

President Edward Inch invites you to attend the
2024 DOUGLAS R. MOORE FACULTY RESEARCH LECTURE

"Can We Regenerate Soil Health and Enhance Corn Productivity in the U.S. Corn Belt through Perennial Cover Crops and Poultry Integration?"

Presented by
Mriganka De, Ph.D.



Monday, April 1, 2024

7:00 P.M.

Ostrander Auditorium, Centennial Student Union
Minnesota State University, Mankato

Refreshments served following the presentation
CSU Lincoln Lounge

 MINNESOTA STATE UNIVERSITY MANKATO



*Douglas R. Moore
Mankato State University
President 1974-1978*

The Douglas R. Moore Faculty Research Lecture was established in the honor of the 9th president of the university. Dr. Douglas R. Moore was named president in March 1974. The college became a university in 1975, and the upper and lower campuses were consolidated during Moore's four years at Mankato State. Additions to Morris Hall, Highland Arena, Nelson Hall, and a new administration building were also completed during Dr. Moore's presidency.

Program

- I. Opening – Dr. Teri Wallace
- II. Welcome – President Edward Inch
- III. Lecture – Professor Mriganka De
- IV. Question and Answer
- V. Announcement of the 2025 Moore
award recipient – President Edward Inch
- VI. Program closes
- VII. Refreshment – Lincoln Lounge

2024 Douglas R. Moore Recipient

Dr. Mriganka De:



I was born and raised in West Bengal, India. After finishing my schooling, I chose Soil Science as a specialization during my BS (Agriculture Hons.) degree program at Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India. Following my graduation in 2007, I further pursued my MS degree in the same field at Punjab Agricultural University, Ludhiana, India where I was awarded a scholarship after competing at the national level for the All-India Junior Research Fellowship examination conducted by the Indian Council of Agricultural Research. My MS research was focused on runoff prediction from a degraded agricultural watershed of Northwest India through the characterization of soil's physical and chemical properties. During my MS program (2007-2009), I was nominated for the "US-India Master's Degree Sandwich program on International Water Management" and came in touch with some renowned soil professors from Iowa State University and the University of Illinois Urbana-Champaign. This program helped me invigorate my broad understanding of Soil Science and Soil Water Engineering, and I started dreaming of going abroad. While preparing for the GRE and TOEFL to apply for graduate schools in the US, I started working as a Research Fellow at Punjab Remote Sensing Center (PRSC), Ludhiana, India, in 2009. During my time at PRSC, I was involved in multi-spectral, multi-sensor, and multi-temporal satellite data analysis using PCI Geomatica 10.1, ArcGIS 9.3 and ERDAS IMAGINE 9.3. I consider this remote sensing knowledge an excellent tool for future research programs.

In 2011, I landed in Gainesville, Florida and started my Ph.D. program in the Department of Soil and Water Science at the University of Florida. Pursuing a Ph.D. program at the University of Florida allowed me to conduct high-quality research on understanding the fate and transport of wastewater-borne nitrogen from septic drainfields to shallow groundwater and nearby surface waters. After finishing my Ph.D. in 2015, I continued my academic career as a postdoctoral research associate at the University of Idaho (UI) and then at Iowa State University (ISU). During my postdoctoral training at the UI (2015-2017), I investigated soil-crop-nutrient dynamics in an irrigated agriculture system in response to crop rotations and different rates and frequency of dairy manure and fertilizer application, with a particular focus on soil nitrogen mineralization, in-season plant nutrient uptake, accumulation and partitioning of macronutrients/micronutrients. In 2017, I started my second postdoctoral work at ISU, where I was focused on understanding carbon and nitrogen cycling in soils and examining the linkage between soil health and water quality in agriculture, grassland, and in-stream ecosystems.

In 2020, I joined as an Assistant Professor in the Department of Biological Sciences at Minnesota State University, Mankato. My current research involves basic and applied aspects of agricultural crop production through nutrient management and regenerative agricultural practices for enhanced productivity, ecosystem services, and environmental sustainability of agroecosystems, focusing on soil nutrient cycling (e.g., carbon and nitrogen) and nutrient retention due to agricultural practices, land-use changes, and environmental gradients. I have authored 13 peer-reviewed journal articles, two book chapters, one extension article, and one newsletter article, and served as a reviewer for more than 15 peer-reviewed Scientific Journals.

Research Statement:

The corn (*Zea mays L.*) production system in the U.S. Midwest is important because corn is used for livestock feed, agricultural exports, consumer products, and ethanol production (Minnesota Corn Growers Association, 2023). The U.S. corn belt is responsible for producing nearly 40% of the world's corn and 80% of the United States' corn, with ~60% coming from the four Midwestern states (Iowa, Illinois, Nebraska, and Minnesota) (Moore et al., 2019). This highly

productive system is well adapted to the regional growing conditions through substantial public and private investment and supporting market infrastructure. However, intensive corn production has caused negative impacts on soil and environmental health. These impacts are aggravated due to monocropping (predominantly corn), large inputs of synthetic nitrogen fertilizer increasing the leaching of nitrogen when it is most vulnerable to loss, and a lack of actively growing rooting systems, leaving the soil exposed to wind and water erosion for more than half of each year.

Cover crops have been proposed to eliminate the extended periods of bare soil in the intensive corn production systems and minimize the impact on surrounding environmental health. In the U.S., annual cover crops (ACCs) are commonly planted in the fall every year and then killed in the spring to allow land preparation for planting the cash crop (e.g., corn), thus leading to high management costs due to labor and materials (Moore et al., 2019). Although the use of ACCs in the Midwest increased ~50% between 2012 and 2017, ACCs use in Minnesota (~580,000 acres) and elsewhere remains low (<4% of total U.S. cropland; USDA, 2019) due to perceived or actual cash crop yield declines (Marcillo & Miguez, 2017; Patel et al., 2019) and uncertainty over financial benefits or other socioeconomic factors (Bergtold et al., 2019), thus, clearly illustrating the need for alternatives. Unlike ACCs grown in a relay cropping system, perennial cover crops (PCCs) can be grown as companion crops with corn and do not need to be replanted or terminated every year, thus requiring minimal management. Moreover, intercropping PCCs into corn production systems has the potential to increase continuous soil surface cover while providing numerous soil health benefits. For example, fibrous and extensive root systems in grasses can help scavenge nutrients, reduce erosion, suppress weed germination and growth, and add organic matter to the soil. Legumes can fix nitrogen from the atmosphere and add it to the soil, help control erosion, and add organic matter to soils (Yu et al., 2022). Moreover, adding plant diversity and keeping living roots in a corn production system may enhance soil biology (i.e., critical to soil health) which can convert nutrients into plant-available forms, and compete with plant pathogens (Baldwin-Kordick et al., 2022; De et al., 2020; Moore et al., 2019). Along with establishing PCCs in corn production systems, poultry (P) integration might be an innovative and sustainable method for corn growers to alleviate some of the need for fertilizer application, especially in light of rising fertilizer costs and environmental concerns. Furthermore, the PCC-P system will provide an enjoyable way of raising healthy P (e.g., turkey) to express their natural behaviors and increase the diversity of their diets by consuming plants, weed seeds, and insects.

While the benefits of ACCs and livestock (e.g., poultry, P) integration have been well documented, the benefits of using PCCs combined with P are limited. To my knowledge, this is the first study to evaluate how on-farm sustainable practices (i.e., the PCC-P integration) impact soil health (physical, chemical, and biological) and crop health to support the adoption of sustainable corn production systems in the U.S. corn belt (especially Minnesota).

Acknowledgments

I would like to dedicate this award to my beloved undergraduate and graduate students who spent many hours in the field and in the “De Lab” collecting, processing, analyzing soil and plant samples. Apart from numerous talented and hardworking students, I take this opportunity to express my profound gratitude to my mentors, collaborators, and funding agency (e.g., Minnesota Department of Agriculture, Undergraduate Research Center, and CSET) for their continuous help and support during the course of my research work. I would like to acknowledge and thank the owner and operator of the Blue Dirt Farm, Mr. Scott Haase, for allowing us to conduct this study at his farm. Lastly, it gives me immense pleasure to thank my parents and wife for their endless love, sacrifice, and constant inspiration throughout this endeavor.

Past Moore Recipients

2023	David Sharlin	"Thyroid Hormone Disrupting Chemicals and Nervous System Development: A Growing Cause for Concern"
2022	Phillip H. Larson	"How Rivers are Born and Evolve: A Paradigm Shift in Earth Science"
2021	J. Scott Granberg-Rademacker and Kevin Parsneau (Government)	"Let's Get Ready to Tweet! An Analysis of Twitter Use by 2018 Senate Candidates"
2020	Xuanhui Wu (Electrical and Computer Engineering and Technology)	"Creation of a Novel Antenna Technology for 5G and Beyond Systems: From a Concept Inspiration on Scratch Paper to Prototypes in the Lab"
2019	Brian Frink (Art)	"Magical Landscapes: A Discussion of the Creation of a Work of Art"
2018	Kuldeep Agarwal (Auto and Manufacturing Engineering Technology)	"3D Printing and the Future of Health and Medicine"
2017	Byron Pike (Accounting and Business Law)	"The Effect of Auditor versus Forensic Mindset on Audit Procedures in Response to Fraud Risk Assessment."
2016	Rebecca Moen (Chemistry and Geology)	"Oxidative Stress and Muscle"
2015	J. Heath Anderson (Anthropology)	"Ashes to Empire: Cerro Magoni and the Toltec State"
2014	David Bissonnette (Family Consumer Science), Mary Hadley (Chemistry and Geology), Penny Knoblich (Biological Sciences)	"Obesity in America: A National Crisis"
2013	Qun (Vincent) Zhang (Electrical and Computer Engineering and Technology)	"Fundamentals and Frontiers of Optical Communication: from Fastest Modems and Routers to Next Generation Computing"
2012	Gwen Westerman (English)	"Dena Ūŋkiyepi (This is who we are): Letters of Dakota People 1848 - 1864"
2011	Liz Miller (Art)	"Drawing Beyond the Line: Using Pattern, Decoration, and Ornament in New Large-Scale Installations"
2010	Vincent Winstead (Electrical and Computer Engineering and Technology)	"Energy Independence through Wind Power: Opportunities, Challenges and the Future"

2009	Lillian Duran (Education)	"Transitional Bilingual Education vs. English-only Instruction in a Head Start Program: An Experimental Longitudinal Comparison"
2008	Steven Losh (Chemistry and Geology)	"Petroleum Exploration and Production Technology: High-Tech Deep Down"
2007	Gina Wenger (Art)	"Images of Manzanar: Investigating the Documentary Photography of the Japanese American Internment Camps"
2006	Russell Palma (Astronomy and Physics)	"NASA's Genesis and Stardust Missions: Exploring the Early Solar System"
2005	Mary Bliesmer, Patricia Earle, Sandra Eggenberger, Norma Krumwiede, Sonja Meiers (School of Nursing)	"Challenges of Chronic Illness: Artistic Interpretation of the Family Reintegration Process"
2004	Charles Lewis (Mass Communication)	"Business, Politics and War: Relations Among American Indians and Whites as Portrayed in the Frontier Press of Mankato, 1857-1868"
2003	Marcia Gentry (Education)	"The Important and Forgotten Role of Affect in Developing Quality Teaching and Learning: Instrumentation to Help Understand the School Experience from Students' Points of View"
2002	Tomasz Inglot (Political Science)	"Building of United Europe: Socio-Economic and Political Challenges of European Enlargement to the East"
2001	Nancy Wicker (Art)	"Identity in an Anonymous Age: Examining Prehistoric Scandinavian Gold Jewelry"
2000	Barry Ries and Melissa Polusny (Psychology)	"The Influence of Natural Disaster on Southern Minnesota Families"
1999	Bruce Jones and Kirk Ready (Automotive and Manufacturing Engineering Technology)	"Alternative Fuels: The Future of the Automobile"
1998	Anne Blackhurst (Counseling and Student Personnel)	"Eating Their Words: How Food Advertisements Sell Disordered Eating to Women"
1997	Winifred Mitchell (Anthropology)	"Giving Thanks in the Upper Midwest: An Ethnography of Minnesota Thanksgivings"

1996	Richard Wintersteen (Social Work)	"Family Burden and the Needs of Mentally Ill Persons: A Cross-Cultural Study of Issues and Consequences"
1995	Louisa Smith (English)	"A Day in Mankato Circa 1900 as Presented in Maud Hart Lovelace's Books"
1994	Jon Hakkila (Mathematics, Astronomy and Statistics)	"Gamma-Ray Bursts and the Milky Way: Old Paradigms Die Hard"
1993	William Lass (History)	"Mankato State: From Normal School to University" (Special 125th Anniversary)
1993	Allan Wiese (Political Science)	"Gambling at Jackpot Junction and Royal River Casinos"
1992	James Booker (Foreign Language) Diana Moxness (Music)	"Word and Music: Inseparable Elements in the Songs of Franz Schubert"
1991	Loretta Johnson (History)	"Memories of the Past: Accounts of Minnesota Shivarees"
1990	Donna Casella (English)	"In Search of Peace: A-Bomb Survivors' Perceptions of Nuclear War and Its Aftermath"
1989	Lewis Croce (History)	"The American Presidency in its World Setting – 1789-1989"
1988	Steven Mercurio (Biology)	"Antidotes for a Chemical Environment"
1987	Kathy Piehl (Library Faculty)	"Surviving the Flood"
1986	Stewart Ross (Music)	"The History and Development of the Band March"
1985	Branko Colakovic (Geography)	"Soviet Moslems: A Population Time Bomb?"
1984	Suzanne Bunkers (English)	"Nineteenth Century Diaries, Journals, Letters and Memoirs: What Midwestern Women Were (Not) Saying"
1983	Tony Filipovitch (Urban and Regional Studies)	"Streetsong: Children in the City"
1982	Hal Walberg (Philosophy)	A Play in Three Acts, "Nietzsche"
1980	Peter Nash (Biology)	"Diet, Nutrition and Cancer Today"
1979	Mary Jo Meadow (Psychology)	"Religious Orientations and Personal Maturity"
1978	Paul Goldstaub (Music)	Original Opera, "The Marriage Proposal"

1977	James Tanner and Robert Finkler (Art)	"Joint Project, Ceramic Sculpture by Tanner and Polymer Paintings by Finkler"
1976	Pearl Englund (Anthropology)	"Study of the Ewe People in Ghana"
1975	Charles Mundale (Political Science)	"The Trouble Within and The Trouble Without"

