 31 Sensitivity to salinity at the emergence and seedling stages of barnyardgrass (Echinochloa crus-galli). weedy rice (Oryza sativa), and rice with different tolerances to ALS-inhibiting herbicides. Silvia Fogliatto, Lorenzo Patrucco, Marco Milan and Francesco Vidotto...... 39 Rattail fescue (Vulpia myuros) interference and seed production as affected by sowing time and crop density in winter wheat. Muhammad Javaid Akhter, Per Kudsk, Solvejg Kopp Mathiassen and Bo Melander.... 52 Effect of environmental factors on the germination and emergence of drunken horse grass (Achnatherum inebrians). Yonghuan Yue, Guili Jin, Weihua Lu, Ke Gong, Wangiang Han, Wenhao Liu and Xueer Wu...... 62 Germination biology of three populations of Navua sedge (Cyperus aromaticus). Aakansha Chadha, Singarayer K. Florentine, Kunjithapatham Dhileepan, Kim Dowling and Christopher Turville ..... 69 Effect of soil moisture regimes on the growth and fecundity of slender amaranth (Amaranthus viridis) and redroot pigweed (Amaranthus retroflexus). Asad M. Khan, Ahmadreza Mobli, Jeff A Werth and Bhagirath S. Chauhan ..... 82 Effects of herbicide management practices on the weed density and richness in dicamba-resistant cropping systems in Indiana. Connor L. Hodgskiss, Travis R. Legleiter, Bryan G. Young and William G. Johnson...... 88 Seed-shattering phenology at soybean harvest of economically important weeds in multiple regions of the United States. Part 1: Broadleaf species. Lauren M. Schwartz-Lazaro, Lovreet S. Shergill, Jeffrey A. Evans, Muthukumar V. Bagavathiannan, Shawn C. Beam, Mandy D. Bish, Jason A. Bond, Kevin W. Bradley, William S. Curran, Adam S. Davis, Wesley J. Everman, Michael L. Flessner, Steven C. Haring, Nicholas R. Jordan, Nicholas E. Korres, John L. Lindquist, Jason K. Norsworthy, Tameka L. Sanders, Larry E. Steckel, Mark J. VanGessel, Blake Young and Steven B. Mirsky..... 95 Seed-shattering phenology at soybean harvest of economically important weeds in multiple regions of the United States. Part 2: Grass species. Lauren M. Schwartz-Lazaro, Lovreet S. Shergill, Jeffrey A. Evans, Muthukumar V. Baqavathiannan, Shawn C. Beam, Mandy D. Bish, Jason A. Bond, Kevin W. Bradley, William S. Curran, Adam S. Davis, Wesley J. Everman, Michael L. Flessner, Steven C. Haring, Nicholas R. Jordan, Nicholas E. Korres, John L. Lindquist, Jason K. Norsworthy, Tameka L. Sanders, Larry E. Steckel, Mark J. VanGessel, Blake Young and Steven B. Mirsky..... 104 Seed germination ecology of meadow knapweed (Centaurea × moncktonii) populations in New York State, USA. Antonio DiTommaso, Lindsey R. Milbrath, Caroline A. Marschner, Scott H. Morris and Anna S. Westbrook ..... 111 An integrated weed management strategy for the control of horseweed (Conyza canadensis).

Theodore R. Vanhie, François J. Tardif, Peter Smith, Saeed Vazan, Michael Cowbrough

and Clarence J. Swanton.....

119