USDA Agricultural Research Service
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ARS Office of National Programs

ARS WEED SCIENCE

Research News and Highlights

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AREA RESEARCH UPDATES

NORTHEAST

Successful invasive weeds interact with diverse resident microbes, which represent a large pool of potential biocontrol agents. The outcome of many plant-microbe interactions is context dependent, making it challenging to assess the nature of weed-microbe associations at any given timepoint but also providing opportunities to manipulate apparently benign microbes into weed-suppressive action. Genome sequences can be used to define the functional potential of microbes and prioritize them for development as biocontrol agents. Supported by an ARS AI-COE/SCINet, a graduate student is now interning at the ARS Foreign Disease-Weed Science Research Unit in Frederick, Maryland to adapt machine learning algorithms to identify genomic features associated with plant pathogenicity in bacteria. High-accuracy classification of bacterial lifestyles was achieved using the identified features, and these models were robust to the missing data common to incomplete genome sequences. The model can now be validated on newly collected microbes and will be applied to predict latent pathogenic ability in weed-associated microbes. This work is expected to increase the rate at which microbial weed biocontrol agents are found while expanding the environmental sources considered for agent discovery.

MIDWEST

Waterhemp is a growing threat to U.S. snap bean production because it contaminates the harvested product, and few tools are available for controlling this weed. Pyroxasulfone and sulfentrazone control waterhemp before the weed emerges, but the two herbicides are not registered for use with snap bean due to concern of crop injury. Researchers at the ARS Global Change and Photosynthesis Research Unit in Urbana, Illinois, with university collaborators, determined snap bean tolerance to pyroxasulfone and sulfentrazone using a panel of 277 entries representing the diversity of snap beans grown in the U.S. over the last century. A handful of entries were tolerant to pyroxasulfone across variable environments, but the margin of crop safety is insufficient for registration of pyroxasulfone on snap bean crops. In contrast, tolerance to sulfentrazone was associated with multiple genomic regions conditioning larger seed size, oxidative stress tolerance, and herbicide metabolism. This new knowledge identifies specific genomic targets that the snap bean seed industry can use to improve sulfentrazone tolerance in sensitive lines, which may facilitate registration of the herbicide, as well as improve environmental stress tolerance in new cultivars.

PLAINS

Field bindweed is a declared noxious weed or regulated species in 22 U.S. states and 5 Canadian provinces. Management includes cultivation, herbicides, and biological control, but this plant remains difficult to control in a variety of habitats and is a priority problem for organic production systems. New candidate arthropod species are being investigated for classical biological control of field bindweed, but evaluating their potential for impact requires understanding the genetic variation and reproduction strategies among North American populations. Researchers at the ARS Pest Management Research Unit in Sidney, Montana, found that different genetic lineages tended to be dominant in eastern versus western bindweed populations in North America, but variation among populations was too high to predict genetic differences based on location. Many populations reproduced by both seed and vegetative spread, but some populations reproduced entirely through rhizome expansion and without seeds. Thus, proposed biological control agents that target roots and reduce vegetative reproduction may substantially limit spread of this noxious weed, providing additional non-chemical control options to bolster integrated weed management programs for bindweed control in both traditional and organic production systems.

PACIFIC WEST

The ability to restore rangeland by establishing grasses is critical but remains very difficult using only seed-based methods. New methods to improve rangeland restoration by including crown buds with seeds are necessary. It may be possible to improve seedling establishment by including growth buds from crowns of native species to augment establishment from seeds. Researchers at the ARS Range and Meadow Forage Management Research Unit in Burns, Oregon, have developed techniques for harvesting, excavating, and storing buds of native plant species, and have developed methods for successfully establishing Sandberg's bluegrass and tufted hairgrass, two important native plants, from crown buds during restoration. This method will be useful to state and federal land management agencies, producers, conservation groups, and anyone attempting to restore these species in degraded and invaded rangeland.

SOUTHEAST

Cogongrass invades many subtropical and tropical areas and is estimated to infest over 500 million hectares world-wide. Asia is most likely the native range of cogongrass from where it was accidentally first introduced to the US in packing material from Japan. Cogongrass was later intentionally introduced for forage in Texas, Mississippi, Alabama, and Florida. Cogongrass is included in the federal noxious weed list and primarily invades the Gulf Coast states from Texas to Florida, Georgia, South Carolina, and Virginia. Over 100,000 hectares are infested in Florida, Alabama, and Mississippi where cost of control may approach $400 per hectare. Cogongrass produces extensive rhizomes and seeds which allow it to spread, persist, and dominate invaded sites. The weed may reproduce vegetatively from rhizomes and is a prolific seed producer. Its leaves can grow to 1.2 to 1.5 meters in height and the plant can thrive in fire-based ecosystems. Although it was once thought to be suitable as food for cattle, the low nitrogen content, poor digestibility, and high silicate levels in the leaves deter grazing. Researchers at the ARS Invasive Plant Research Laboratory in Fort Lauderdale, Florida are conducing native range surveys for Cogongrass potential agents in Australia, Japan, and South Africa, and South Korea. The surveys revealed as many as 60 potential new agents, including a crown borer, a stem borer, a shoot tip feeder, and a shot borer. Research to colonize and host range determination is continuing.

OFFICE OF NATIONAL PROGRAMS

THE WEEDS ATLAS

In spite of the daunting challenges posed by weeds and invasive plants, integrated management, several effective chemistries, and the development of new technology are signaling that ongoing and renewed efforts are worthwhile. However, coordination is needed to better address the problem of weeds and invasive plants at the national level. Federal agencies and several non-profits have some of the largest land holdings, while many universities and colleges work closely with practitioners and managers who oversee a diversity of agroecosystems and natural areas. Thus, there is an urgent and pressing need to be better informed across groups, organizations, and agencies about research and management activities targeting weeds and invasive plants. Hence, The Weeds Atlas!

The Weeds Atlas is a tool that allows for the monitoring of weed and invasive plant activities across the United States. By entering simple information that provides a brief description of the target species, location, and activity, all can contribute, and all can benefit. Contact information allows for inquiries to obtain further details on a specific location or target species. The Weeds Atlas is meant to address coordination and collaboration efforts across both research and management activities in the U.S. from all who are interested in weeds and invasive plants. So, go ahead and submit your data or make a connection by seeing what is going on and where.

RESEARCH SPOTLIGHT

DR. ALI WRIGHT

The WSN caught up with Ali to talk about her research on herbicide resistance and itchgrass, one of the most challenging weeds in sugar cane, and some of her advice to those considering a career in weed science. Ali is a weed scientist at the ARS Sugarcane Research Unit in Houma, Louisiana.

Ali Wright, PhD
Research Scientist
ARS Sugarcane Research Unit
Houma, Louisiana

WSN: How are you doing? What's the weather been like where you are this winter?

Ali: I'm doing well. Winter was pretty mild until last week when we had some freezing rain overnight. It was strange to see icicles hanging from the street signs. Mostly we have been getting some rain which is much needed as we had a period of extreme drought this summer.

WSN: So, the weather in the southeast is acting similar to elsewhere – a bit erratic. How does this impact your research?

Ali: Right now, in the greenhouse I am working with Italian ryegrass and, being a winter annual, it is thriving with the cooler temperatures. This past summer, however, the extreme drought was paired with a run of exceptionally hot days. When we needed to be in the field, my technician and I would start at sunrise so we could finish data collection before the heat got to where it was unsafe to be in the field. At planting in late summer, we usually apply a pre-emergence herbicide treatment. With the drought there wasn't enough rainfall for the pre-emergence treatment to be effective, so we had to apply a post-emergence treatment for itchgrass control. Like everyone, we just have to be mindful of the weather and adapt when needed.

WSN: These seem pretty dramatic, but a necessary response. As far as what you are doing at planting to deal with the conditions, are sugarcane growers following your lead and has this caused you to work more closely with your university collaborators?

Ali: On our research farm, other plots, in addition to the weed science plots, were treated post-emergence to manage itchgrass. On a larger scale, the whole Louisiana sugarcane production region was affected by the drought. My colleagues at LSU ran into the same issues with weed control at planting due to the lack of rain. We are collaborating on projects, including one focused on itchgrass, which is our worst weed in sugarcane.

WSN: What do you think makes itchgrass the worst weed in sugarcane? Any others that are a close second, third, fourth,,,,,,?

Ali: Sugarcane is a perennial grass crop, so it's not surprising that the worst weed in sugarcane is a grass species. Like many weed species, itchgrass is a prolific seed producer. It also self-fertilizes so it only takes one plant setting seed to cause a problem in subsequent years. Many populations in the area will produce seed throughout the growing season – one exception was a population that only produced seed mid-fall. The seed can very easily spread – my colleagues and I have found it on our clothes after being in an infested field. If allowed to persist unmanaged, itchgrass can very quickly take over an area. I have seen it proliferate along ditchbanks, bayous, railroads, and around telephone poles – areas where weeds are not being actively managed. Not many herbicides are effective in controlling this weed – pendimethalin is effective for pre-emergence control and asulam is an effective post-emergence treatment against escapes, but that's mostly it for herbicides that are registered in sugarcane. Cultivation is another management strategy for itchgrass. Like some of our problem weeds, itchgrass is a non-native species, originally from Asia. Other problematic weeds include bermudagrass and nutsedge. Johnsongrass historically has been a problem but less so now than it used to be. We are starting to see more vaseygrass in sugarcane. In some areas we have paraquat and PSII inhibitor resistant Italian ryegrass – this is a project I have been working on with Dr. Al Orgeron at the LSU AgCenter. Morningglory can be a problem as it will twine around the stalks and interfere with harvest. Itchgrass, however, is really what is at the forefront of growers' minds when it comes to weeds.

Ali Wright doing research in a sugarcane field in Louisiana. (Photo credit: Mandy Guidry)

WSN: That really explains it and shows the importance of your research. How critical was your undergraduate and graduate training in allowing you to do what you do today, as a weed scientist at ARS?

Ali: I would say that my undergraduate and graduate training has been very critical. When I started my undergraduate degree, I knew that I wanted to do molecular biology research. I majored in recombinant genetics at Western Kentucky University and during my time there worked in Dr. Rodney King's lab where I studied bacteriophage. Both my classwork and my training with Dr. King gave me a very solid background in molecular biology. Later, when I was applying those skills to herbicide resistance problems as an ARS technician, I decided to go back to school to earn a doctorate at Mississippi State University. While I was there, one of my graduate committee members, Dr. Vijay Nandula, taught me how to use the spray chamber to perform dose responses and also how to perform enzyme assays to detect target site resistance to ALS inhibitors. I have a very similar spray chamber here in Houma that I use frequently. During my graduate work I also gained experience with transcriptomics which was very helpful during my post-doc - I am hoping to eventually put those skills to work in some projects I have planned in my current position. My background in molecular biology gives me a skill set that complements those of my LSU colleagues, allowing for some great collaborations, such as investigating herbicide resistance.

WSN: You have been able to maximize what you have learned and connecting with several key individuals along your career path has definitely been instrumental in practical ways, and probably in the areas of mentoring and advising, too. It has been great to visit with you and as we end, do you have any sage advice that you could share with others about the field of weed science?

Ali: Yes, I have been very fortunate to have had excellent mentors throughout my education and career. I don't know about sage advice, but something that has helped me in weed science and that I think is an advantage is having a diverse background when it comes to my research experience. In addition to weed science, I have worked in microbiology and plant pathology and those diverse experiences make me a better weed scientist and collaborator, particularly as weed science itself is such a diverse field that can encompass and interact with several disciplines. So, I would recommend, particularly for anyone who is very early in their weed science career, to try to build a varied and diverse research experience as that will be useful later on.

WSN: Terrific! Thanks, Ali. We look forward to hearing more about your research in weed science. Your projects and approach are inspiring and will continue to have an impact for growers and on weed science both now and hopefully, long into the future. Take care.

ARS WEED SCIENCE MEETINGS AND OUTREACH

2022 WSSA-ARS Weed Science Webinar Series

- All 10 webinars from the series were recorded and are now available free for viewing at this ARS website.

2024 ARS National Program 304 Plant Protection and Quarantine

- Retrospective review in preparation for the 2025-2030 Action Plan. Please submit comments, concerns, and/or suggestions at the website.

Educational Videos/Guides:

- Biocontrol against a thirsty invasive grass in arid regions of the U.S. (Albany, CA)
- Cheating cheatgrass (Reno, NV)
- The Sagebrush Sea – innovative Restoration (Burns, OR)
- Wildfire mitigation (Reno, NV)
- Cover crops for weed control: the keys for success (Beltsville, MD)

ARS WEED SCIENCE POSITIONS

Recent Hires

- Dr. Casey Barickman – ARS Natural Products Utilization Research Unit, Oxford, MS
- Dr. Olivia Landau – ARS Wheat Health, Genetics, and Quality Research Unit, Pullman, WA
- Dr. Jens Beets – ARS Invasive Species and Pollinator Health Research Unit, Albany, CA
- Dr. Vijaya Varanasi – ARS Crop Production Systems Unit, Stoneville, MS
- Dr. Allen Dray – ARS Invasive Plant Research Unit, Fort Lauderdale, FL

Current Openings

- Weed Ecologist – ARS Columbia Plateau Conservation Research Center, Pendleton, Oregon (TBD)
- Weed Scientist – ARS Northwest Sustainable Agroecosystems Research Unit, Pullman, Washington (TBD)

SELECT ARS PAPERS

(recently published by researchers in weed science)

- Ashley B. C. Goode, **Philip W. Tipping**, **F. Allen Dray Jr**., Ryann J. Valmonte, Brittany K. Knowles & Eileen Pokorny (2023) Effects of invasive plant haplotypes on a biological control agent (*Lepidelphax pistiae*) fecundity and impact, Biocontrol Science and Technology, 33:11, 1041-1050, DOI: 10.1080/09583157.2023.2272229

- Linhao Xu, Ashley B.C. Goode, **Philip W. Tipping**, **Melissa C. Smith**, Lyn A. Gettys, Brittany K. Knowles, Eileen Pokorny, Luz Salinas, Donald L. DeAngelis (2024) Less is more: Less herbicide does more when biological control is present in *Pontederia crassipes*. Ecological Modelling, 487, 110566. https://doi.org/10.1016/j.ecolmodel.2023.110566

- **G.S. Wheeler**, E.C. Lake, E. Mattison, G.F. Sutton (2024) Host range, biology, and climate suitability of *Callopistria exotica*, a potential biological control agent of Old World climbing fern (*Lygodium microphyllum*) in the USA. Biological Control 188: 105410. https://doi.org/10.1016/j.biocontrol.2023.105410

- **Smith, M.C.**, Julian, P., DeAngelis, D., Zhang, B. Ecological benefits of integrative weed management of *Melaleuca quinquenervia* in Big Cypress National Preserve. *BioControl* (2023). https://doi.org/10.1007/s10526-023-10229-y

- **Dale A. Halbritter**, Eutychus Kariuki, **Gregory S. Wheeler**, **Min B. Rayamajhi**, Carey Minteer, Quentin D. Read (2024) Changes in plant architecture in Brazilian peppertree damaged by the biological control agent, Pseudophilothrips ichini (Hood) (Thysanoptera: Phlaeothripidae). Biological Control 188:105434 https://doi.org/10.1016/j.biocontrol.2023.105434

- Preiss, V.D., **Wonkka, C.L.**, McGranahan, D.A., Lodge, A.G., Dickinson, M.B., Kavanagh, K.L. et al. (2023) Exotic herbivores and fire energy drive standing herbaceous biomass but do not alter compositional patterns in a semiarid savanna ecosystem. *Applied Vegetation Science*, 26, e12749. Available from: https://doi.org/10.1111/avsc.12749

- **West, N.M.**, Branson, D.H., Muscha, J.M., & Campbell, J.W. (2023). Early Impacts of Invasive Shrub Removal on Riparian Arthropod Communities. *Ecological Restoration 41*(4), 189-198. https://www.muse.jhu.edu/article/911493

- Donovan, V. M., Crandall, R., Fill, J., & **Wonkka, C. L.** (2023). Increasing large wildfire in the eastern United States. *Geophysical Research Letters*, 50, e2023GL107051. https://doi.org/10.1029/2023GL107051

- McGranahan, D.A.; **Wonkka, C.L.** (2024) Pyrogeography of the Western Great Plains: A 40-Year History of Fire in Semi-Arid Rangelands. *Fire*, *7*, 32. https://doi.org/10.3390/fire7010032

- Kirk W. Davies, **Chad S. Boyd**, Lauren N. Svejcar, Danielle R. Clenet (2024) Long-term effects of revegetation efforts in annual grass–invaded rangeland. Rangeland Ecology & Management 92:59-67. https://doi.org/10.1016/j.rama.2023.10.001

- Corinna M. Holfus, **Chad S. Boyd**, Roxanne C. Rios, Kirk W. Davies, Stella M. Copeland, Ricardo Mata-González (2024) Wyoming big sagebrush transplant survival and growth affected by age, season of planting, and competition. Rangeland Ecology & Management 92:1-11. https://doi.org/10.1016/j.rama.2023.09.005

- Na-Bo Sun, Li-Jing Min, Xin-Peng Sun, Zhi-Wen Zhai, **Joanna Bajsa-Hirschel**, Zhe-Cheng Wei, Xue-Wen Hua, **Charles L. Cantrell**, Hao Xu, Stephen O. Duke, and Xing-Hai Liu (2024) Novel Pyrazole Acyl(thio)urea Derivatives Containing a Biphenyl Scaffold as Potential Succinate Dehydrogenase Inhibitors: Design, Synthesis, Fungicidal Activity, and SAR. Journal of Agricultural and Food Chemistry 72:2512-2525. https://doi.org/10.1021/acs.jafc.3c07735

- Rebong, D., Henriquez Inoa, S., Moore, V. M., Reberg-Horton, **S. C., Mirsky**, S., Murphy, J. P., & Leon, R. G. (2023). Breeding allelopathy in cereal rye for weed suppression. *Weed Science*, 1–11. https://doi.org/10.1017/wsc.2023.64

- **Williams, M.M., II**, Hausman, N.E., Saballos, A., Landau, C.A., Brooks, M.D., Flannery, P., Tracy, W.F. and Thompson, C.J. (2024), First report of severe tolpyralate sensitivity in corn (*Zea mays*) discovers a novel genetic factor conferring crop response to a herbicide. Pest Manag Sci, 80: 1645-1653. https://doi.org/10.1002/ps.7896

- **Joanne C. Chee-Sanford**, Lynn M. Connor (2023) Comparison of microbial community assemblages in the rhizosphere of three Amaranthus spp. PLOS One https://doi.org/10.1371/journal.pone.0294966

- Christopher Landau, Kevin Bradley,…**Martin M Williams**, (2023) The silver bullet that wasn't: Rapid agronomic weed adaptations to glyphosate in North America, *PNAS Nexus*. 2:pgad338 https://doi.org/10.1093/pnasnexus/pgad338

- **Young, Stephen L**., **James V. Anderson**, **Scott R. Baerson**, **Joanna Bajsa-Hirschel**, **Dana M. Blumenthal**, **Chad S. Boyd**, **Clyde D. Boyette**, **Eric B. Brennan**, **Charles L. Cantrell**, **Wun S. Chao**, **Joanne C. Chee-Sanford**, **Charlie D. Clements**, **F. Allen Dray**, Stephen O. Duke, **Kayla M. Eason**, **Reginald S. Fletcher**, **Michael R. Fulcher**, **John F. Gaskin**, **Brenda J. Grewell**, **Erik P. Hamerlynck**, **Robert E. Hoagland**, **David P. Horvath**, **Eugene P. Law**, **John D. Madsen**, **Daniel E. Martin**, **Clint Mattox**, **Steven B. Mirsky**, **William T. Molin**, **Patrick J. Moran**, **Rebecca C. Mueller**, Vijay K. Nandula, **Beth A. Newingham**, **Zhiqiang Pan**, **Lauren M. Porensky, Paul D. Pratt**, **Andrew J. Price**, **Brian G. Rector**, **Krishna N. Reddy**, **Roger L. Sheley**, **Lincoln Smith**, **Melissa C. Smith**, **Keirith A. Snyder**, **Matthew A. Tancos**, **Natalie M. West**, **Gregory S. Wheeler**, **Martin M. Williams**, **Julie Wolf**, **Carissa L. Wonkka**, **Alice A. Wright**, **Jing Xi**, Lew H. Ziska (2023) Agricultural Research Service weed science research: past, present, and future. *Weed Science* 71: 312–27. https://doi.org/10.1017/wsc.2023.31