



# ARS Weed Science

Research News and Highlights



## SUMMER 2022

### AREA - RESEARCH UPDATES



#### NORTHEAST

“The future of agriculture is for it to be more precise and sustainable,” says Dr. Steven Mirsky, Weed Ecologist. This focus has resulted in interest from [USA Today](#) and by Secretary Vilsack during a recent visit he made to the Beltsville Agriculture Research Center (BARC). By working on ruggedized, weatherproof and inexpensive IoT sensors, an on-the-ground view of nutrients, humidity, and other factors, including weeds, are being fed into software platforms for use by growers. In a new [Areawide Pest Management](#) project, sensors and automation are the basis for implementing integrated, sustainable weed management in partnership with research teams and farmers spread across the US.



#### MIDWEST

Weeds are challenging for growers and [new research](#) suggests this could get worse with climate change. Prediction models for corn growing regions, such as the Midwest, overlook the effects of weeds on yields. Yet, weeds are the

primary pest of concern in terms of diminished quality, quantity, and harvestability for corn growers. [Studies](#) by Dr. Marty Williams, Weed Ecologist, and his colleagues are providing new insight into how increasing drought conditions, as a result of climate change, are ratcheting up the level and intensity of weed interference. Without the highest level of control, which is herbicide-based, corn yields decline significantly. Climate change is exacerbating the effects of herbicide resistance on corn and emphasizing again the need for new weed management systems.



#### PLAINS

Plant competition or interference is the main problem with having weeds in cropping system. Dr. David Horvath, Weed Physiologist, and a team of scientists are conducting [research](#) using transcriptomics methods to elucidate some of the finer details of how weeds interact with crops. What they have found, so far, is that when weeds are present early in the season, the crop plant initiates a defense response similar to when threatened by bacterial

and fungal diseases. The detection and response activity switches the crop plant from expansion and development to defense and protection, which results in a slowing of growth regardless of whether resources are limiting or not. Similarly, when a crop plant detects weeds, the response of the crop is a diminished growth and development trajectory, as resources are re-directed for the production of seed to ensure survival of the next generation even at the expense of vigorous growth. Combined, these observations indicate that weed-induced yield losses can be prevented if the crop can be blocked from detecting or responding to weeds early in the season. These and other ongoing studies are aimed at developing sustainable integrated weed management approaches appropriate for agricultural intensification in the northern Great Plains.



### PACIFIC WEST

Invasive plants that infest water systems, both human-made and natural, can have devastating effects on hydrological processes, plant and animal species, as well as to local, state, and region-wide delivery systems. A holistic research approach that considers the ecology and biology of the target invader and management implications from both control and impact aspects has been the focus of the [program](#) led by Dr. John Madsen, Weed Biologist. In a comprehensive set of papers published in a Special Issue of the *Journal of Aquatic Plant Management*, the [USDA-ARS Delta Region Areawide Aquatic Weed Project](#) was the feature. The project, which was funded from 2014 to 2019, aimed to improve control of floating water

hyacinth (*Eichhornia crassipes*), submersed Brazilian waterweed (*Egeria densa*), and riparian arundo (*Arundo donax*). Each of the 14 [published papers](#), which cover the biology and ecology, monitoring, management techniques, modeling, and operations, highlight the results of the project, which has improved aquatic weed control in the critical water resource nexus of the California Delta.



### SOUTHEAST

The focus of most genomic weed research has been to identify and neutralize specific traits to make individuals more susceptible/less resistant to management (i.e., seed shattering, herbicide resistance, Vavilovian mimicry). However, the recent availability of genomes for many major weed species is now opening up new opportunities: these highly adaptable and successful plants can be studied and exploited by identifying and utilizing their novel genetics as a template to improve crop resilience to climate change. [Research](#) being conducted by Dr. Bill Molin, Weed Physiologist, and his colleagues is part of a growing body of literature that is exploring the genomics of several different weed species to learn more about their unparalleled ability to overcome adverse environments and conditions. The goal is ultimately to select weed biotypes that are more drought and high-temperature tolerant, preserve the germplasm, and identify the genes responsible for the traits for eventual utilization within certain crops.



## OFFICE OF NATIONAL PROGRAMS – NEWS UPDATE

The [Travel Enrichment Experience](#) program through the Weed Science Society of America offers graduate students an opportunity to gain insight on weed science research and activities at a location away from their home institution. Up to six awards are made each year by WSSA to graduate students who apply and select their preferred institution, organization, or company. In 2022, Sarah Kezar, PhD student at Texas A&M, has chosen ARS Office of National Programs to learn about weed science research, policy and programmatic operations both within the agency and through the many partnerships it has with other federal departments that are addressing weeds and invasive plants. Sarah is working with Dr. [Steve Young](#), ARS National Program Leader, who oversees research on weeds and invasive pests. It will be a week packed full of meetings and activities that will serve as a base for Sarah to build upon as she looks for career opportunities following the completion of her graduate studies at Texas A&M.

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### RESEARCH SPOTLIGHT: DR. CARISSA WONKKA

WSN sat down with Carissa to discuss her research, one of her favorite plants, and an individual who has influenced her career the most. She is a research ecologist at the ARS Northern Plains Agricultural Research Lab in Sidney, MT.



**WSN:** Hi Carissa, how are you?

**Carissa:** I am doing well. We got fires done and got some rain. Good start to the field season.

**WSN:** Great to hear about your field work being successful. I'm sure that you have to adjust to the weather for much of your research. By the way, thanks again for taking time out of your day to talk about your research for the WSN. Perhaps you could share a little bit of your background to get started.

**Carissa:** It has indeed been an adjustment for weather moving my research to the northern Great Plains. That comment leads nicely into my background. I grew up on the east coast in Massachusetts, but after getting an undergraduate degree in wildlife management from the University of MA, I moved west for an internship at the Appleton Whittell Research Ranch - an Audubon research facility in Arizona. A large wildfire had just come through the area, and I spent my summer working with ranchers and assessing wildfire impacts across the fence in the ungrazed Research Ranch and on neighbors working cattle ranches. It was a formative experience and at that point I made a plan to get a law degree to familiarize myself with policy issues that land managers face and then go to grad school to obtain ecology degrees, with a specific focus on rangeland and fire ecology.

I attended Texas A&M for my master's in Range Ecology and PhD in Ecosystem Science and Management where I studied restoration approaches for woody-plant invaded rangelands. I explored both biophysical and legal components of rangeland restoration from a plant community and "people community" perspective. The goal of that research was to try to understand how to overcome the resilience of the woody-plant invaded state and restore grass dominance to these rangeland systems. I continued that line of research during my Post Doc at the University of Nebraska where we explored the mechanisms of persistence for resprouting and non-resprouting

woody plants and assessed the potential of extreme prescribed fire to overcome that resistance and restore grass dominance to eastern redcedar and mesquite invaded rangelands.

I started my position with ARS as a restoration ecologist after my post-doc in April 2020.

**WSN:** Interesting. I don't think I've ever met an ecologist, who is also a "lawyer". Has this been helpful in your current research, or do you anticipate it will have more of an impact should your career take a different turn away from empirical field ecology studies?

**Carissa:** There are a few of us law-backgrounded ecologists out there. I do believe it is helpful in my current research. While I have much more of a biophysical emphasis in my current research, rangelands are ultimately coupled human natural systems, and I am still very much involved in research to identify barriers to management adoption. A full understanding of rangeland resilience and invasion dynamics requires an understanding of the humans that are very much a part of those systems. I am working currently on a project assessing barriers to prescribed fire use in Northern Great Plains Rangelands. Sometimes the barriers are a lack of ecological understanding and need for my biophysical research, but more often than not there are regulatory hurdles or capacity issues exacerbated by regulation. Understanding how regulation impacts adoption is as essential to understanding rangeland system resilience as understanding grass community response to prescribed burning, and that requires an ability to access and interpret statutes and regulations and understanding how the legal system functions in managers' day to day lives. All of this was facilitated by my legal training (I am not a lawyer technically because I am not barred in any state, just an ecologist with legal training.)

**WSN:** Yeah, that makes sense. I think, as ecologists, we often get very interested and passionate about the plants and sometimes don't give enough thought to the practitioners and all that they encounter, as you have mentioned. From a research program perspective, I imagine that you are working with a diverse group of researchers in addressing the topic of coupled human natural systems. How has this developed for you, and can you share some of the benefits?

**Carissa:** I've been really lucky to be able to work with a lot of really talented researchers from a lot of different backgrounds in addressing some of these broad systems questions. It's always been really important to develop work as part of a team with a broad skill set. I am currently developing research with a great team of scientists that include university researchers, the USGS, USFS with backgrounds in ecological modeling, invasion genetics, systems ecology, and landscape ecology. We are thinking about early warning indicators for insipient invasions to increase EDRR capacity. In broad projects such as these, having diverse backgrounds and areas of expertise is key to pulling off the myriad types of research that are necessary to make the project successful. My research program has also really benefited from ongoing collaborations with colleagues from my PhD and postdoctoral work and expanding that network internationally to colleagues with similar research questions. We can never answer the question in one grant cycle, so I've been lucky to keep developing some of those ideas with collaborators who are really dedicated to filling more and more of our knowledge gaps. And of course, I have a whole new avenue of collaboration with other ARS ecologists in my current position.

**WSN:** Networks are key, even in research. So, shifting a bit, since you are relatively new in your position with ARS, what are some of the top research projects in your program that you will be working on, especially related to weeds and invasive plants, going forward?

**Carissa:** Much of my current research is focused on identifying restoration options for degraded rangelands - either weed-invaded or highly disturbed (e.g. energy development) via studies focused on identifying characteristics of rangelands that decrease susceptibility to weed invasion and reinvasion, including plant community traits, plant physiology, and soil physical, chemical, and biotic feedbacks that modulate community dynamics and physiology, as well as assessing management impacts (especially fire and grazing as they primary drivers of plant community trajectories in rangelands) on native rangeland invasibility and the competitive performance of weeds.

One study I am particularly excited about that I recently initiated with collaborators at the ARS Livestock and Range Research Lab is to assess plant physiological and soil responses to fire and different grazing strategies. Fire and grazing shape rangeland plant species composition and productivity through direct consumption of biomass and by altering soil moisture & temperature, light availability, and other small-scale environmental changes. These changes potentially affect soil microbes as well as plant nutrient and moisture availability, which in turn effect rangeland productivity by altering plant physiology and biomass allocation. These effects differ among species; invasive species might differ from native species in responses to fire and grazing management. Understanding differential plant responses to fire and grazing will help us identify management strategies to decrease weeds and increase rangeland health. The mechanistic approach of assessing plant physiological responses and plant-soil feedbacks will make the findings more transferable to other rangeland systems and other invasive species. And by exploring these responses in both the invasive species (we are looking at invasive grasses) and native species, we can better get at the mechanisms underpinning the competitive advantages of invasive species and how management modulates these mechanisms.

Another that I am excited about is a multi-scaled assessment of a plant traits-based approach to pipeline reclamation. Disturbances that clear existing vegetation from an area, such as pipeline construction, create opportunities for invasive species to expand and potentially spread into intact ecosystems. In order to reduce the potential for spread of invasive species along pipelines, reclamation should seek to restore native plant communities that are resistant to invasion. A functional traits-based approach could increase restoration success by providing a means for applying ecological theories of community assembly to the selection of species seeded or planted to meet restoration objectives. I am testing several seed mixes based on their traits distribution and several different theories of community assembly to see if the resulting communities are competitive at excluding invasive grasses from disturbed areas.

**WSN:** Wow! Exciting stuff. Your collaborative approach is obvious and really goes a long way in helping us better understand what is happening to these ecosystems in support of improved management practices. Your reclamation research reminds me of similar studies occurring in neighboring states on restoring oil pads. These “small-scale” disturbances are proving to be quite a challenge as they serve as niches in which invasive plants can take advantage of. Great to hear that you are addressing this topic. Now, I want to get a little myopic and have you tell me which is your favorite invasive plant (and you can include a native one, too) and why?

**Carissa:** That’s an unexpected question! Aren’t we supposed to hate all invasive species? ☹️ As a systems-focused person (either ecosystem level or plant-system level), I guess I don’t think a lot about individual species as much as I focus on their traits or their role in community processes, but I do have a lot of respect for (and research interest in) invasive grasses. The level of trait plasticity and the different life-history strategies they employ to quickly gain dominance in a community is pretty impressive. While I am really enjoying studying the physiology of crested wheatgrass and invasive annual bromes currently, I am excited about future plans for research on cogongrass and Lehman’s lovegrass because of their potential to drastically alter fire regimes with great impacts to ecosystem function. But my preference for grasses is likely just a reflection of my love of grasslands and grassland ecology generally.

**WSN:** Sorry for the curveball, but I couldn’t resist. Each plant, invasive or native, has its own set of characteristics and features that make them truly remarkable, even if they are undesirable. Of course, that is all in the eye of the beholder, according to Waldo Emerson, who said a weed is simply a plant whose virtues we haven’t yet discovered. Hey, speaking of famous people, there are a number of stalwarts in ecology, some well-known and others not so much. Has one of these individuals influenced your career? Can you tell us a little bit about that one person?

**Carissa:** There are so many researchers who I look up to and all of them have influenced my career – we do truly stand on the shoulders of giants. But I think if I have to point to someone who has been really influential in my thinking regarding ecological dynamics and my perspectives as an ecologist, Monica Turner really comes to the forefront for me. She has been wildly influential in developing the field of landscape ecology and a systems perspective that is always in my mind as I develop research questions. The importance of scale to ecological

dynamics and capturing variability at relevant scales is something I strive to keep in mind with every research project. I heard her give a talk one of my first times attending the Ecological Society of America's annual meetings and was astounded at how easily she explained really complicated ecological concepts and have always endeavored to have that level of clarity in my communication. I think she is a great role model for any female ecologist - wildly successful with impactful research yet she still seems humble and down to earth.

**WSN:** Fantastic – thanks for sharing that. Well, I want to bring our time to a close, but before I do, are there any last parting words that you would like to share?

**Carissa:** Only that it's an exciting and important time to be studying biological invasion. Climate change and global trade, shifting land-uses, and increasing pressure to develop have all put tremendous stress on our natural resource base. All of this will really exacerbate weed-related issues necessitating outside-the-box solutions. I am just very excited to be part of a team at NPARL and with my other USDA and university colleagues that get to address such important issues. Thanks for taking the time to chat with me about my research!

**WSN:** Absolutely! Looking forward to highlighting your research in upcoming issues of the newsletter. Thanks again!

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## EVENTS AND ANNOUNCEMENTS

### The 2022 WSSA-ARS Weed Science Webinar Series

From April to June, weekly webinars were given by ARS weed scientists. Each webinar addressed a different topic related to weeds and invasive plants. Topics included integrated weed management, biological control, climate change, and many more. A question-and-answer session followed each presentation with audience participation. All 10 webinars were recorded and are now available free for viewing. For more information and access to the webinars, click on this [link](#).

### ARS Weed Science Positions

The following positions are listed with status – open(ing), closed, or filled. Please check jobs.gov for more information or contact [Steve Young](#).

- Weed Research Agronomist - Morris, MN (opening)
- Weed Scientist/Research Agronomist - Stoneville, MS (opening)
- Weed Ecologist/Physiologist/Geneticist - Stoneville, MS (closed)
- Weed Research Scientist - Corvallis, OR (filled)
- Weed Research Agronomist - Houma, LA (filled)

### ARS Weed and Invasive Plant Science Field Days

Some activities happening this summer/fall. Check out those in your region.

- [Aquatic Weed School](#) - Davis, CA (October 31 - November 1) - An intensive 2-day course focused on issues associated with developing weed management strategies in a variety of aquatic systems.
  - [Sugar Cane Field Day](#) - Schriever, LA (July 15) - Walking tour of weed control in sugar cane.
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