Bill Raun

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Native of Minden, Nebraska

Spanish (bilingual proficiency ILR 5)

**EDUCATION**

Ph.D. University of Nebraska, Lincoln, Nebraska

Dissertation Chairmen: Professor R.A. Olson and Dr. D.H. Sander

Major Field: Agronomy

Allied Fields: Biometry

Date: 1985

M.S. Oklahoma State University, Stillwater, Oklahoma

Thesis Chairman: Dr. R.L. Westerman

Major Field: Agronomy

Date: 1982

B.S. Oklahoma State University, Stillwater, Oklahoma

Major Advisor: Dr. W.W. Huffine

Major Field: Agronomy

Date: 1979

**PROFESSIONAL EXPERIENCE**

June 2004-present: Regents Professor, Plant and Soil Sciences, Oklahoma State University

Sep. 2010-present: Walter R. Sitlington Chair in Agriculture

Jan 2018-present: Senior Editor, Agrosystems Geosciences & Environment

Jan 2012-Dec 2017: Editor, Agronomy Journal

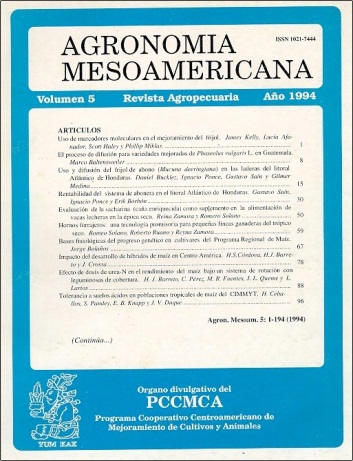
June 2006-Aug 2010: Melvin and Mary Jones Distinguished Professorship of Agronomic Sciences

June 1999-May 2004: Professor, Plant and Soil Sciences Dept., Oklahoma State Univ.

June 1996-May 1999: Associate Professor, Plant and Soil Sciences Dept., Oklahoma State Univ.

Dec. 1991-May 1996: Assistant Professor, Plant and Soil Sciences Dept., Oklahoma State Univ.

Responsibilities: Plan, budget, design and implement field and laboratory research in soil fertility and plant nutrition for MS and PhD graduate students. Develop sensor-based technologies for increased grain yields and nitrogen use efficiency in cereal crops. Continuous coordination of > 70 field experiments per year (short and long-term) addressing nutrient use efficiency in wheat, corn, alfalfa, cotton, switchgrass, sorghum, soybeans, and bermudagrass. Environmentally safe fertilization for cereal production, evaluation of alternative production practices, and characterization of N transformations in soils. Teaching graduate level 'soil plant nutrient cycling and environmental quality' and junior-senior level 'topics in precision agriculture', national and international project proposals for outside funding, and supervision of field and laboratory experiments conducted by graduate students.

June 1987-November 1991: Maize staff, Regional Agronomist, CIMMYT, based in Guatemala City, Guatemala. Responsibilities: Developmental assistance via national programs in Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, Dominican Republic, Haiti and Cuba. Management of budget, distributed by project in nine countries. Coordination of agronomic research trials with 41 national program representatives. Research in maize/legume production systems, planning of projects, recommendations for future research needs, implementation of experiments and agronomy/statistics training. Coordination of Central America Maize National Program Committee. Co-founder of Agronomía Mesoamericana, ISSN 1021-7444, 1990- v.1-present, agronomic journal in Central America for the advancement of agricultural sciences, published biannually in Spanish (abstract in English). Also, preparation of science bulletins in Spanish relative to applied nutrients in tropical soils. Senior editor of the proceedings 'Manejo de Suelos Tropicales en Latinoamérica', technical editing and final preparation of 57 research articles pertaining to management of tropical soils (North Carolina State University).

December 1985-May 1987: Post-doctoral fellow, CIMMYT Wheat Program, based both in Texcoco, and Ciudad Obregon, Mexico. Responsibilities: Consulting on soil-related problems for wheat production, formal course training in soil fertility and statistics, research plot work in soil fertility, statistical analysis of agronomy program experiments, team interaction with bread wheat, durum wheat, triticale, wide crosses and cytogenetics programs within CIMMYT.

January 1983-December 1985: Research assistantship, Department of Agronomy, University of

Nebraska-Lincoln. Responsibilities: Research plot work, statistical analysis of various project experiments, maize and wheat plant tissue analysis, soil test correlation and calibration with plant tissue data and teaching for Professor R. A. Olson and Dr. D. H. Sander.

January 1981-December 1982: Research assistantship, Department of Agronomy, Oklahoma State University. Responsibilities: Research plot work on soil fertility experiments conducted throughout the state of Oklahoma, statistical and laboratory analysis for Dr. R. L. Westerman.

**TEAM LEADERSHIP**

1999-present: Team development of a new-age hand-planter for the third world capable of planting single seeds and by-plant placement of N fertilizer.

1992-present: Since joining OSU, worked with a large multidisciplinary group of scientists to develop the GreenSeeker sensor-based variable N rate fertilization system that increases nitrogen use efficiency by 15% in winter wheat and corn.

1991-present: Senior or co-PI on grants totaling >$8,600,000 from various competitive sources including USDA, Georgia-Pacific, USAID, NASA, OCAST, NRI, Farmland Industries, Potash Phosphate Institute, the Noble Foundation, and non-competitive funding.

1992-present: Coordinator of the Soil Fertility Research and Education Advisory Board, and that includes Administration and Annual Reporting on OK Senate Bill 314 and 432, $265,000/year.

1992-present: Major advisor for 90 completed graduate degrees (64 MS, 26 PhD). Currently advise 10 graduate students. Supervisor and research coordinator for 5 part time employees.

1987-1991: Successfully worked with National Program research leaders in 8 Central American countries to formally establish *Agronomia Mesoamericana*, Spanish agronomic journal for the advancement of agricultural sciences.

**CARREER GOALS**

* Deliver third world hand-planter for corn, sorghum, and rice capable of portioning seed (singles, multiples) and sidedress fertilization with urea.
* Refine sensor based technologies capable of increasing cereal grain yields and nutrient use efficiencies.
* Advance agronomic nutrient fertilization optimization algorithms (NFOA’s) that can be employed by both advanced and resource poor farmers for improved nutrient use.
* Refine precision corn leaf orientation systems that maximize light interception, optimize plant spacing and increase corn grain yields
* Deliver affordable and functional NDVI sensors for use in determining fertilizer N rates in cereals
* Implement integrated agronomic research projects across scientific fields consistent with environmental concerns.
* Enhance team-oriented research projects that are the product of the researchers themselves who want to work together and who want to make a contribution to our world. **RESUME SUMMARY**

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| --- | --- |
| **Publications Total** | |
| Refereed Journal Publications | 237 |
| Books | 3 |
| Book Chapters | 15 |
| Patents | 12 |
| Proceedings | 20 |
| Popular Press, Departmental Books | 35 |
| Web Sites | 9 |
| **Teaching** | |
| Soil Plant Nutrient Cycling and Environmental Quality 5813 | SP92,SP94,SP96,SP98,SP00,SP02,SP04,SP06,SP08,SP10,SP12,SP14,SP16,SP18,SP20 (avg./class. 17) |
| Senior Seminar 4571 | FA94 (20) |
| Seminar 5020 | SP94, FA94, SP95, SP05, FA05 (avg./class. 16) |
| Precision Agriculture 4213 | SP97, SP99, SP01, SP02, SP03, SP04, SP06, SP07,SP08, SP10, SP11 (avg./class. 25) |
| Soil Nutrient Management 4234 | FA04, FA05, FA06, FA07, FA08 (avg./class. 35) |
| Research Methods 5112 | SP05,SP07,SP09,SP11,SP13, SP15,SP17,SP19 (avg./class. 15) |
| **Total** number of students (all classes) | **908** |
| **Professional Invitations** | |
| International Invitations, (paper required) | 11(9) |
| National Invitations, (paper required) | 15(8) |
| **Thesis Required Graduate Degrees as Major Advisor (95)** | |
| Current M.S. and Ph.D. degrees in progress | 10 |
| Master of Science completed as Major advisor | 67 |
| Doctor of Philosophy completed as Major advisor | 29 |
| **Total** | **107** |
| **Competitive Grants And Proposals (72)** | |
| 1989-present | **$8,813,928** |
| **International Student Travel** | |
| Fully funded travel for faculty and graduate students traveling to Mexico, Uzbekistan, Kenya, Ethiopia, Zimbabwe, India, Turkey, Australia, Russia, and China to conduct sensor based N fertilization training with CIMMYT on short (1-week) and long-term (4 month) study. | 117 |
| **Miscellaneous** | |
| Hirsch Index | Google Scholar, 61 |
| Senior Editor, Agrosystems, Geosciences, & Environment | 3 |
| Years of service as Editor, Agronomy J. | 6 |
| Years of service as Technical Editor, Agronomy J. | 8 |
| Years of service as Associate Editor, Agronomy J. | 6 |
| Years of service as Associate Editor, J. Plant Nutrition | 9 |
| Editorial Board, Journal of Plant Nutrition, 2014-present | 6 |
| **TOTAL years editorial service** | **38** |
| Field Days and Workshops Coordinated | 8 |
| International Workshops Coordinated | 2 |
| International Agronomic Networks Established | 1 |
|  |  |
| Board Member, public/private organizations | 3 |
| National & International Awards | 21 |

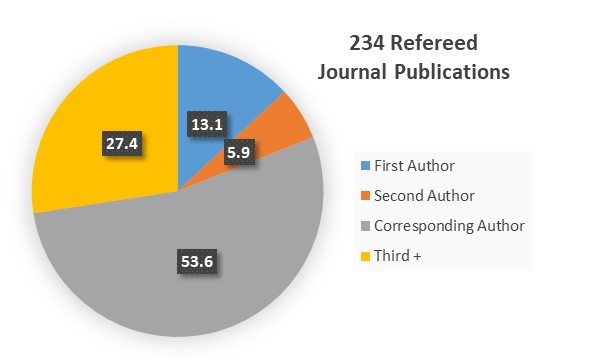
**CAREER HIGHLIGHTS and IMPACT 1985-present**

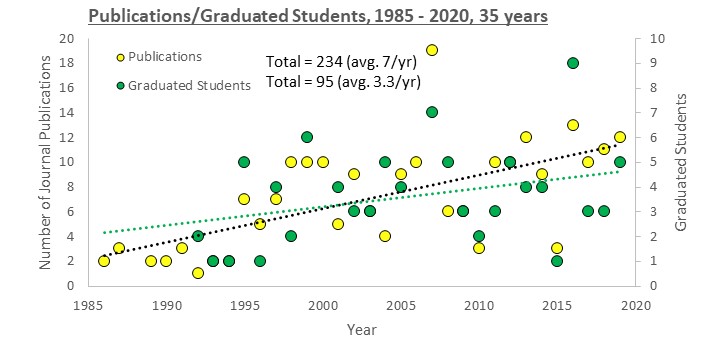
* **1985:** Long-term trial that was initiated to evaluate residue management in spring wheat near Ciudad Obregon, Mexico is being continued today by CIMMYT staff
* **1987:** Legume interseeding trials started throughout Central America in a regional structure showed that *Vigna* spp could be grown under high shade within corn, thus decreasing soil erosion on marginal, highly sloping land.
* **1990:** Co-founder of **Agronomia Mesoamericana**, ISSN 1021-7444, agronomic journal in Central America for agricultural scientists
* **1992:** Initiated work with a multidisciplinary group (Engineering and Agronomy) to develop improved N fertilization for cereal crops
* **1993:** First to publish on the use and applications of stability analysis for interpreting treatment by environment interactions in agronomic experiments (Agron. J. 85:159).
* **1995:** Documented the presence of inorganic N buffering in wheat production that explained why NO3-N leaching was limited in these environments (Agron. J. 87:827).
* Used tritium-helium water dating techniques to partition NO3-N contamination into pre WWII and post WWII categories, consistent with the time (post WWII) when inorganic fertilizers were first used.
* **1996:** Published definitive data showing how spectral radiance measurements could be used for correcting in-season fertilizer N deficiencies in wheat. (Trans. ASAE 39:1623).
* **1997:** Consistent with work in corn documenting plant NH3 loses, work in wheat showed that losses approached 40 kg N/ha at average yield levels. (J. Plant Nutr. 20:389).
* **1998:** Microvariability work showed significant differences in soil-test properties in agricultural fields at distances less than 0.5 m apart (Soil Sci. Soc. Am. J. 62:683)
* **1999:** Long-term application of high N rates in continuous winter wheat showed that soil organic C could be significantly increased (Soil Tillage Res. 47:323)
* Published comprehensive review manuscript documenting nitrogen use efficiencies for cereal production worldwide at 33% (Agron. J. 91:357)
* **2000:** Showed that forage production systems have much higher N use efficiencies since plants are not allowed to approach maturity when plant losses are known to increase (J. Plant Nutr. 23:1505).
* **2001:** Showed that final wheat grain yield levels could be predicted from mid-season NDVI readings collected from winter wheat over various years and locations and that could be used for adjusting fertilizer N rates (Agron. J. 93:131).
* **NTech Industries** formally established, and a joint venture agreement was initiated with Oklahoma State University to deliver the **GreenSeeker** sensing and agronomic technologies to farmers around the world.
* **2002:** Using mid-season prediction of yield, the response index, and N adjustments based on these values, NUE’s in wheat were increased by 15% over conventional practices (Agron. J. 94:815)
* Published comprehensive long-term trial work showing the value of using the response index as a guide for improved fertilizer N management (J. Plant Nutr. 26:249)
* **Sensor Based Nitrogen Rate Calculator** established on-line that includes 24 functional algorithms for various crops whereby farmers can obtain improved mid-season fertilizer recommendations (<http://www.soiltesting.okstate.edu/SBNRC/SBNRC.php>)
* **2003:** SOIL 5813 Class project results in the 4th “class project” to publish as a part of nutrient management instruction (J. Plant Nutr. 26:1561).
* Optical Sensing Nitrogen Management Group meets for the first time in Stillwater, OK. Focus on increased NUE for corn and wheat production included attendees from Oklahoma, Nebraska, Missouri, Minnesota, Illinois, Kansas, North Dakota, Iowa, Mexico, Canada, Virginia, and Maryland.
* **2004:** Automated calibration stamp developed as an alternative to sensors for use in determining optimum fertilizer N rates (Agron. J. 97:338)
* **2005:** Comprehensive publication of components that comprise the crop nitrogen algorithm (Commun. Soil Sci. Plant Anal. 36:2759), and recorded US Patent 6,880,291.
* Documented plant to plant variability that exceeded 2780 kg/ha in corn production over 3 countries, and 7 states, further enhancing the need for precision sensing technologies that treat this variability (Agron. J. 97:1603)
* International Network for Improving NUE established (<http://www.nue.okstate.edu/Nitrogen_Conference2003/2006_Regional_Trial.htm>)
* Over **1000 N Rich Strips** established in farmer fields in Oklahoma on over 125,000 acres. Using the Sensor Based N Rate Calculator, a net profit exceeding $10/acre has been realized for those farmers participating in this program.
* **2006:** NUE web site established in 1996 ([www.nue.okstate.edu](http://www.nue.okstate.edu)) receives its 70,000 hit, averaging 50 + per day. Site reports comprehensive information on how to improve nitrogen use efficiency in cereal production.
* Ramp Calibration Strip initiated to replace the calibration stamp for increased farmer adoption and improved N management in virtually all crops.
* **2007:** RAMP or N Rich Strips extended in over 2000 farmer fields with a service area exceeding 200,000 acres.
* 5th consecutive year, for Optical Sensing Nitrogen Management Group meeting, started in 2003, now hosted by Monsanto Co. Attendees have risen from 30 in 2003 to now over 75.
* **2008:** By-plant N fertilization strategy implemented in corn production systems that resulted in increased NUE.
* N Rich Strips adopted by Oklahoma Fertilizer Dealers throughout central and western portions of the state. Areas using the GreenSeeker sensor based N recommendations in many other regions in the US, and around the world have become extensive.
* OSU N fertilization methodology was fully endorsed by Dr. Norman Borlaug (1970 Nobel Peace Prize Recipient). Use of the OSU N fertilization approach in the US, and other parts of the world documented in various popular press sources (<http://www.nue.okstate.edu/International/GreenSeeker.htm>).
* **2009:** Published joint article with Dr. Norman Borlaug (CSA News, 54:21-22) on the importance of generational recommitment to education in the developing world. First iteration of the pocket sensor completed and tested. Seed orientation project initiated showing that leaf architecture could be controlled at planting.
* **2010:** Seed orientation at planting resulting in leaves perpendicular to the row (all plants) and increased corn grain yields. Development of seed orientation equipment initiated via a joint project with BAE. 67 NDVI Pocket Sensors, tested, with a new prototype now being used. Team development of new age hand planter for the third world.
* **2011:** Release of the Grain Protein Optimizer option on the Sensor Based Nitrogen Rate Calculator. Release of the NH3 loss calculator for guided urea applications.
* **2012:** Team development of a new-age hand-planter for the third world capable of planting single seeds and by-plant placement of N fertilizer.
* First year as Editor, of Agronomy Journal, the most prestigious agricultural journal in the world.
* On-line class (SOIL 5813) taught in the Department of Plant and Soil Sciences, that included 23 on-campus and 2 on-line students at Louisiana State University and the Noble Foundation.
* **2013:** Release of third world hand planter capable of holding 5000+ seeds and that can be singulated. Successful completion of first year as Editor, Agronomy Journal.
* On-line class (SOIL 5112) taught in the Department of Plant and Soil Sciences, that included 16 on-campus and 2 on-line.
* **2014:** Hosted International Hand Planter Workshop, January 16, 2014. Attendance in person and on-line included 89 people. Countries that attended the workshop on-line included Bangladesh, Burundi, Belize, Brazil, Colombia, El Salvador, Ethiopia, Guatemala, India, Kenya, Malawi, Mexico, Mozambique, Sierra Leone, Nepal, Philippines, Tanzania, Togo, Uganda, USA, Zambia, and Zimbabwe (<http://nue.okstate.edu/Hand_Planter/osu_hand_planter_workshop.html>)
* **2015:** 13th annual NUE conference hosted in Auburn, AL. Published class paper documenting the need to analyze years independently in long-term trials.
* **2016:** Published CSA News article on the Impact Factor in ASA journals, and what this means to science. Published joint paper with colleagues from the NUE group on the value of sensor based algorithms developed by land grant universities and that are available to all farmer at no cost. Documented wide scale variability in optimum N rates in maize, for the Central Great Plains.
* **2017:** Published Agronomy Journal paper that documented World Phosphorus Use Efficiency to be 16% for cereal production. Also published Agronomy Journal paper documenting the weaknesses of using yield goals for predicting fertilizer N rates. Invited to the National Academy of Sciences, Science Breakthrough Initiative, October 2-4, Irvine, CA.
* **2018:** Agronomy Journal Manuscript documented World N, P, and K Use efficiency at 33, 16, and 19% for the three main macronutrients. Documented the importance of randomness in biological systems and how different components were subsequently independent thus requiring separate estimates of each in composite algorithms. Internationally available podcast from Field, Lab, Earth (Am. Soc. Agron.) posted on the OSU Hand Planter, Madison, WI.
* **2019:** Manuscript in Agronomy Journal showed why so many biological processes have been influenced by randomness and where this randomness has led to their being independent. This follows the 2nd law of thermodynamics that established the presence of increased entropy in biological systems with time.   
    
  Second year with Mandela Fellows has now delivered 50 hand planters in 25 different African countries. 2019 Grant Application with Rotary International was successful and that will deliver the hand planter in Nigeria. This includes manufacturing training so that they can produce them in-country.

From 1991 to present our project has completed >20 significant products per year. Significant products include refereed journal publications, graduate students receiving degrees, books published, chapters published, patents issued, workshops completed, web sites developed, grants obtained, classes taught, and proceedings published. Data reported above **does not** contain popular press, abstracts, and extension bulletins. This is updated, and reported each year using outcome based goals. This mechanism ensures that a completion document (publication, proceeding, etc.) accompanies each proposed project. This has assisted in our being able to generate 1.5 significant products per month over a 29-year period.

Classes taught by year, 1991 – 2020 (29 years)







**JOURNAL PUBLICATIONS**

1. Olson, R. A., W. R. Raun, Yang Shou Chun and J. Skopp. 1986. Nitrogen management and interseeding effects on irrigated corn and sorghum and on soil strength. Agron. J. 78:856-862.
2. Raun, W. R., D. H. Sander and R. A. Olson. 1986. Emergence of corn as affected by source and rate of solution fertilizers applied with the seed. J. of Fert. Issues. 3(1):18-24.
3. McCallister, D. L., C. A. Shapiro, W. R. Raun, F. N. Anderson, G. W. Rehm, O. P. Engelstad, M. P. Russelle and R. A. Olson. 1987. Rate of phosphorus and potassium buildup/decline with fertilization for corn and wheat on Nebraska mollisols. Soil Sci. Soc. Am. J. 51:1646-1652.
4. Raun, W. R., R. A. Olson, D. H. Sander and R. L. Westerman. 1987. Alternative procedure for total phosphorus determination in plant tissue. Commun. Soil Sci. Plant Anal. 18:543-557.
5. Raun, W. R., D. H. Sander and R. A. Olson. 1987. Phosphorus fertilizer carriers and their placement for minimum till corn under sprinkler irrigation. Soil Sci. Soc. Am. J. 51:1055-1062.
6. Raun, W. R., D. H. Sander and R. A. Olson. 1989. Nitrogen fertilizer carriers and their placement for minimum till corn under sprinkler irrigation. Agron. J. 81:280-285.
7. Raun, W. R., H. J. Barreto, D. H. Sander and R. A. Olson. 1989. Frozen versus non-frozen sample preparation for plant tissue phosphorus analysis. Commun. In Soil Sci. Plant Anal. 20(1-2) 197-211.
8. Caceros, O.A., P. Gonzalez, I.Hidalgo, B. Moscoso and W.R. Raun. 1990. Ensayo exploratorio de métodos é interacciones de elementos en la aplicación de fertilizantes en el cultivo de maíz. Agron. Meso. 1:7-13.
9. Pierre, R., A. Robles, R. Celado, W.R. Raun and H.J. Barreto. 1990. Maize yield response to sulfur and phosphorus applied under different tillage systems in the Dominican Republic. Sulphur in Agriculture, Volume 14:16-19.
10. Raun, W. R., and R. L. Westerman. 1991. Nitrate-N and phosphate-P concentration in winter wheat at varying growth stages. J. of Plant Nutr. 14:267-281
11. Raun, W.R., and H.J. Barreto. 1991. Maize yield response as affected by sulfur, phosphorus and nitrogen as banded applications on a volcanic ash derived tropical soil. Commun. In Soil Sci. and Plant Anal. 22(15-16) 1661-1676.
12. Sosa, J.H., V.M. Mendoza, E.N. Ascencio, A.G. Alvarado, S. Bonilla and W.R. Raun. 1991. Efecto del calcio y azufre en el sistema maíz-frijol en ladera ante un nivel de nitrogeno y fósforo en El Salvador, 1989. Agron. Meso. 2:61-65.
13. Gordon, Roman, Andres Gonzalez, Jorge Franco, Nivaldo De Gracia, Adys de Herrera and William Raun. 1992. Evaluación de dosis y metodos de aplicación de azufre y su efecto residual en el cultivo de maíz en dos localidades de Azuero Panamá. Agron. Meso. 3:52-56.
14. Raun, W. R., H. J. Barreto, and R. L. Westerman. 1993. Use of stability analysis for long-term soil fertility experiments. Agron. J. 85:159-167.
15. Raun, W.R. and H.J. Barreto. 1993. Maize grain yield response to sulphur fertilization in Central America. Sulphur in Agriculture, Volume 16:26-30.
16. Westerman, R.L, R.K. Boman, W.R. Raun and G.V. Johnson. 1994. Ammonium and nitrate nitrogen in soil profiles of long-term winter wheat fertilization experiments. Agron. J. 86:94-99.
17. Guertal, E.A., W.R. Raun, R.L. Westerman and R.K. Boman. 1994. Applications of stability analysis for single-site, long-term experiments. Agron. J. 86:1016-1019.
18. Raun, W.R. and H.J. Barreto. 1995. Regional maize grain yield response to applied phosphorus in Central America. Agron. J. 87:208-213.
19. Sembiring, H., W.R. Raun, G.V. Johnson and R.K. Boman. 1995. Effect of wheat straw inversion on soil water conservation. Soil Sci. 159:81-89.
20. Boman, R.K., R.L. Westerman, W.R. Raun and M.E. Jojola. 1995. Time of nitrogen application: effects on winter wheat and residual soil nitrate. Soil Sci. Soc. Am. J. 59:1364-1369.
21. Boman, R.K., R.L. Westerman, W.R. Raun, and M.E. Jojola. 1995. Spring-applied nitrogen fertilizer influence on winter wheat and residual soil nitrate. J. Prod. Agric. 8:584-589.
22. Raun, W.R., and G.V. Johnson. 1995. Soil-plant buffering of inorganic nitrogen in continuous winter wheat. Agron. J. 87:827-834.
23. Johnson, G.V., and W.R. Raun. 1995. Nitrate leaching in continuous winter wheat: use of a soil-plant buffering concept to account for fertilizer nitrogen. J. Prod. Agric. 8:486-491.
24. Phillips, S.B., W.R. Raun and N.T. Basta. 1995. Use of reflectometry for determination of nitrate-nitrogen in well water. J. of Plant Nutr. 18:2569-2578.
25. Westfall, D.G., J.L. Havlin, G. Hergert and W.R. Raun. 1996. Nitrogen management in dryland cropping systems. J. Prod. Agric. 9:192-199.
26. Stone, M.L., J.B. Solie, W.R. Raun, R.W. Whitney, S.L. Taylor and J.D. Ringer. 1996. Use of spectral radiance for correcting in-season fertilizer nitrogen deficiencies in winter wheat. Trans. ASAE 39(5):1623-1631.
27. Altom, W., J.L. Rogers, W.R. Raun, G.V. Johnson and S.L. Taylor. 1996. Long-term rye-wheat-ryegrass forage yields as affected by rate and date of N application. J. of Prod. Agric. 9:510-516.
28. Solie, J.B., W.R. Raun, R.W. Whitney, M.L. Stone and J.D. Ringer. 1996. Optical sensor based field element size and sensing strategy for nitrogen application. Trans. ASAE 39(6):1983-1992.
29. Stone, Marvin L., John B. Solie, Richard W. Whitney, William R. Raun and Heather L. Lees. 1996. Sensors for detection of nitrogen in winter wheat. SAE Technical paper series. SAE Paper No. 961757. SAE, Warrendale PA.
30. Gavi, F., N.T. Basta and W.R. Raun. 1997. Wheat grain cadmium as affected by long-term fertilization and soil acidity. J. Environ. Qual. 26:265-271.
31. Boman, R.K., W.R. Raun, R.L. Westerman and J.C. Banks. 1997. Long-term nitrogen fertilization in short-season cotton: interpretation of agronomic characteristics using stability analysis. J. Prod. Agric. 10:580-585.
32. Taylor, S.L., G.V. Johnson and W.R. Raun. 1997. A field exercise to acquaint students with soil testing as a measure of soil fertility status and field variability. J. Nat. Resour. Life Sci. Educ. 26:132-135.
33. Kanampiu, F.K., W.R. Raun and G.V. Johnson. 1997. Effect of nitrogen rate on plant nitrogen loss in winter wheat varieties. J. of Plant Nutr. 20(2&3):389-404.
34. Gavi, F., W.R. Raun, N.T. Basta and G.V. Johnson. 1997. Effect of sewage sludge and ammonium nitrate on wheat yield and soil profile inorganic nitrogen accumulation. J. of Plant Nutr. 20(2&3):203-218.
35. Raun, William R., Gordon V. Johnson, Jeffory A. Hattey, Shannon L. Taylor and Heather L. Lees. 1997. Nitrogen cycle ninja, a teaching exercise. J. Nat. Resour. Life Sci. Educ. 26:39-42.
36. Phillips, S.B., W.R. Raun, and G.V. Johnson. 1997. Seasonal and long-term changes in well water nitrate-nitrogen. J. Environ. Qual. 26:1632-1637.

1. Raun, W.R., J.B. Solie, G.V Johnson, M.L. Stone, R.W. Whitney, H.L. Lees, H. Sembiring and S.B. Phillips. 1998. Micro-variability in soil test, plant nutrient, and yield parameters in bermudagrass. Soil Sci. Soc. Am. J. 62:683-690.
2. Sembiring, H., W.R. Raun, G.V. Johnson, M.L. Stone and S.B. Phillips. 1998. Detection of nitrogen and phosphorus nutrient status in bermudagrass using spectral radiance. J. Plant Nutr. 21:1189-1206.
3. Sembiring, H., G.V. Johnson and W.R. Raun. 1998. Extractable nitrogen using hot potassium chloride as a mineralization potential index. J. Plant Nutr. 21:1253-1271.
4. Sembiring, H., W.R. Raun and G.V. Johnson. 1998. Nitrogen accumulation efficiency: relationship between excess fertilizer and soil-plant biological activity in winter wheat. J. Plant Nutr. 21:1235-1252.
5. Sembiring, H., W.R. Raun, G.V. Johnson, M.L. Stone, J.B. Solie and S.B. Phillips. 1998. Detection of nitrogen and phosphorus nutrient status in winter wheat using spectral radiance. J. Plant Nutr. 21:1207-1233.
6. Raun, W.R., G.V. Johnson, S.B. Phillips and R.L. Westerman. 1998. Effect of long-term nitrogen fertilization on soil organic C and total N in continuous wheat under conventional tillage in Oklahoma. Soil & Tillage Res. 47:323-330.
7. Goedeken, Michael W., Gordon V. Johnson, William R. Raun and Steven B. Phillips. 1998. Soil test phosphorus crop response projections to variable rate application in winter wheat. Commun. Soil Sci. Plant Anal. 29:1731-1738.
8. Raun, W.R., G.V. Johnson, H. Sembiring, E.V. Lukina, J.M. LaRuffa, W.E. Thomason, S.B. Phillips, J.B. Solie, M.L. Stone and R.W. Whitney. 1998. Indirect measures of plant nutrients. Commun. In Soil Sci. Plant Anal. 29:1571-1581.
9. Raun, W.R., N.T. Basta, J.A. Hattey, H. Zhang, and G.V. Johnson. 1998. Changing departmental names from agronomy to plant, crop and soil sciences. J. Nat. Resour. Life Sci. Educ. 27:113-116.
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10. Raun, W.R., and J.S. Schepers. 2008. Nitrogen management for improved use efficiency. p.675-693. *In* J.S. Schepers and W.R. Raun (eds.) Nitrogen in agricultural systems. Agron. Monogr. 49. ASA, CSSA, SSSA, Madison, WI.
11. Meisinger, J.J., J.S. Schepers, and W.R. Raun. 2008. Crop nitrogen requirement and fertilization. p.563-612. *In* J.S. Schepers and W.R. Raun (eds.) Nitrogen in agricultural systems. Agron. Monogr. 49. ASA, CSSA, SSSA, Madison, WI.
12. Raun, William R., Ivan Ortiz-Monasterio, and John B. Solie. 2009. Temporally and spatially dependent nitrogen management for diverse environments. *In* Brett F. Carver (ed) Wheat:Science and Trade. Wiley-Blackwell Publishing: Chapter 10, 203-214.
13. Schepers, J.S., and W.R. Raun. 2010. Nitrogen sensors to fine tune the nutrient management decision making process. In Advances in Nitrogen Management for Water Quality, (eds) Jorge A. Delgado and Ronald F. Follett. Soil and Water Cons. Soc. Ankeny, IA. pp. 207-229
14. Girma, Kefyalew, and William Raun 2010. Nutrient and water use efficiency. *In* Jim Camberato (ed.) Handbook of Soil Science. CRC Press, Inc. Boca Raton, FL.
15. Stone, Marvin, and William Raun. 2015. Sensing Technology for Precision Crop Farming, *In* Precision Agriculture Technology for Crop Farming. Pg 21-54. DOI: 10.1201/b19336-3. CRC Press.
16. Zhang, Hailin and W.R. Raun. 2016. Oklahoma Homeowner’s Handbook For Soil And Nutrient Management. 3rd Edition. Dept. of Plant and Soil Sciences. Oklahoma State University, Stillwater, OK.

**PATENTS**

1. Raun, W.R., G.V. Johnson, J.B. Solie, and M.L. Stone. 2003. Process for in-season fertilizer nitrogen application based on predicted yield potential. US Patent No. 6,601,341 B2. Issued, August 5, 2003.
2. Stone, M.L., D. Needham, J.B. Solie, W.R. Raun, and G.V. Johnson. 2003. Optical spectral reflectance sensor and controller. US Patent No. 6,596,996 B1, Issued July 22, 2003.
3. Raun, W.R., G.V. Johnson, J.B. Solie, and M.L. Stone. 2004. A process for in-season fertilizer nitrogen application based on predicted yield potential. U.S. Patent. 10,195,138. (CIP of U.S. Patent 6,601,341).
4. Raun, W.R., G.V. Johnson, J.B. Solie, and M.L. Stone. April 19, 2005. A process for in-season fertilizer nitrogen application based on predicted yield potential. U.S. Patent. 6,880,291 B2, Issued, April 19, 2005.
5. Stone, M.L., D. Needham, J.B. Solie. W.R. Raun, and G.V. Johnson. 2005. Optical Spectral Reflectance Sensor and Controller. U.S. Patent. 6,855,933 B2, Cont. of 6,596,996, Issued Feb 15, 2005.
6. Raun, W.R., G.V. Johnson, J.B. Solie, M.L. Stone, K.W. Freeman. 2007. Use of within-field-element-size CV for improved nutrient fertilization in crop production. US Patent No. 7,188,450 B2. Issued, March 13, 2007.
7. Solie, J.B., M.L. Stone, W.R. Raun, 2009. Handheld optical sensor for measuring the normalized difference vegetative index in plants. Prov. Patent 61/219,053.
8. Solie, J.B., W.R. Raun, and A.D. Monroe. 2009. Method for variable rate nitrogen application for plants. Prov. Patent 61/219,057.
9. Solie, J.B., M.L. Stone, and W.R. Raun. 2010. Hand held optical sensor for measuring the normalized difference vegetative index in plants. Prov. Patent 12/820,669
10. Koller, A. Adrian, William R. Raun, and Randal K. Taylor. 2012. Singulating hand planter and fertilizer applicator. Serial No. 61/799,338. Disclosure, July 26, 2012.
11. Koller, A. Adrian, Randal K. Taylor, and William R. Raun. 2012. Seed orienting corn planter. Disclosure, March 28, 2012.
12. Koller, A., Adrian, Randal K. Taylor, and William R. Raun. 2016. US Utility Patent Appl. No. 14/776,848 (based on Int’l. Patent Appl. No. PCT/US2014/030400 filed 3/17/14). Singulating Hand Planter and Fertilizer Applicator. OSU Ref. No. 2013.01.
13. Koller Adrian, Randal Taylor, and William Raun. 2017. Singulating hand planter and fertilizer applicator. Patent No. US 9,635,801 B2, May 2, 2017.

**SERVICE TO PROFESSIONAL SOCIETIES  
  
SSSA** Soil Science Society of America; **ASA** American Society of Agronomy

2018-present Agrosystems, Geosciences, & Environment Senior Editor

2017-present ASA Books Editor

2011-2017 Editor, Agronomy Journal, ASA-SSSA-CSSA

2010-2011 Senior Associate Editor, Agronomy Journal, ASA-SSSA-CSSA

2010-present Associate Editor, Journal of Plant Nutrition

2001-2007 **Technical Editor-Soils**, Agronomy Journal, ASA-SSSA-CSSA (responsible for 12 Associate Editors and annually handled more than 80 manuscripts)

2003-2009 SSSA Rapid Response Team (S536.1)

2001-2004 SSSA Division S-8 Board Representative

1996-2001 Associate Editor, Agronomy Journal

2000-2001 Larson Hydro Memorial Scholarship Committee

1998-2000 ASA Membership Committee

**PROFESSIONAL ACTIVITIES**

Co-Chairman, Sensor Based Nutrient Management Community, ASA, 2012

International Plant Nutrition Institute (IPNI) Advisory Group, 2008

RESOURCE 21, Agriculture Advisory Board Member, Farmland Industries, 1997-1999

National Research Initiative Panel Member, USDA, Water Resources Assessment and Protection, 1995

National Research Initiative Panel Member, USDA/CSREES, WRAP, 1999

Member, Oklahoma Agribusiness Retailers Association (OARA), 1992-present

Farmland/University Fertilizer Advisory Board, 1992 - 2001

Advisor, Agronomy Graduate Student Organization, 1992 - 1995

National Research Council, Committee on Sustainable Agriculture for The Humid Tropics, 1990

Member of the American Association for the Advancement of Science, 1984

Member of the American Society of Agronomy, 1981-present

Member of the Soil Science Society of America, 1981-present

Member of the Crop Science Society of America, 2010-present

**AWARDS/Recognition**

OSU Extension Weed Science, Outstanding Group Award, January 15, 2019

Leo M. Walsh Soil Fertility Distinguished Lectureship, Phoenix, AZ, November 8, 2016

Graduate College Commencement Speaker, Oklahoma State University, 2015

Soil Science Society of America, Applied Research Award, 2015

Great Plains Soil Fertility Leadership Award, 2014

PrecisionAg Award of Excellence, Legacy Award, 2013

Pierre C. Robert Precision Agriculture Senior Scientist Award, 2010

Eminent Faculty Award, Oklahoma State University, 2009

ASA-CSSA-SSSA, Award of Excellence. Oklahoma Homeowner’s Handbook for Soil and Nutrient Management (E-1003), 2009

Gamma Sigma Delta Experienced Research Scientist Award, 2009

Sarkeys Distinguished Professor Award, Oklahoma State University, 2007

Werner L. Nelson Award for Diagnosis of Yield-Limiting Factors, American Society of Agronomy, 2006

Melvin D. and Mary E. Jones Distinguished Professorship of Agronomic Sciences, 2006

Regents Distinguished Research Award, Oklahoma State University, 2004

United States Dept. of Agriculture Secretary’s Honor Award, 2002 – GreenSeeker Research Team

Fellow, Soil Science Society of America, 2001

Fellow, American Society of Agronomy, 2000

Robert E. Wagner Award, Potash & Phosphate Institute, 1997

James A. Whatley Award, Oklahoma State University, 1996

Widaman Trust Distinguished Graduate Assistant, University of Nebraska, 1985

Gamma Sigma Delta, 1984

Sigma Xi, 1984

**INTERNATIONAL WORKSHOPS**

1. Raun, W.R., J.S. Schepers, G.V. Johnson, J.B. Solie, and M.L. Stone. 2003. Coordinated “Crop Nitrogen Algorithm Workshop” that included scientists from the USDA-ARS, Mexico, and Universities from Nebraska, Oklahoma, Kansas, Missouri, Virginia, and Colorado. May 19-20, 2003. Results from all presentations published simultaneously on the web, with a comprehensive summary.  
   <http://nue.okstate.edu/Nitrogen_Conference2003/Planning_Session.htm>
2. Schepers, J.S., J. Shanahan, G. Varvel, W. Wilhelm, N. Kitchen, W.R. Raun, and M.L. Stone. 2004. Coordinated “Crop Nitrogen Algorithm Workshop” that included scientists from the USDA-ARS, and Universities from Nebraska, Texas, Kentucky, Illinois, Minnesota, Oklahoma, Kansas, Missouri, Idaho, Colorado, Arizona, Canada, , Mexico. August 5-6, 2004. Results from all presentations published simultaneously on the web.  
   <http://nue.okstate.edu/Nitrogen_Conference2003/Planning_Session2004.htm>
3. Raun, W.R., and R.K. Taylor. 2014. Hand Planter Workshop included scientists from all over the world, January 16, 2014. Results from all presentations published on the web. All presentations were delivered live over the web to 22 different third world countries, including many in the US. <http://nue.okstate.edu/Hand_Planter/osu_hand_planter_workshop.html>

**INTERNATIONAL NETWORK FOR IMPROVING NUE**

1. The NUE network was first started in 2003 (Stillwater, OK). This international group has since met every year (16th annual conference was held in Manhattan, KS, 2018). Has resulted in a network of collaborating scientists that now includes groups from Argentina, Canada, Mexico, China, and the USA. A combined effort of more than 75 scientists working in nitrogen management has accelerated progress needed for improving nitrogen use efficiency using precision sensing technologies.   
   <http://nue.okstate.edu/Conferences_Workshops.htm>. The NUE website was started in 1996 ([www.nue.okstate.edu](http://www.nue.okstate.edu))

**FIELD DAYS and WORKSHOPS COORDINATED**

1. Variable rate technology field day. PI’s. Marvin Stone, John Solie, Richard Whitney, and Bill Raun. Conducted for research and industry groups involved in variable rate application of fertilizers. 107 people in attendance. Hennessey, OK, March 22, 1996.
2. Wheat Workshop. Jointly conducted with Gene Krenzer, Bob Hunger, Tom Royer, and Roger Gribble for CCA advanced training using hands-on examples in management, entomology, pathology, soil fertility and weed management. Lahoma, OK, May 15, 1998.
3. Wheat 2000 Workshop. Jointly conducted with Gene Krenzer, Bob Hunger, Tom Peeper, Jim Stritzke, Tom Royer, Ray Sidwell, and Aaron Guenzi for CCA advanced training using hands-on examples in management, entomology, pathology, soil fertility and weed management. Lahoma, OK, May 18, 2000.
4. CCA Hands-on Training, Jointly conducted with Gener Krenzer, Bob Hunger, Tom Royer, Ray Sidwell, John Solie, Tom Peeper, and Case Medlin. For CCA advanced training using hands-on examples of precision agriculture, soil fertility, entomology, pathology, and weed management. Lahoma, OK, May 16, 2002.
5. Wheat 2004 Workshop, CCA Hands-on Training, Jointly conducted with Gene Krenzer, Bob Hunger, Tom Royer, Ray Sidwell, John Solie, Tom Peeper, and Case Medlin. For CCA advanced training using hands-on examples of precision agriculture, soil fertility, entomology, pathology, and weed management. Lahoma, OK, May 20, 2004.
6. Sensor-Based N Rich Strip Workshop, Jointly conducted with John Solie, Marvin Stone, Kyle Freeman, Ross Love, and Carol Jones, for 35 attendees from Oklahoma, and Canada. Stillwater, OK January 11-12, 2005.
7. Sensor-Based N Rich Strip Workshop, Jointly conducted with John Solie, Marvin Stone, Kyle Freeman, Randy Taylor, Ross Love, Carol Jones, Hailin Zhang, and Jeff Edwards for 65 attendees from Oklahoma, Michigan, Kansas, and Canada. Stillwater, OK, January 19-20, 2006.
8. RAMP and N Rich Strip Training of Ag Educators in Oklahoma and Kansas. Jointly conducted with Randy Taylor, John Solie, Ross Love, Hailin Zhang, and Jeff Edwards for 70 attendees. Stillwater, OK January 18-19, 2007.
9. Annual International NUE Conference, Stillwater, OK, Aug 4-5, 2010 (attended by 100 scientists from all over the world)
10. Colorado State University Sensor Based N Rate Workshop. April 9-10, 2013 (attended by 5 scientists)

**R&D RESULTS IN INDUSTRY**

The first sensor-based N rate applicator was conceived, developed, tested, and shown at an OSU field day on March 22, 1996 (PI’s John Solie, Marvin Stone, Bill Raun and Gordon Johnson). From 1996 to 1998, informal discussions were held with John Deere Co., Toro Equipment, and Case IH, concerning the commercial application of this work but no formal agreement was made. Our OSU precision sensing team initiated discussions with John Mayfield (future president of NTech Industries) in the fall of 1998. From 1998 to 2001, continued research and development of the sensor-based variable N rate applicator developed at OSU took place. On October 15, 2001, NTech Industries was formally established and a joint venture was signed with OSU concerning the sale of sensor based N rate applicators combined with continued R&D at OSU. NTech is now owned by Trimble which is actively selling the GreenSeekerTM Hand-held sensors and field scale variable N rate applications. Hand held sensors are now used in *Canada, Mexico, Ecuador, Argentina, China, India, Turkey, Australia, Uzbekistan, Russia, Zimbabwe, Kenya, Ethiopia,* ***USA****: Idaho, Maryland, Virginia, Nebraska, Kansas, Missouri, Colorado, Iowa, Minnesota, Ohio, North Carolina, North Dakota, Kentucky, Tennessee, Colorado, South Dakota, Texas, California, Illinois, and Oklahoma*.

**WEB SITES DEVELOPED and MAINTAINED**

1. Raun, W.R. 1996-present. Improving nitrogen use efficiency for winter wheat production. [www.nue.okstate.edu](http://www.nue.okstate.edu).Okla. Agric. Exp. Sta. Stillwater, OK. (hits to date, >200,000)
2. Raun, W.R., R.L. Westerman and G.V. Johnson. 1998-present. Soil fertility research and education. [www.dasnr.okstate.edu/fertilizer\_checkoff](http://www.dasnr.okstate.edu/fertilizer_checkoff).Okla. Agric. Exp. Sta. Stillwater, OK. (hits to date, 2530)
3. Raun, W.R., J.B. Solie, M.L. Stone, G.V. Johnson and R.W. Whitney. 1998-present. Precision agriculture in Oklahoma. [www.dasnr.okstate.edu/precision\_ag](http://www.dasnr.okstate.edu/precision_ag)*.* Okla. Agric. Exp. Sta. Stillwater, OK. (hits to date, 12,405)
4. Raun, W.R., G.V. Johnson, E.G. Krenzer, W.E. Thomason, R. Hunger, T. Royer, R. Gribble, R. Sidwell, G. Cuperus, A. Goforth, J. Hise. 2000-2002. Wheat 2000 Workshop. [www.dasnr.okstate.edu/wheat2000](http://www.dasnr.okstate.edu/wheat2000). Okla. Agric. Exp. Sta. Stillwater, OK.
5. Raun, W.R., G.V. Johnson, and R.L. Westerman. 2000-present. Soil plant nutrient cycling and environmental quality. <http://soil5813.okstate.edu>. Okla. Agric. Exp. Sta. Stillwater, OK.
6. Raun, W.R., J.B. Solie, G.V. Johnson, and M.L. Stone. 2000-present. Precision Agriculture, SOIL 4213. <http://soil4213.okstate.edu>. Okla. Agric. Exp. Sta. Stillwater, OK. (hits to data, 7454)
7. Raun, W.R., and D.B. Arnall. 2004-present. Soil Nutrient Management, SOIL 4234. <http://soil4234.okstate.edu>. Okla. Agric. Exp. Sta. Stillwater, OK. (hits to date, 4,473)
8. Raun, W.R. 2005-present. Research Methods in Plant and Soil Sciences, SOIL 5112. Okla. Agric. Exp. Sta. Stillwater, OK. [www.nue.okstate.edu/Research\_Methods/Research.html](http://www.nue.okstate.edu/Research_Methods/Research.html)
9. Raun, W.R., and R.K. Taylor, 2013. OSU Singulating Hand Planter for the Third World. Okla. Agric. Exp. Sta. Stillwater, OK. <http://nue.okstate.edu/Hand_Planter.htm>

**GRANTS AND PROPOSALS**

1. Olson, R.A., W.R. Raun and D.H. Sander. 1983-85. Placement of phosphorus and nitrogen fertilizers for minimum till corn under sprinkler irrigation. Responsible for annual reports submitted to the Tennessee Valley Authority. Grant funded for $32500.
2. Raun, W.R., D.H. Sander and R.A. Olson. 1984. Response of irrigated corn yields to nitrogen sources applied with a urease inhibitor. Grant funded by Allied Chem. Co., for $2500 in 1984 and $2500 in 1985.
3. Raun, W.R., 1988. Methods of applying sulfur for maize grown on volcanic ash derived soils in Central America. Submitted to The Sulphur Institute, February 1988. Grant funded for $5000, November 1988, $5000, November 1989 and $5000, November 1990.
4. Raun, W.R., and T.J. Smyth. 1989. Phosphorus source and method evaluation for Central America. Submitted to Texasgulf Export Corporation, January, 1989. Grant funded, August, 1989 for $55,000.
5. CRP-CIMMYT. 1991. Jointly obtained additional funding for the new agronomic journal 'Agronomía Mesoamericana' from the European Economic Community ($80,000 for the period 1991-1994).
6. Basta, N.T., W.R. Raun, E.R. Allen, G.V. Johnson and M.P. Anderson. 1993. Impact of long-term cropping on cadmium in wheat and evaluation of agroecosystem Cd bioavailability indicators. Submitted to the OSU-Targeted Research Initiative, June 1, 1993 for $7740. Grant funded, August, 1993.
7. Raun, W.R. and G.V. Johnson. 1993. Effect of timing of residue and fertilizer nitrogen incorporation on N use efficiency in winter wheat. Submitted to Farmland Industries Inc., November 18, 1993 for $24,000. Funded for $24000, February 9, 1994.
8. Raun, W.R., G.V. Johnson and R.K. Boman. 1994. Prediction of inorganic nitrogen buffering capacities in continuous cropping production systems. Submitted to OSU-Targeted Research Initiative, June 10, 1994 for $11000. Funded for $11000, July 7, 1994.
9. Stone, M.L., J.B. Solie, R.W. Whitney and W.R. Raun. 1994. Precision real-time split application of nitrogen based on crop needs. Submitted to OSU-Targeted Research Initiative, June 10, 1994 for $15100. Funded for $15,100, July 7, 1994.
10. Gillen, R.L., W.R. Raun and F.T. McCollum. 1994. Effects of grazing management on rangeland soils. Submitted to OSU-Targeted Research Initiative, June 10, 1994 for $5,067. Funded for $5067, July 7, 1994.
11. Raun, W.R., and S.L. Taylor. 1994. Long-term rye-wheat-ryegrass forage yields as affected by rate and date of N application. Project analysis submitted to the Noble Foundation, January, 1994 for $10000. Funded for $10,000, September, 1994.
12. Raun, W.R., and S.L. Taylor. 1995. Changes in soil test indices in a long-term rye-wheat-ryegrass forage production system as affected by rate and date of N application. Project analysis submitted to the Noble Foundation, February, 1995 for $10,000. Funded for $10,000, March, 1995.
13. Westerman, R.L., G.V. Johnson and W.R. Raun. 1989 - present. Continuation of soil fertility research and education project, SB-314.
14. Raun, W.R., G.V. Johnson, M.L. Stone, J.B. Solie, R.W. Whitney. 1995. Implementation of sensor based variable rate technology for bermudagrass production in south central Oklahoma, October, 1995 for $100,000. Funded for $100,000, November, 1995.
15. Raun, W.R., G.V. Johnson and S.B. Phillips. 1996. Use of tritium/helium-3 groundwater dating in north-central Oklahoma well water. Submitted to Environmental Institute for Water and Energy Research, February, 1996. Funded for $8925, April, 1996.
16. Johnson, G.V., and W.R. Raun. 1996. Calibration of phosphorus fertilization for winter wheat forage production. Submitted to the Noble Foundation, February, 1996 for $10,000. Funded for $10000, May, 1996.
17. Raun, W.R., J.B. Solie, G.V. Johnson, M.L. Stone, R.W. Whitney, H. Sembiring and H.L. Lees. 1996. Field element size for soil phosphorus and potassium in continuous production systems. Submitted to the Potash Phosphate Institute, September 1996. Funded for $2000, December, 1996, $2000 in 1997, $2,000 in 1998.
18. Raun, W.R., M.L. Stone, J.B. Solie, G.V. Johnson and R.W. Whitney. 1997. Development of sensor-based technologies for detecting in-season nitrogen deficiencies in winter wheat and bermudagrass. Submitted to the Noble Foundation, February 1997. Funded for $150,000, April, 1997.
19. Solie, J.B., M.L. Stone, R.W. Whitney, J. Baird, G.V. Johnson, W.R. Raun and K. Conway. 1997. Development of optical sensor based variable rate technology for turfgrass management. Submitted to John Deere and Co., February 1997. Funded for $300,000, April, 1997.
20. Raun, W.R. and G.V. Johnson. 1997. Effect of Nitrogen Rate, Method of Application and Residue Management on N Use Efficiency and Estimated N Loss in Winter Wheat. Submitted to Farmland Industries Inc., May 1997 for $16000. Funded for $16,000, June 1997.
21. Raun, W.R., J.B. Solie and G.V. Johnson. 1998. Development of spectral indices to improve nitrogen use efficiency in wheat: Breaking the 50% use efficiency barrier. Submitted to International Research Support Program (IRSP), February, 1998, Funded for $4,000, March, 1998.
22. Raun, W.R., and M.L. Stone. 1999. Continued development of spectral indices to predict yield potential and improve nitrogen use efficiency in wheat. Submitted to International Research Support Program (IRSP), February, 1999, Funded for $4,000, March, 1999.
23. Stone, M.L., J.B. Solie, W.R. Raun and G.V. Johnson. 1999. Sensor-based, in-season estimated yield for winter wheat and bermudagrass. Submitted to the Noble Foundation, February 1999. Funded for $50,000, April, 1999.
24. Johnson, G.V., A.R. Klatt, R.F. Elliott, M.L. Stone, J.B. Solie and W.R. Raun. Application of in-season estimated yield for variable rate nitrogen application. Submitted to the Noble Foundation, February 2000. Funded for $175,000, April 2000.
25. Solie, J.B., M.L. Stone, R. Elliott, G.V. Johnson, A.R. Klatt and W.R. Raun. Field Scale Applicator and System for In-Season Fertilizer Nitrogen Application Based on Optically Sensed Predicted Yield. Submitted to the OSU Targeted Research Initiative Program, February 2000. Funded for $20,000, April 2000.
26. Raun, W.R., J.B. Solie and A.R. Klatt. Continued Development of Spectral Indices to Predict Yield Potential and Improve Nitrogen Use Efficiency in Wheat. Submitted to the OSU International Research Support Program (IRSP), February 2000, Funded for $4000, March, 2000.
27. Raun, W.R, J.B. Solie, M.L. Stone, G.V. Johnson, R. Elliott, A.R. Klatt, K.D. Sayre and M. Reynolds. System for In-Season Fertilizer Nitrogen Application Based on Predicted Yield. Submitted to the National Research Initiative (NRI) Competitive Grants Program, January 2000. Submitted for $468,929, funded for $382,000, December 1, 2000.
28. Smith, Michael W., W.R. Raun and G.V. Johnson. Nitrogen strategies to reduce pecan alternate bearing. Submitted to OCAST, spring 2000. Funded for $80,656, June, 2000.
29. Raun, W.R., G.V. Johnson, J.B. Solie, M.L. Stone, K.D. Sayre, M.P. Reynolds, and S.B. Phillips. 2001. Field testing of a sensor-based applicator for nitrogen and phosphorus fertilization. Submitted to Application of Geospatial and Precision Technologies, NASA (CSREES, Cooperative State Research, Education, and Extension Services), Competitive Grants Program, March, 2001 for $656,240, funded for $575,000, September 1, 2001.
30. Schepers, J.S., J.F. Shanahan, D.D. Francis, K.H. Holland, W.R. Raun, G.V. Johnson, J.B. Solie, M.L. Stone, and Chunsheng Hu. 2003. Crop Sensor-Based Nitrogen Management to Protect Water Quality. Submitted to OICD for $109,000, Funded for $109,000, June, 2003.
31. Raun, W.R, and K.W. Freeman. 2003. Fall and Spring Applied Urea-N Sources for Winter Wheat Production. Submitted to Georgia-Pacific, September 2003 for $23,800, funded for $23,800, October, 2003.
32. Raun, W.R. Funding for Post-Doctoral Fellow, Agricultural Division. Submitted to the Noble Foundation, September 2003, Funded in April of 2004 for $125,000.
33. Raun, W.R., G.V. Johnson, and R.L. Westerman. Soil Fertility Research and Advisory Board. Senate Bill 314, established in November of 1989 and initially established by Dr. Robert L. Westerman, total since 1989-present, $3,738,833.
34. Raun, W.R., J.B. Solie, M.L. Stone, H. Zhang, J. Lamb, and G. Randall. 2004. Laser measured height and NDVI coefficient of variation for by-plant, real-time, variable nitrogen rate application in corn. Submitted to United States Dept. of Agric., NRI, for $759,255, March, 2004.
35. Raun, W.R., J. Mosali, J.B. Solie, D. Redfearn, M.L. Stone, J. Ball, and W. Altom. 2004. Improving Bermudagrass Forage Pasture Production via Sensor Based Methods of Identifying Weed Species and Methods of Control. Submitted to the Noble Foundation, July 2004, Funded for $37,500, August 2004.
36. Raun, W.R., K.D. Sayre, R. Gupta, J.B. Solie, M.L. Stone, K. Freeman, K. Martin, and I. Ortiz-Monasterio. 2004. Technological Extension of Sensor-Based Nitrogen Fertilization Algorithms for Increased Cereal Production and Use Efficiency. Submitted to USAID via CIMMYT, for $185,613 August 2004, Funded for $120,000, Jan 2005.
37. Raun, W.R., J.B. Solie, M.L. Stone, and H. Zhang. 2005. Sitlington Enriched Graduate Scholarship, Precision Agriculture By-Plant Methodology. Submitted for $5000/year, 3 years, 2 students, funded for $30,000, Feb, 2005.
38. Stone, M.L., W.R. Raun, J.B. Solie, H. Zhang, and G. Brown. 2005. Improved Nitrogen Fertilization and Use Efficiency for Wheat and Corn in Northern Italy. Submitted to Fondazione Cassamarca for $25,000, July 2005.
39. Raun, W.R., J.B. Solie, M.L. Stone, and H. Zhang. 2006. Sitlington Enriched Graduate Scholarship, RAMP and New VRT Applicator. Submitted for $5000/year, 3 years, 2 students, funded for $30,000, Feb, 2006.
40. Brorsen, W., F. Epplin, J. Solie, and W. Raun. 2006. Economics of Precision Sensing Technologies in Oklahoma Wheat. TIP, OAES. Funded for $27,392, January, 2006.
41. Taylor, R., B. Woods, R. Gribble, W. Raun, J. Solie, M. Stone, H. Zhang. 2006. Extension of the GreenSeeker Sensor Based Nitrogen Rate Recommendations for Corn and Wheat Farmers in Oklahoma. TIP, OAES. Funded for $21,000, January, 2006.
42. Weckler, P., W. Raun, G. Bell, J. Solie, M. Stone, N. Maness, B. Morgan, R. Taylor. 2006. Development of laser-based biosensor technologies. TIP, OAES, Funded for $50,000, January 2006.
43. Zhang, Hailin, and W.R. Raun. 2006. Extension of RAMP Technology for Improved N fertilization. Centennial Scholars Program, 21st Century Plant Enterprises. Funded for $60,000, February 2006.
44. Raun, W., K. Freeman, B. Arnall, and R. Teal. 2006. Precision Sidedress UAN Application for Corn Production. Submitted to the Fluid Fertilizer Foundation for $3000, Funded, February 2006.
45. Arnall, D.B., and W.R. Raun. 2006. Evaluation of foliar N sources for corn production. Submitted to Tesenderlo Kerley Co. for $4000, funded for $4000, March 2006.
46. Raun, W.R., J.B. Solie, R. Taylor, H. Zhang, and A. Sutherland. 2007. Relationship between fractional water indices from the Mesonet and estimated yield potential using mid-season Greenseeker readings. Sitlington Enriched Graduate Scholarships, submitted for $5000/year, 3 years, 2 students, funded for $30,000, Feb, 2007.
47. Raun, W.R., J.B. Solie, A. Sutherland, and R. Taylor. 2007. Real-Time Use of Mesonet Weather Data for Refined GreenSeeker Sensor Based N Recommendations in Winter Wheat. TIP, OAES-OCES. Funded for $61,422, February 2007.
48. Wang, Ning, Chad Godsey, Hailin Zhang, Randy Taylor, Bill Raun, and John Solie. 2008. Smart field data acquisition system for precision agriculture. TIP, OAES-OCES. Funded for $44,615, February 2008.
49. Raun, W.R., Ning Wang, Randy Taylor and John Solie. 2008. By-plant N fertilization strategy for corn production. Sitlington Enriched Graduate Scholarships, submitted for $5000/year, 3 years, 2 students, funded for $30,000, Feb, 2008.
50. Raun, W.R., J.B. Solie, M.L. Stone, R. Taylor, and D.B. Arnall. 2008. Development and delivery of the second generation optical pocket sensor for maximizing nitrogen use efficiency in cereal production systems. Oklahoma Conservation Commission. Funded for $133,000, June 2008.
51. Arnall, D.B., W.R. Raun, D. Edmonds, Yumiko Kanke, and Brian Arnall. 2008. Evaluation of 521G43 and Nitamin 30L Foliar N Products for Winter Wheat Production. Funded for $19,077, October, 2008.
52. Raun, W.R., D. Edmonds, D.B. Arnall, and Y. Kanke. 2009. Evaluation of 521G43 and Nitamin 30L Foliar N Products for Winter Wheat Production. Georgia Pacific. Funded for $19,077, January 2009.
53. Raun, W.R., J.B. Solie, R.K. Taylor, M. Stone, D.B. Arnall, and N. Wang. 2009. Development and testing of the Optical Pocket Sensor. Sitlington Enriched Graduate Scholarships, submitted for $5000/year, 3 years, 2 students, funded for $30,000, Feb, 2009.
54. Raun, W.R., D.B. Arnall. 2010. Coordination of the 2010 NUE Workshop in Stillwater, OK. Support for $1500 sought from Monsanto, Co., Funded for $1500, January 2010.
55. Raun, W.R., D.B. Arnall. 2010. Coordination of the 2010 NUE Workshop in Stillwater, OK. Support for $1000 sought from Bayer Crop Science., Funded for $1500, January 2010.
56. Raun, W.R., D.B. Arnall. 2010. Coordination of the 2010 NUE Workshop in Stillwater, OK. Support for $2000 sought from Trimble., Funded for $1000, January 2010.
57. Raun, W.R., D.B. Arnall. 2010. Coordination of the 2010 NUE Workshop in Stillwater, OK. Support for $1500 sought from Ag Leader., Funded for $1500, January 2010.
58. Raun, W.R., D.B. Arnall. 2010. Coordination of the 2010 NUE Workshop in Stillwater, OK. Support for $2000 sought from John Deere., Funded for $1000, February 2010.
59. Raun, W.R., R.K. Taylor, N. Wang. 2011. Use of measured stalk diameter for improved prediction of yield. Sitlington Enriched Graduate Scholarships, submitted for $5000/year, 3 years, 2 students, funded for $30,000, Feb, 2011.
60. Raun, W.R., Randy Taylor, Adrian Koller, and Brian Arnall. 2012. Development of a new third world hand planter. Submitted to AGCO corporation for $20,000, funded for $20,000, April, 2012
61. Khosla, Raj, William Raun, Timothy Shaver, Luis Longchamps, Robin Reich and Bruce Bosely. 2013. The 4R Nutrient Stewardship with Proven Techniques and Technologies to Enhance Nutrient Use Efficiency, Productivity and Environmental Sustainability. NRCS-CIG Grant. OSU portion funded for $96,000, Nov, 2013.
62. Raun, W.R., R.K. Taylor, N. Wollenhaupt. 2014. Refinement/Extension of the OSU-AGCO Singulating Hand Planter. Submitted to TBDC-OSU for $31,000, funded for $30,000, May 1, 2014.
63. Raun, W.R., and R.K. Taylor. 2016. Stage Testing and Delivery of the OSU Hand Planter. Sitlington Enriched Graduate Scholarships, submitted for $5000/year, 3 years, 2 students, funded for $15,000, Feb, 2016.
64. Raun, W.R., and Joshua Ringer. 2017. Promotion and Delivery of the Greenseeder Hand Planter. Submitted to ASA Reinvest, for $9750, 2/29/2017, funded for $9750, 6/9/2017.
65. Raun, W.R., Joshua Ringer, and Randy Taylor. 2017. New Age Hand Planter for the Developing World. Submitted to Rotary International for $33,500, 9/1/2017.
66. Raun, W.R., Joshua Ringer, and Randy Taylor. 2017. TBDP Phase II, Value and Distribution of the OSU Greenseeder Hand Planter. Submitted to TBDP, for $33,400, 9/29/2017.
67. Raun, Omara, Aula, Oyebiyi, Dhillon. 2018. International Rotary Global Grant #1876785. Int. Districts 5630 and 9211. Submitted for $51,814. September, 2018.
68. Raun, W.R., Joshua Ringer. 2018. Future Frontiers for OSU’s Hand Planter. Sitlington Enriched Graduate Scholarships, submitted for $5000/year, 3 years, 2 students, Jan, 2018.
69. Raun, W.R., J. Dhillon, G. Wehmeyer. 2018. Documenting potassium and sulfur use efficiency in cereal crops. Submitted to NUTRIEN, Jan 2018, funded for $5000.
70. Raun, W.R., Craig Edwards, and John Long. 2019. Distribution of the OSU World Hand Planter. Sitlington Enriched Graduate Scholarships, submitted for $10000/year, 3 years, 2 students, Jan, 2019.
71. Raun, W.R., Fikayo Oyebiyi, Gwen Wehmeyer, Elizabeth Eickhoff. 2019. Rotary International Global Grant #1876785, Wassa District – APO, Abuja, Nigeria. Delivery and Training of the OSU Hand Planter. Funded for $59,000, December 20, 2019.
72. Raun, W.R., Craig Edwards, John Long and Randy Taylor. 2020. Production and Training, OSU Hand Planter. Sitlington Enriched Graduate Scholarships, submitted for $5000/year, 3 years, 1 student, Jan, 2020.

**TEACHING AND SOFTWARE DEVELOPMENT**

1. Soil fertility and statistics training with CIMMYT Wheat trainees at the B.S. level having diverse backgrounds in agricultural research. Teaching focused on experimental design for 'On Farm Research' programs. Soil fertility and statistics taught in Spanish and English.
2. Barreto, H. J., and W. R. Raun. 1988. MST Data Assistant, Integrated Data Management System. Software program for data entry and transformations. Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), Apdo. Postal 6-641. Mexico D.F. 06600
3. Soil-Plant Nutrient Cycling and Environmental Quality, Plant and Soil Sciences 5813, (3 hours), spring semester, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016. Subject matter includes the study of relationships between soil nutrient supply/plant response and associated theoretical applications, nutrient cycling for N, P, K and S, applied techniques for determining fertilizer response and yield goals, and dynamics of soil organic C. Supplemental text prepared for class use, and that is published on the web (<http://soil5813.okstate.edu>).
4. Seminar, Plant and Soil Sciences 5020, (1 hour). Taught in the spring 1994, fall 1994, spring 1995, fall 2005, spring 2005. Designed for formal presentation of M.S. and Ph.D. research topics in agronomic sciences.
5. Senior Seminar, Plant and Soil Sciences 4571, (1 hour), fall semester, 1994. Exiting course for seniors in agronomy that addresses current issues in soil and crop science. Formal reporting on specific topics is required. Strengths and weaknesses of their B.S. program is discussed.
6. Precision Agriculture, Plant and Soil Sciences 4213 (3 hours), spring semester, 1997, 1999, 2001, 2002, 2004, 2006, 2007, 2008, 2010, 2011. Taught over the web (<http://soil4213.okstate.edu>) with the Department of Biosystems and Agricultural Engineering. Address the use of indirect measures for nutrient analyses, applications of GPS and GIS, sensor-based technologies employing visible and non-visible portions of the spectra, use of geostatistics in determining field element size, methods of establishing critical nutrient levels, and resultant recommendations.
7. Soil Nutrient Management 4234 (4 hours), fall semester 2004, 2005, 2006, 2007, 2008, 2009. Taught over the web (<http://soil4234.okstate.edu>). Junior-Senior level class that includes nutrient deficiencies, and nutrient management for cereal crops, and turfgrass. Added topics include soil testing, Bray’s mobility concept, micronutrients in agriculture, and comprehensive study of nitrogen cycling and interrelationships of crop management with the environment.
8. Research Methods 5112 (2 hours) spring semesters 2005, 2007, 2009, 2011, 2013, 2015, 2017. Also taught over the web. (<http://www.nue.okstate.edu/Research_Methods/Research.html>). Biometrical and statistics applications for M.S. and Ph.D. students in Biological Sciences.

**GRADUATE STUDENT THESES:** (Major Advisor)

1. Attefat, Mehdi. 1992. Leaching and Contamination of NO3-N in Agricultural and Nonagricultural Systems. M.S. Thesis.
2. Ascencio, Edgar Noel. 1992. Sequential measurements of soil ammonium-N and nitrate-N from two long-term wheat fertility experiments with variable N rates. M.S. Thesis.
3. Sembiring, Hasil. 1993. Effect of surface residue inversion on moisture conservation. M.S. Thesis.
4. Jojola, Michael E. 1994. Accuracy and precision of total nitrogen using automated dry combustion. M.S. Thesis.
5. Ascencio, Edgar Noel. 1995. Sequential measurements of soil NH4-N and NO3-N from two long-term fertility experiments with variable N rates, and distribution of soil profile NO3-N under flooded conditions using a bromide tracer. Ph.D. Dissertation.
6. Kanampiu, Fred, 1995. Effect of nitrogen rate on plant nitrogen loss in winter wheat varieties and glutamine synthetase activity. Ph.D. Dissertation.
7. Gavi-Reyes, Francisco. 1995. Effect of applied sewage sludge, ammonium nitrate and phosphorus on yield of winter wheat, soil profile inorganic nitrogen accumulation and cadmium uptake. Ph.D. Dissertation.
8. Ball, Jeff B. 1995. Effect of nitrogen rate, method of application and residue management on estimated N loss in winter wheat. M.S. Thesis.
9. Phillips, Steven B. 1995. Seasonal and long-term variability in well water nitrate-nitrogen. M.S. Thesis.
10. Taylor, Shannon L. 1996. Bermudagrass forage yield response to high rates of applied urea and ammonium nitrate and the use of spectral radiance for estimating nitrogen deficiencies and soil variability. M.S. Thesis
11. Chen, Jing. 1997. Winter wheat and cheat response to foliar fertilizer nitrogen application. M.S. Thesis.
12. Keahey, Dale, Alan. 1997. Improving fertilizer nitrogen use efficiency using alternative legume interseeding in continuous corn production systems. M.S. Thesis.
13. Lees, Heather, L. 1997. I. Development of field standards for variable rate technology and II. Estimating gaseous nitrogen losses from *Triticum aestivum* L. using 15N. M.S. Thesis.
14. Sembiring, Hasil. 1997. Management of nitrogen and phosphorus experiments using spectral radiance and soil N mineralization in winter wheat and bermudagrass. Ph.D. dissertation.

1. Thomason, Wade E. 1998. I. Winter wheat fertilizer nitrogen use efficiency in grain and forage production systems and II. Detection of nitrogen deficiencies in cotton using spectral radiance measurements and cotton response to topdress applications. M.S. Thesis
2. Lukina, Erna V. 1998. Effect of row spacing, N rate and growth stage on spectral radiance in winter wheat. M.S. Thesis.
3. LaRuffa, Joanne M. 1999. Optimum field element size for maximum yields in winter wheat using variable nitrogen rates. M.S. Thesis.
4. Phillips, S.B. 1999. I. Alfalfa yield response to method and timing of applied phosphorus, II. Effect of dual applied phosphorus and gypsum on wheat forage and grain yield. Ph.D. Dissertation.
5. DeLeon, Micah. 1999. Determination of phosphorus nutritional status using spectral response. M.S. Thesis.
6. Dennis, Jeremy. 1999. Winter wheat and cheat response to late-season foliar nitrogen applications. M.S. Thesis.
7. Woolfolk, Curt W. 2000. Influence of late-season foliar nitrogen applications on grain protein win winter wheat. M.S. Thesis.
8. Cossey, Doug. 2000. Relationship between ammonium and nitrate in wheat plant tissue and estimated plant nitrogen loss. M.S. Thesis.
9. Mullen, R.W. 2001. Effect of foliar nitrogen on wheat quality and cheat reduction. M.S. Thesis.
10. Wynn, K. 2001. Effect of long-term application of biosolids and ammonium nitrate on winter wheat yield, nitrogen uptake, and heavy metal accumulation. M.S. Thesis.
11. Thomason, W.E. 2001. I. Production system techniques to increase nitrogen use efficiency in winter wheat, II. Switchgrass response to harvest frequency, and time, and rate of applied nitrogen. Ph.D. Dissertation.
12. Lukina, E.V. 2001. I. Evaluation of alternative methods for determining estimated yield. II. Use of In-Season Estimates of Yield for topdress applications of fertilizer nitrogen in winter wheat. Ph.D. Dissertation.
13. Freeman, Kyle W. 2002. Late-season prediction of wheat grain yield and grain protein. M.S. Thesis.
14. Teal, Roger T. 2002. Effect of tillage and anhydrous ammonia application on nitrogen use efficiency of hard red winter wheat. M.S. Thesis
15. Moges, Shambel. 2002. Use of red and green NDVI for yield prediction in winter wheat. M.S. Thesis.
16. Mullen, Robert. 2002. I. Estimation of nitrogen mineralization in soils from long-term application of fertilizer and its effect on winter wheat response to topdress nitrogen, II. Use of in-season sensor derived response indices to predict the response index at harvest. Ph.D. Dissertation.
17. Humphreys, Micah, 2003. Indirect estimates of soil electrical conductivity for improved prediction of yield. M.S. Thesis.
18. Hodgen, Paul. 2003. I. Use of a response index and in-season predicted yield to determine topdress nitrogen needs, II. Relationship between the response index determined in-season and at harvest. M.S. Thesis.
19. Lawles, Jason. 2004. Peanut yield response to foliar applied phosphorus. M.S. Thesis.
20. Mosali, Jagadeesh. 2004. Effect of foliar application of phosphorus on winter wheat grain yield, and Use of in-season reflectance for predicting yield potential. Ph.D. Dissertation.
21. Girma, Kefyalew. 2004. I. Identification of optical spectral signatures for detecting cheat and ryegrass in winter wheat. II. Determination of optimum rate and growth stage for foliar applied phosphorus in corn. Ph.D. Dissertation.
22. Morris, Keri, 2004. Mid-season recovery to nitrogen stress in winter wheat. M.S. Thesis.
23. Arnall, Brian, 2004. Relationship between coefficient of variation measured by spectral reflectance and plant density at early growth stages. M.S. Thesis.
24. Teal, Roger, 2005. I. Influence of hybrid, population and nitrogen rate on plant spectral prediction of corn yield, II. Effect of tillage and anhydrous ammonia application on nitrogen use efficiency of hard red winter wheat. Ph.D. Dissertation.
25. Martin, Kent, 2005. Expression of spatial variability in corn (Zea Mays L.) as influenced by growth stage using optical sensor measurements. M.S. Thesis.
26. Freeman, Kyle, 2005. Influence of beds and row spacing in winter wheat, and by-plant prediction of corn forage yield. Ph.D. Dissertation.
27. Moges, Shambel. 2005. Yield potential estimation in grain sorghum (Sorghum bicolor L.), and effects of plant height, sensing angle and height on yield prediction of corn (Zea mays L.). Ph.D. Dissertation.
28. Mack, Clint. 2006. Validation of nitrogen calibration strip technology for prescribing accurate topdress nitrogen fertilizer. M.S. Thesis.
29. Lawles, Kyle. 2006. Effect of delayed emergence on corn grain yield. M.S. Thesis.
30. Walsh, Olga S. 2006. Effect of delayed nitrogen fertilization on corn grain yields. M.S. Thesis.
31. Tubana, Brenda. 2007. Adjusting mid-season nitrogen using a sensor-based optimization algorithm to increase use efficiency in corn. Ph.D. Dissertation.
32. Chung, Byungkyun. 2007. Evaluation of spatial resolutions for predicting corn grain yield. 2007. Ph.D. Dissertation.
33. Holtz, Starr. 2007. Total nitrogen uptake as a function of time in corn and winter wheat. M.S. Thesis.
34. Dotson, Clint, 2007. Effect of nitrogen fertilizer rate and placement on corn grain yield. M.S. Thesis.
35. Turner, Pamela. 2008. Indirect measurement of crop plant height using sonar. M.S. Thesis.
36. Edmonds, Daniel. 2008. Maize grain yield response to variable row nitrogen fertilization. M.S. Thesis.
37. Arnall, Brian. 2008. I. Development of a yield prediction model for mid-season nitrogen recommendations of cotton (Gossypium hirsutum L.), II. Use of by-plot CV’s for refining mid-season fertilizer nitrogen rates. Ph.D Dissertation.
38. Daft, Cody. 2008. By-plant nitrogen response as function of delayed emergence in corn (Zea mays L.). M.S. Thesis.
39. England, Brandon, 2008. Stream and flat fan topdress application of urea ammonium nitrate in winter wheat (Triticum aestivum L.). M.S. Thesis.
40. Desta, Birehane, 2009. Identification of spectral bands for detecting nitrogen and phosphorus deficiencies in winter wheat. M.S. Thesis.
41. Walsh, Olga, 2009. I. Real-time use of soil moisture data for refined Greenseeker sensor based nitrogen recommendations in winter wheat. II. Effect of foliar P fertilization on corn grain yield and phosphorus use efficiency. Ph.D. Dissertation.
42. Kanke, Yumiko, 2009. Red-edge as a potential index for detecting differences in plant nitrogen status in winter wheat. M.S. Thesis.
43. Vossenkemper, Jake. 2009. Maize (Zea mays L.) Grain Yield Response to Nitrogen Applied at Different Distances Away from the Row. M.S. Thesis.
44. Torres, Guilherme. 2010. Effect of Foliar Phosphorus and Surfactants on Winter Wheat (Triticum aestivum L.) Grain yield. M.S. Thesis.
45. Waldschmidt, Kevin. 2011. Effect of Plant Population and Nitrogen Rate on Spectral Properties and Grain Yield of Winter wheat. M.S. Thesis.
46. Kelly, Jonathan. 2011. By Plant Prediction of Corn (Zea mays L.) Grain Yield Using Height and Stalk Diameter. M.S. Thesis.
47. Rutto, Emily. 2011. Ability of cotton to recover from early season nitrogen stress, and maize (Zea mays L.) grain yield response to distance nitrogen is placed away from the row. Ph.D. Dissertation.
48. Mohammed, Yesuf, 2012. Nutrient sources and harvest frequency for quality dual purpose switchgrass (Panicum virgatum l.) production, and the effect of pH, nitrogen and phosphorus on biomass and quality of two teff (Eragrostis teff (zucc) trotter) varieties. Ph.D Dissertation.
49. Macnack, Natasha, 2012. In season prediction of nitrogen use efficiency and grain protein in winter wheat (Triticum aestivum L.). M.S. Thesis.
50. Crain, Jared, 2012. Evaluation of the Oklahoma State University NDVI pocket sensor. M.S. Thesis.
51. Chim, Bee, 2012. Effect of seed distribution and population on maize (Zea mays L.) grain yield. M.S. Thesis.
52. Mullock, Jeremiah, 2012. By-plant sidedress nitrogen in corn (Zea mays l.) based on plant height and normalized difference vegetation index. M.S. Thesis.
53. Torres, Guilherme. 2012. Precision planting of maize (Zea mays L.). Ph.D Dissertation.
54. Wyatt, Ethan. 2013. Effect of droplet size and nitrogen rate on protein content of hard red winter wheat (Triticum aestivum L.). M.S. Thesis.
55. Dhital, Sulochana. 2013. Influence of foliar sulfur, chloride and nitrogen on winter wheat (Triticum aestivum L.) grain yield and total nitrogen. M.S. Thesis.
56. Omara, Peter. 2013. Effect of seed distribution and population on maize (Zea mays L.) grain yield. M.S. Thesis.
57. Bushong, Jacob. 2014. I. Utilizing soil moisture data with optical sensors to determine nitrogen fertilizer recommendations in winter wheat, II. Alternative nitrogen fertilization strategies for maize in a water limited environment. PhD. Dissertation.
58. Miller, Eric, 2014. I. Nitrogen and water use efficiency as influenced by maize hybrid and irrigation, II. Predicting pre-plant nitrogen applications to maize using indicator crop N-rich reference strips. Ph.D Dissertation.
59. Macnack, Natasha. Effect of Fertilizer Nitrogen (N) on Soil Organic Carbon, Total N and Soil pH in Long-Term Continuous Winter Wheat. 2014. PhD. Dissertation.
60. Mullock, Jeremiah. 2015. I. Effect of preplant nitrogen distance from corn rows on grain yield and nitrogen uptake. II. Development of a winter wheat sensor-based nitrogen rate algorithm for Kansas and Oklahoma. PhD. Dissertation.
61. Aula, Lawrence, 2015. Effect of Fertilizer Nitrogen (N) on Soil Organic Carbon, Total N and Soil pH in Long-Term Continuous Winter Wheat M.S. Thesis.
62. Dhillon, Jagmandeep. 2016. Evaluation of Drum Cavity Size and Planter Tip on Singulation and Plant Emergence in Maize (Zea mays L.). M.S. Thesis.
63. Driver, Ethan. 2016. M.S. Thesis. Optimum Preplant Nitrogen rates in Winter Wheat (Triticum aestivum L.) and Maize (Zea mays L). M.S. Thesis.
64. Ramos Del Corso, Mariana. 2016. I. Soil Organic Carbon (SOC), Total Nitrogen (TN), and Soil pH, in long term Continuos Winter Wheat (Triticum Aestivum L.) Experiment. II. Evaluation of Foliar UAN and Timing on Grain Yield and Nitrogen Concentration in Winter Wheat (Triticum aestivum L.). M.S. Thesis.
65. Figueiredo, Bruno. 2016. Effect of Micronutrient Fertilizer on Winter Wheat Grain Yield. M.S. Thesis.
66. Schlobohm, Ryan. 2016. Evaluation of mid-season UAN Application Depth in Winter Wheat. M.S. Thesis.
67. Golden, Melissa. 2016. Mid-Season Prediction of Wheat Grain Yield Potential and Nitrogen Response. M.S. Thesis.
68. Remondet, Nicole. 2016. Seasonal Changes in Estimated Nitrogen Response in Winter Wheat (Triticum aestivum L.). M.S. Thesis.
69. Alideki, Daniel. 2016. Influence of Tillage and Side-dress Nitrogen on Maize (Zea Mays L.) plant stand and Grain yield using the Greenseeder Hand Planter with altered drum cavity sizes. M.S. Thesis.
70. Dhital, Sulochana. 2016. I. Variability in Optimum Nitrogen Rates for Maize. PhD. Dissertation, II. Effect of Preplant/Early Irrigation, Nitrogen and Population Rate on Winter Wheat Grain Yield. PhD Dissertation.
71. Wehmeyer, Gwen. 2017. Optimum Preplant Nitrogen Rate in Maize (Zea mays L.) and Sorghum (Sorghum bicolor L.). M.S. Thesis.
72. Nambi, Eva. Effect of Plant Spacing and Seeding Density on Sorghum (Sorghum bicolor L) Grain Yields Using the OSU Hand Planter. 2017. M.S. Thesis.
73. Oyebiyi, Fikayo. 2017. Maize (Zea mays L.) Grain Yield Response to Method of Nitrogen Fertilization with Indigenous and Precision Planters. M.S. Thesis.
74. Fornah, Alimamy. 2018. Effect of Row Spacing, Plant Density, Nitrogen Rate, and Planting Method on Maize (Zea mays L.) Grain Yield. PhD Dissertation.
75. Lemings, Robert, 2018. Optimum Time and Rate of Fertilizer Nitrogen for Winter Wheat (Triticum aestivum L) and Maize (Zea mays L.) Grain Yield. M.S. Thesis.
76. Eickhoff, Elizabeth. 2018. Effect of Applying Nitrogen with Sorghum Seed (Sorghum bicolor) on Emergence and Final Grain Yield. M.S. Thesis.
77. Figueiredo, Bruno. 2019. I. Applied Use of Climatological Data to Refine Optimum Times for Nitrogen Stress Sensing in Winter Wheat (Triticum aestivum L). II. Value of composite NDVI and Growing Degree Day Data in Oklahoma, 1992 to 2017. PhD Dissertation.
78. Lynch, Tyler. 2019. Effect of Residual Nitrogen in Winter Wheat Following a Simulated Failed Summer Crop. M.S. Thesis.
79. Davidson, Dillon, 2019, Effect of Different Methods and Timing of Nitrogen Application on Sorghum (Sorghum Bicolor L) Grain Yield. M.S. Thesis.
80. Ray, Toyosha, 2019. Impact of Plant Population/Reduced Stands on Maize (Zea mays L.) Grain Yields Using the OSU Hand Planter. M.S. Thesis.
81. Dhillon, Jagmandeep, 2019. Influence of Method, Timing, and Nitrogen Rate on Winter Wheat (Triticum aestivum L.) Grain Yield and Estimated Plant Nitrogen Loss. PhD. Dissertation.
82. Wehmeyer, Gwen, 2020, I. Optimum Sulfur Application for Soybean (Glycine max) in Oklahoma, II. Influence of Preplant and Topdress Nitrogen on Winter Wheat (Triticum aestivum L.) Grain Yield. PhD Dissertation.
83. Peter Omara, 2020, PhD
84. Eva Nambi. 2021, PhD
85. Fikayo Oyebiyi, 2021, PhD
86. Lawrence Aula, 2021, PhD
87. Elizabeth Eickhoff, 2021, PhD
88. Tyler Carpenter, 2021, MS
89. Austin Benzing, 2021, MS

**MAJOR ADVISOR, GRADUATE DEGREE PROGRAMS, 1991-present**

Name Country Degree Completion Date

1. Attefat, Mehdi Iraq M.S 1992
2. Ascencio, Edgar Noel. El Salvador M.S. 1992
3. Sembiring, Hasil. Indonesia M.S. 1993
4. Jojola, Michael E. USA M.S. 1994
5. Ascencio, Edgar Noel. El Salvador Ph.D. 1995
6. Kanampiu, Fred Kenya Ph.D. 1995
7. Gavi-Reyes, Francisco Mexico Ph.D. 1995
8. Ball, Jeff B. USA M.S. 1995
9. Phillips, Steven B. USA M.S. 1995
10. Taylor, Shannon L. USA M.S. 1996 \*\*
11. Chen, Jing China M.S. 1997
12. Keahey, Dale, Alan. USA M.S. 1997
13. Lees, Heather, L. USA M.S. 1997 \*\*
14. Sembiring, Hasil Indonesia Ph.D. 1997 \*\*\*
15. Thomason, Wade USA M.S. 1998
16. Lukina, Erna V. Uzbekistan M.S. 1998
17. LaRuffa, Joanne M. USA M.S. 1999 \*\*
18. Phillips, Steven B. USA Ph.D. 1999 \*\*\*
19. Dennis, Jeremy USA M.S. 1999
20. DeLeon, Micah Argentina M.S. 1999
21. Cossey, Doug USA M.S. 1999
22. Woolfolk, Curt USA M.S. 1999
23. Mullen, R.W. USA M.S. 2001 \*\*
24. Lukina, Erna, V. Uzbekistan Ph.D. 2001 \*\*\*
25. Thomason, Wade USA Ph.D. 2001 \*\*\*
26. Wynn, Kathie J. USA M.S. 2001
27. Freeman, Kyle W. USA M.S. 2002 \*\*
28. Teal, Roger USA M.S. 2002
29. Moges, Shambel Ethiopia M.S. 2002
30. Mullen, R.W. USA Ph.D. 2003 \*\*\* **†**
31. Humphreys, M. USA M.S. 2003
32. Hodgen, Paul USA M.S. 2003
33. Lawles, Jason USA M.S. 2004
34. Mosali, Jagadeesh India Ph.D. 2004
35. Brixey, Keri USA M.S. 2004
36. Arnall, Brian USA M.S. 2004
37. Girma, Kefyalew Ethiopia Ph.D. 2004 \*\*\*
38. Martin, Kent USA M.S. 2005 \*\*
39. Freeman, Kyle W. USA Ph.D. 2005 \*\*\*
40. Teal, Roger USA Ph.D. 2005 β
41. Moges, Shambel Ethiopia Ph.D. 2005
42. Mack, Clinton USA M.S. 2007
43. Lawles, Kyle USA M.S. 2007
44. Byungkyun, Chung Korea Ph.D. 2007
45. Tubana, Brenda Philippines Ph.D. 2007 β \*\*\*
46. Holtz, Starr USA M.S. 2007 \*\*
47. Walsh, Olga Russia M.S. 2007
48. Dotson, Clint USA M.S. 2007
49. Arnall, Brian USA Ph.D. 2008 \*\*\*
50. Turner, Pam USA M.S. 2008
51. Edmonds, Daniel USA M.S. 2008 \*\*£
52. England, Brandon USA M.S. 2008
53. Daft, Cody USA M.S. 2008
54. Walsh, Olga Russia Ph.D. 2009 \*\*\*
55. Desta, Birehane Ethiopia M.S. 2009
56. Kanke, Yumiko Japan M.S. 2009 Σ € \*\*
57. Vossenkemper, Jacob USA M.S. 2010
58. Torres, Guilherme Brazil M.S. 2010 \*\*
59. Waldschmidt, Kevin USA M.S. 2011
60. Kelly, Jonathan USA M.S. 2011 \*\*
61. Rutto, Emily Kenya Ph.D. 2011 \*\*\*€
62. Mohammed, Yesuf Ethiopia Ph.D. 2012
63. Macnack, Natasha Suriname M.S. 2012
64. Crain, Jared USA M.S. 2012
65. Chim, Bee Malaysia M.S. 2012 \*\*
66. Mullock, Jeremiah USA M.S. 2012
67. Torres, Guilherme Brazil Ph.D. 2013 \*\*\*
68. Wyatt, Ethan USA M.S. 2013
69. Dhital, Sulochana Nepal M.S. 2013
70. Omara, Peter Uganda M.S. 2013
71. Bushong, Jake USA Ph.D. 2014 \*\*\*
72. Miller, Eric USA Ph.D. 2014
73. Macnack, Natasha Suriname Ph.D. 2014 β
74. Aula, Lawrence Uganda M.S. 2014
75. Mullock, Jeremiah USA Ph.D. 2015
76. Dhillon, Jagmandeep India M.S. 2016
77. Driver, Ethan USA M.S. 2016
78. Ramos Del Corso, M. Brazil M.S. 2016
79. Figueiredo, Bruno Brazil M.S. 2016
80. Schlobohm, Ryan USA M.S. 2016
81. Golden, Melissa USA M.S. 2016
82. Remondet, Nicole USA M.S. 2016
83. Alideki, Daniel Uganda M.S. 2016
84. Dhital, Sulochana Nepal Ph.D. 2016 \*\*\*
85. Weymeyer, Gwen USA M.S. 2017
86. Nambi, Eva Uganda M.S. 2017
87. Oyebiyi, Fikayo Nigeria M.S. 2017
88. Fornah, Alimamy Sierra Leone Ph.D. 2018 ∞
89. Lemings, Robert USA M.S. 2018
90. Eickhoff, Elizabeth USA M.S. 2018 \*\*
91. Tyler Lynch USA M.S. 2019
92. Davidson, Dillon USA M.S. 2019
93. Figueiredo, Bruno Brazil Ph.D. 2019
94. Ray, Toyosha USA M.S. 2019
95. Dhillon, Jagmandeep India Ph.D. 2019 \*\*\*
96. Wehmeyer, Gwen USA Ph.D. 2020 ‡
97. Eickhoff, Elizabeth USA Ph.D. 2020 ‡
98. Omara, Peter Uganda Ph.D 2020 ‡
99. Oyebiyi, Fikayo Nigeria Ph.D. 2020 ‡
100. Aula, Lawrence Uganda Ph.D. 2020 ‡
101. Nambi, Eva Uganda Ph.D. 2020 ‡
102. Carpenter, Tyler USA M.S. 2021 ‡
103. Benzing, Austin USA M.S. 2021 ‡

\*\* Outstanding M.S. student, Department of Plant and Soil Sciences

\*\*\* Outstanding Ph.D. student, Department of Plant and Soil Sciences  
£ Phoenix award winner, Outstanding M.S. Student, Oklahoma State University  
β Williams Outstanding Ph.D Thesis Award Recipient  
Σ Williams Distinguished Fellowship Recipient  
€ Graduate College Research Fellowship Recipient

∞ Outstanding PhD Student, Presidents Leadership Recognition

‡ Current graduate student

**†** 2004 Emil Truog, SSSA Recipient (outstanding SOILS Ph.D student international, SSSA)

Research Thesis (M.S.) and/or Dissertation (Ph.D) required for all degrees.

Since 1992, 50% of the students receiving the outstanding M.S. and/or Ph.D student award in the Department of Plant and Soil Sciences have come from the soil fertility project.

**PROFESSIONAL INVITATIONS**

1. ASA-SSSA-CSSA meetings, San Antonio, TX, November 13, 2019. Symposium speaker, Unpredictable Nature of Environment on Nitrogen Supply and Demand.
2. Precision Ag System Community Symposium 2018, Baltimore, MD. A case study for Precision Agriculture, Achieving Sustainable Goals.
3. History of the NUE Conference, July 31, 2018. Manhattan, KS.
4. National Academy of Sciences, Science Breakthrough Initiative, October 2-4, 2017, Irvine, CA.
5. Opportunities for Sensor Based Nitrogen Management in Cereals, August 7, 2017, Baton Rouge, Louisiana. Invited
6. Global Horticulture Conference, Stillwater, OK, November 17, 2016. Invited speaker, Global Implications of the OSU Greenseeder Hand Planter.
7. ASA-SSSA-CSSA meetings, Phoenix, AZ, November 8, 2016. Invited speaker, Leo M Walsh Soil Fertility Distinguished Lectureship.
8. Workshop on Long-Term Nutrient Management Studies. March 2, 2016, Denver, CO.
9. New Age Hand Planter for the Developing World. OSU Soil Biology Symposium, December 5, 2015, Stillwater, OK
10. Value of the “Nitrogen Cycle Ninja” exercise, 1996-present, February 6, 2015. Growmark, Bloomington, Indiana
11. Agronomy in the Context of Conservation Agriculture: Nutrient Management. Beyond Diagnostics: Insights and Recommendations for Remote Sensing Workshop; Mexico City, Mexico, December 16, 2013, Bill and Melinda Gates Foundation. Presentation delivered by Eric Miller.
12. InfoAG conference, Springfield Illinois, July 16, 2013. PrecisionAg Award of Excellence, Legacy Award, Speaker.
13. FertBio Conference, Maceio Brazil, September 17-21, 2012. Keynote Speaker.
14. NeATA Conference, Grand Island, NE, February 9-10, 2011.
15. 10th Annual International Precision Agriculture Conference, Denver, CO, July 18-21, 2010. Keynote Speaker, Opening Plenary Session.
16. ASA-SSSA-CSSA meetings, Pittsburgh, PA, Nov 4, 2009. Invited speaker, “Strategies for improving nutrient use efficiency in corn and small grains.”
17. ASA-SSSA-CSSA meetings, New Orleans, LA, Nov 3, 2007. Invited speaker, “Nitrogen Management for Wheat and Corn, What you Shouldn't Do.
18. ASA-SSSA-CSSA meetings, Indianapolis, IN, Nov 4, 2006. Invited speaker,
19. ASA-SSSA-CSSA meetings, Salt Lake City, UT, Nov 6-10, 2005. Invited speaker “What New Equipment Is Available to Improve N-Use Efficiency?”
20. 7th International Wheat Conference, Mar de Plata, Argentina, November 27-December 2, 2005. K.W. Freeman and W.R. Raun. Advances in nitrogen handling strategies to increase the productivity of wheat
21. AAPRESID Rosario, Argentina, August 10-13, 2004. Invited speaker “Aumentando la eficiencia del uso de nitrogeno en cereales.
22. ASA-SSSA-CSSA meetings, Denver, CO, Nov 2-6, 2003. Invited symposium speaker '’Variable Nitrogen Management of Field Crops.’
23. Great Plains Soil Fertility Workshop, Denver, CO, March 7-8, 2000. Invited symposium speaker ‘In-season fertilizer nitrogen application based on predicted yield potential.’
24. ASA-SSSA-CSSA meetings, Salt Lake City, Utah, October 31-November 4, 1999. Invited symposium speaker 'Implementing Diagnostic Tools for Nitrogen.
25. Intensive Wheat Management Conference, March 4-5, 1998, Denver, Colorado. Invited symposium speaker, 'Sensor based nutrient management.'
26. 5th International Symposium on Soil & Plant Analysis, August 2-7, 1997, Bloomington, Minnesota. Invited symposium speaker, Testing for the future: New Technologies.
27. The American Society for Horticultural Science (ASHS), July 23-26, 1997, Salt Lake City, Utah. Invited symposium speaker, ‘Soil-plant inorganic N buffering and indirect measures of nutrient analyses.’
28. CIMMYT, Ciudad Obregon, Mexico, February 9-12, 1997. Cooperation with Dr. Ken Sayre on methods to improve N-use efficiency in wheat using estimated plant N loss and spectral radiance measurements.
29. KSU/Farmland Industries Crop Production Update, Manhattan, Kansas. Invited speaker in 1994, 1995 and 1996 to discuss ‘Soil-plant inorganic N buffering,’ ‘Use of foliar fertilizers for cheat control in winter wheat,’ and ‘Applications of sensor-based technologies for detecting nutrient deficiencies.’
30. ASA-SSSA-CSSA meetings, Indianapolis, IN, November 1996. Invited symposium speaker ‘Enhancing soil testing and recommendations to meet the future.’
31. Great Plains Soil Fertility Workshop, Denver, CO, March, 1996. Symposium speaker ‘Use of spectral radiance for detecting in-season N deficiencies in winter wheat.’
32. ASA-SSSA-CSSA meetings, Cincinnati, OH, November, 1993. Invited symposium speaker, ‘Methods of improving research plot uniformity in long-term experiments.’
33. Andean Region Agriculture, Caracas, Venezuela, December, 1990. Symposium speaker, ‘Improved methods of phosphorus placement in volcanic ash soils.’
34. PCCMCA, San Salvador, El Salvador, March, 1990. Invited symposium speaker, ‘Applications of experimental designs in field experiments.’
35. CIAT, Cali, Colombia, January, 1989. Invited to participate in the strategic planning of ‘Agronomic Research in the IARC’s.
36. PCCMCA, San Pedro Sula, Honduras, March, 1989. Invited symposium speaker, ‘Legume Interseeding in Maize production
37. PCCMCA, San Jose, Costa Rica, March 1988. Invited symposium speaker, ‘Use of zero-tillage in the tropics and adverse impacts of burning.’

**CIMMYT RESEARCH PAPERS**

1. Raun, W. R., and K. D. Sayre. 1986. Use of line-source experiments for wheat genotype screening and yield stability analysis. CIMMYT Wheat Program, Mexico D.F.
2. Raun, W. R., and K. D. Sayre. 1986. Interplot competition; bias in observed grain yield as affected by different neighboring wheat and triticale genotypes. CIMMYT Wheat Program, Mexico D.F.
3. Sayre, K. D., and W. R. Raun. 1986. Evaluation of irrigation timing, and nitrogen rate on the effects of yellow berry in 38 different durum wheat genotypes. CIMMYT Wheat Program, Mexico D.F.
4. Sayre, K. D., and W. R. Raun. 1986. Yield trial of selected bread wheat, durum wheat, triticale and barley genotypes under salt stress. CIMMYT Wheat Program, Mexico D.F.
5. Sayre, K. D., and W. R. Raun. 1986. Durum wheat salt tolerance, Guaymas, Mexico. CIMMYT Wheat Program, Mexico. D.F.
6. Wall, P. C., P. Hobbs, D. A. Saunders, M. A. McMahon, W. R. Raun and R. L. Westerman. 1986. Integrated cultural and chemical control of *Avena fatua* and *Phalaris minor* in spring wheat. CIMMYT Wheat Program, Mexico. D.F.
7. Proyectos Colaborativos en Agronomía, Desarrollo y Mejoramiento de Germoplasma en Maíz. 1989. CIMMYT, Guatemala City, Guatemala.
8. Análisis de los Ensayos Regionales de Agronomía. 1990. Programa Regional de Maíz Para Centro América, Panamá y El Caribe. CIMMYT, Guatemala City, Guatemala.
9. Análisis de los Ensayos Regionales de Agronomía. 1991. Programa Regional de Maíz Para Centro América, Panamá y El Caribe. CIMMYT, Guatemala City, Guatemala.

**POPULAR PRESS and DEPARTMENTAL PUBLICATIONS**

1. Boman, R.K., J.J. Sloan, R.L. Westerman, W.R. Raun and G.V. Johnson. 1992. Using phosphorus fertilizers to maintain wheat forage and grain yields on acid soils. Better Crops. 76:(4) 16-19.
2. Raun, W.R. and E.N. Ascencio. 1992. Azufre: Estas considerando este elemento en su regimen de fertilización?. (technical brochure in Spanish for the Sulphur Institute, Washington D.C.)
3. Westerman, R.L. 1992. Soil Fertility Research Highlights, Efficient Use of Fertilizers. Okla. Agric. Exp. Sta., Agronomy 92-1. 223 pages.
4. Horn, G.W., W.R. Raun, G.A. Highfill, C. Bown and R.K. Boman. 1993. Evaluation of bloat potential of cattle as affected by N and K fertilization in continuous winter wheat. Animal Science Research Report, Oklahoma State University.
5. Johnson, G.V. (ed). 1993. Oklahoma soil fertility handbook. Prepared 2½ chapters included in this 8 chapter volume. Also assisted in compiling and editing the handbook.
6. Raun, W.R., R.K. Boman, S.L. Taylor, R.L. Westerman, G.V. Johnson and E.A. Guertal. 1993. Soil Fertility Research Highlights. Okla. Agric. Exp. Sta., Agronomy 93-1. 266 pages.
7. Johnson, G.V., and W.R. Raun. 1994. Oklahoma soil fertility research, applications for nutrient management and the environment, 1989-1993. Okla. Agric. Exp. Sta., Agronomy 94-2. 50 pages.
8. Boman, R.K., S.L. Taylor, W.R. Raun, G.V. Johnson, D.J. Bernardo and L.L. Singleton. 1996. The Magruder plots, a century of wheat research in Oklahoma. Okla. Agric. Exp. Sta., Agronomy 96-1. 69 pages.
9. Raun, W.R., J.B. Solie, G.V. Johnson, M.L. Stone, R.W. Whitney, H.L. Lees, H. Sembiring and S.L. Taylor. 1997. Small scale variation in soil test phosphorus and bermudagrass yield. Better Crops. 81:(1) 14-16.
10. Stone, M.L., W.R. Raun, G.V. Johnson, J.B. Solie, R.W. Whitney, H. Sembiring, J.M. LaRuffa and E.V. Lukina. 1997. Sensing nitrogen deficiencies in winter wheat and bermudagrass. Better Crops. 81:(4) 15-16.
11. Sembiring, H., J.M. LaRuffa, S.B. Phillips, E.V. Lukina, W.E. Thomason, J. Chen, H.L. Lees, D.A. Keahey, J.L. Dennis, D.A. Cossey, M.W. Goedeken, S.L. Norton, B.M. Howell, M.J. DeLeon, S.L.Taylor, J.B. Solie, M.L. Stone, R.W. Whitney, N.T. Basta, J.A. Hattey, H. Zhang, R.L. Westerman, G.V. Johnson and W.R. Raun. 1997. Soil Fertility Research Highlights. Okla. Agric. Exp. Sta., 364 pages.
12. Goedeken, Mick, Gordon Johnson and Bill Raun. 1998. Expectations of precision phosphate management. Better Crops. 82:(1) 28-31.
13. Zhang, Hailin, Gordon Johnson, Bill Raun, Nick Basta and Jeff Hattey. 1998. OSU Soil Test Interpretations. F-2225. Okla. Coop. Ext. Serv. Okla. State Univ. Stillwater, OK.
14. Basta, N.T., W.R. Raun and F. Gavi. 1998. Wheat grain cadmium under long-term fertilization and continuous winter wheat production. Better Crops. 82:(2) 14-15.
15. Raun, W.R., G.V. Johnson, M.L. Stone, J.B. Solie, W.E. Thomason, and E.V. Lukina. 1999. In-season prediction of yield potential in winter wheat. Better Crops. 83:(2) 24-25.
16. LaRuffa, J.M., G.V. Johnson, S.B. Phillips and W.R. Raun. 1999. Sulfur and chloride response in Oklahoma winter wheat. Better Crops: 83(4):28-30.
17. Mullen, R.W., G.V. Johnson, J.F. Stritzke, J.L. Caddel, S.B. Phillips and W.R. Raun. 2000. Alfalfa yield response to method and rate of applied phosphorus. Better Crops: 84(3):18-23.
18. Lukina, E.V., K.W. Freeman, R.W. Mullen, K.J. Wynn, W.E. Thomason, Roger Teal, Jagadeesh Mosali, Tao Feng, D.E. Needham, C.N. Washmon, J.B. Solie, M.L. Stone, N.T. Basta, J.A. Hattey, H. Zhang, S. Deng, J.M. Shaver, R.L. Westerman, G.V. Johnson and W.R. Raun. 2000. Soil Fertility Research Highlights. Okla. Agric. Exp. Sta., 342 pages.
19. Mullen, R.W., G.V. Johnson, J.F. Stritzke, J.L. Caddel, S.B. Phillips and W.R. Raun. 2001. Alfalfa responds to high P rates, P banding. Fluid Journal. Winter, 9-11.
20. Mullen, R.W., K.W. Freeman, G.V. Johnson, and W.R. Raun. 2001. The Magruder plots, long-term wheat fertility research. Better Crops: 85(4):6-8.
21. Mullen, R.W., W.R. Raun, and G.V. Johnson. 2003. Sensor-based N management strategy. Fluid Journal 11(3):12-13.
22. Johnson, Gordon, and Bill Raun. 2003. Sensor-based N management. In Southern Plant Nutrition Management Conference, Rasnake, M. (ed.). Olive Branch, Mississippi, Oct 7-8. Samuel Roberts Noble Foundation.
23. Raun, W.R., G.V. Johnson, J.B Solie, M.L. Stone, K.L. Martin, and K.W. Freeman. 2004. In-Season Fertilizer N Rates using Predicted Yield Potential and the Response Index. Better Crops 88(2): 8-11.
24. Zhang, H., and W.R. Raun. 2004. Chloride and Sulfate Status in Oklahoma Soils. Southern Plant Nutrition Management Conference Proceedings. October 5-6. Olive Branch, MS.
25. Melchiori, Ricardo, Octavio Caviglia, Augustin Bianchini, Nelson Faccendini, y William Raun. 2005. Utilizacion de sensors remotos para fertilizacion nitrogenada en maiz. Simposio de Fertilidad en Rosario, PPI, Rosario, Argentina.
26. Raun, W.R., G. Johnson, S. Phillips, W. Thomason, J. Dennos, and D. Cossey. 2006. Late-season applied N can increase alfalfa yields. Fluid Journal. 14 (2): 20-23.
27. Girma, K., B. Raun, H. Zhang, and J. Mosali. 2006. What about foliar P on corn and winter wheat? Fluid Journal. 14(3):17-19.
28. Raun, W.R., and R.W. Mullen. 2008. Long-term field experiments around the world, special supplement to celebrate 100 years of agronomy journal. 2008 Calendar, American Society of Agronomy.
29. Edmonds, D.E., M.C. Daft, W.R. Raun, J.B. Solie, and R.K. Taylor. 2008. Determining mid-season nitrogen rates with ramp calibration strip technology. Better Crops. 92:16-18.
30. Walsh, Olga, Yumiko Kanke, Daniel Edmonds and Bill Raun. 2009. Improving mid-season nitrogen recommendations for winter wheat using soil moisture data. Better Crops. 93:26-27.
31. Borlaug, Norman, Christopher Dowswell, Bill Raun, and Ed Runge. 2009. A generational recommitment to abolishing world hunger. CSA News, April, 54:21-22.
32. Desta, Birehane, Brian Arnall, and Bill Raun. 2009. The evolution of reference strips in Oklahoma. Okla. Coop. Ext. Service. PSS-2558.
33. Torres, Guilherme, Brian Arnall and Bill Raun. 2009. Effect of weather conditions on yields at Lahoma, Oklahoma. Current Report CR-2176. Okla. Coop. Ext. Serv., Stillwater, OK.
34. Raun, Bill, John Solie, Jerry May, Hailin Zhang, Jonathan Kelly, Randy Taylor, Brian Arnall, and Ivan Ortiz-Monasterio. 2010. Nitrogen Rich Strips for wheat, corn, and other crops. E-1022. Oklahoma State University, Stillwater, OK.
35. Arnall, Brian, Bill Raun. 2013. Impact of sensor based nitrogen management on yield and soil quality. Current Report. Okla. Coop. Ext. Serv. CR2270.
36. Taylor, Randy, Bill Raun, Nyle Wollenhaupt, Eric Lam, and Edgar Ascencio. 2014. The Greenseeder, User Manual. Okla. State Univ.

**RESEARCH BULLETINS**

1. Olson, R. A., W. R. Raun and G. J. Teichmeier. 1984. High yield corn-soybeans-wheat rotation study. Soil Science Research Report, University of Nebraska. pp. 18.1-18.2
2. Raun, W. R., D. H. Sander and R. A. Olson. 1984. Response of irrigated corn yields to nitrogen sources applied with a urease inhibitor. Soil Science Research Report, University of Nebraska. pp. 10.1-10.3.
3. Raun, W. R., D. H. Sander and R. A. Olson. 1984. Pressure injection of UAN for irrigated corn. Soil Science Research Report, University of Nebraska. pp. 7.1-7.6.
4. Raun, W. R., R. A. Olson and D. H. Sander. 1984. Emergence of corn as affected by source and rate of solution fertilizers applied with the seed. Soil Science Research Report, University of Nebraska. pp. 21.1-21.4.
5. Allen, E.A., G.V. Johnson and W.R. Raun. 1992. Banding phosphate in wheat: a temporary alternative to liming. Fertilizer Checks. Agron. Dept., Oklahoma State University.
6. Johnson, G.V., W.R. Raun and E.A. Allen. 1992. Fertilizer use and nitrates in groundwater. Fertilizer Checks. Agron. Dept., Oklahoma State University.
7. Raun, W.R., G.V. Johnson, R.K. Boman and E.R. Allen. 1992. Accumulation of ammonium and nitrate in soils cropped to continuous winter wheat. Fertilizer Checks. Agron. Dept., Oklahoma State University.
8. Johnson, G.V., and W.R. Raun. 1994. Nitrogen fertilizers for Oklahoma (facts and myths). Okla. Coop. Extension. Serv. L-245.
9. Raun, W.R and G.V. Johnson. 1994. Use of urea in winter wheat, forage and pasture production systems. Okla. Coop. Extension Serv. L-244.
10. Johnson, G.V., W.R. Raun and S.L. Taylor. 1996. Oklahoma fertilizer checkoff, research in fertilizer use and efficiency and environmental protection. Okla. Coop. Extension Serv. L-262.
11. Johnson, G.V., W.R. Raun, M.L. Stone, J.B. Solie and R.W. Whitney. 1996. Sensor-based variable rate technology in Oklahoma. Okla. Coop. Extension Serv. L-279.
12. Stone, Marvin, John Solie, Richard Whitney, Bill Raun and Gordon Johnson. 1996. Sensor-based-precision-agriculture at OSU. Okla. Coop. Extension Serv. PT 96-10.
13. Johnson, G.V., and W.R. Raun. 1996. Long-tern winter wheat grain yield trends. Okla. Coop. Extension Serv. PT 96-12.
14. LaRuffa, J.M., W.R. Raun and G.V. Johnson. 1997. Analysis of rainfall patterns in Oklahoma. Okla. Coop. Extension Serv. PT 97-30.
15. LaRuffa, J.M., B. Woods, G.V. Johnson and W.R. Raun. 1997. Effect of nitrogen fertilizer source on bermudagrass yield. Okla. Coop. Extension Serv. PT 97-40.
16. Johnson, G.V., N.T. Basta, H.A. Zhang, J.A. Hattey and J.H. Stiegler. 1998. Science-based animal waste phosphorus management for Oklahoma. Okla. Coop. Extension Serv. PT 98-1.
17. LaRuffa, J.M., G.V. Johnson, S.B. Phillips and W.R. Raun. 1999. Sulfur and chloride response in Oklahoma winter wheat. Okla. Coop. Extension Serv. PT 99-09.
18. Johnson, G.V., N.T. Basta and W.R. Raun. 2000. Soil Quality Indicators: A Chemical Perspective. Okla. Coop. Extension Serv. PT 2000-12.
19. Teal, R.K., S.L. Osborne, G.V. Johnson and W.R. Raun. 2001. Application of nitrogen fertilizer on bermudagrass. Okla. Coop. Extension Serv. PT 2001-12.
20. Johnson, G.V., and W.R. Raun. 2001. Using a response index to improve nitrogen management for winter wheat. PT 2001-18.
21. Johnson, G.V., W.R. Raun, J.B. Solie, and M.L. Stone. 2003. Developing and using nitrogen-rich strips. PT-2003-7.
22. Johnson, G.V., W.R. Raun, J. Solie, and M. Stone. 2002. A new fertilizer management strategy:nitrogen-rich field strips and variable rate application. PT 2002-19.
23. Johnson, G.V., W.R. Raun, J. Solie, and M. Stone. 2002. Managing nitrogen fertilizer using a nitrogen rich strip: projected profitability. PT 2002-21.
24. Johnson, G.V., and W.R. Raun. 2003. Soil nutrient chemistry and wheat yields: A 110-year study. PT 2003-8.
25. Arnall, D.B., W.R. Raun, G.V. Johnson, and K.L.Martin. 2003. Conditions Leading to Outstanding Yields at Lahoma, Oklahoma. PT 2003-15.
26. Girma, Kefyalew, Hailin Zhang, and Bill Raun 2005. Do Nitrogen Fertilizer Sources and the Timing of Application Affect Winter Wheat Yields and Profit? PT 2005-9.
27. Sheffield, Jessica, Bill Raun, John Solie, Marvin Stone, and Hailin Zhang. 2006. Are you spending too much on nitrogen fertilizer? PT 2006-4.

**PROCEEDINGS**

1. Raun, W. R., P. N. Fox and P. A. Burnett. 1990. Preliminary comparisons of barley yellow dwarf scores on CIMMYT nurseries in contrasting environments using nonparametric correlations. In Burnett, P.A., ed. World Perspectives on Barley Yellow Dwarf. CIMMYT, Mexico, D.F., Mexico.
2. Boman, R.K., W.R. Raun, R.B. Westerman, J.V. Altom, D.S. Murray, and J.C. Banks. 1994. Effect of nitrogen source and method of placement on cotton produced under varying weed management intensities. p. 1555-1558. In D.J. Herber and D.A. Richter (eds.) Proc. Beltwide Cotton Prod. Res. Conf., San Diego, CA. 5-8 January. Natl. Cotton Council, Memphis, TN.
3. Johnson. G.V., and W.R. Raun. 1994. Use of subsoil NO3-N as an index for environmentally safe N management in continuous winter wheat. In J.L. Havlin (ed.) Proc. Great Plains Soil Fertility Conference. 5:127-130.
4. Raun, W.R., G.V. Johnson, R.K. Boman, S.L. Taylor, M.E. Jojola and R.L. Westerman. 1994. Estimation of inorganic nitrogen buffering capacity in soils. In J.L. Havlin (ed.) Proc. Great Plains Soil Fertility Conference. 5:42-46.
5. Barreto, H. J. and W. R. Raun. 1994. Probability of economic maize yield response to sulfur fertilization in Central America. In Proc. 15th International Congress of Soil Science, Acapulco, Mexico, Vol. 5A:326-332.
6. Westfall, D.G., W.R. Raun, J.L. Havlin, G.V. Johnson, J.E. Matocha and F.M. Hons. 1994. Fertilizer management. p. 33-36. In B.A. Stewart and W.C. Moldenhauer (ed.) Crop residue management to reduce erosion and improve soil quality. United States Dep. of Agric. Conservation Research Report Number 37, Washington, DC.
7. Boman, R.K., W.R. Raun, R.L. Westerman and J.C. Banks. 1995. Nitrogen by environment interactions in long-term cotton production. In Proc. Beltwide Cotton Prod. Res. Conf., San Antonio, TX. 3-6 January. Natl. Cotton Council, Memphis, TN. Vol 2:1300-1303.
8. Raun, W.R., M.L. Stone, J.B. Solie, S.L. Taylor, S.B. Phillips and G.V. Johnson. 1996. Use of spectral radiance for detecting in-season N deficiencies in winter wheat. In J.L. Havlin (ed.) Proc. Great Plains Soil Fertility Conference. 6:8-13.
9. Rogers, G.L., W. Altom, W.R. Raun, G.V. Johnson and S.L. Taylor. 1996. Long-term rye-wheat-ryegrass forage yields as affected by rate and date of applied N. *In* J.L. Havlin (ed.) Proc. Great Plains Soil Fertility Conference. 6:61-66.
10. Phillips, S.B., G.V. Johnson and W.R. Raun. 1996. Alfalfa yield response to method and rate of applied P and weed intensity. *In* J.L. Havlin (ed.) Proc. Great Plains Soil Fertility Conference. 6:57-60.
11. Raun, W.R., G.V. Johnson, J.B. Solie, M.L. Stone, R.W. Whitney, H. Sembiring, H.L. Lees and S.L. Taylor. 1996. Potential replacement for traditional soil test calibration: sensor based plant analysis. In S.M. Combs (ed.) Enhancing soil testing and recommendations to meet the future. p. 27-32. ASA, annual meetings, Indianapolis IN.
12. Raun, W.R., G.V. Johnson, H. Sembiring, E.V. Lukina, J.M. LaRuffa, W.E. Thomason, S.B. Phillips, J.B. Solie, M.L. Stone and R.W. Whitney. 1997. Indirect measures of plant nutrients. p. 146-155. *In* Ann Wolf (ed.) International Soil and Plant Analysis Symposium. Proc. Minneapolis, MN, Aug 2-7, 1997. Soil and Plant Analysis Council, Athens, GA.
13. Basta, N.T., W.R. Raun and F. Gavi. 1998. Wheat grain cadmium as affected by long-term fetilization and soil acidity. *In* Alan J. Schlegel (ed.) Proc. Great Plains Soil Fertility Conference. 7:1-6.
14. Phillips, S.B., J. Chen, W.R. Raun, G.V. Johnson, D.A. Cossey, D.S. Murray and R.B. Westerman. 1998. Winter wheat and cheat response to foliar nitrogen applications. *In* Alan J. Schlegel (ed.) Proc. Great Plains Soil Fertility Conference. 7:89-94.
15. Raun, W.R., G.V. Johnson, J.B. Solie, M.L. Stone, S.B. Phillips, J.L. Dennis, D.A. Cossey, J.M. LaRuffa, W.E. Thomason, E.V. Lukina, M.J. DeLeon, J.L. Rogers and W. Altom. 1998. Sensor based nutrient management. *In* Proc. Intensive Wheat Management Conference, Potash & Phosphate Institute. 1:18-24.
16. Caddel, J.L., G.V. Johnson, W.R. Raun, J.F. Stritzke and S.B. Phillips. 1998. Alfalfa response to rates and methods of applied phosphorus fertilizer. Proc. 54th So. Past. For. Crop Improv. Conf. Lafayette, LA. p. 66-70
17. Raun, W.R., J.B. Solie, M.L. Stone, G.V. Johnson, E.V. Lukina, W.E. Thomason and J. Wang. 2000. In-season fertilizer nitrogen application based on predicted yield potential. *In* Alan J. Schlegel (ed.) Proc. Great Plains Soil Fertility Conference. 8:64-68.
18. Solie, J.B., W.R. Raun, M.L. Stone, G.V. Johnson, E.V. Lukina, W.E. Thomason, D.E. Needham and C.N. Washmon. 2000. In-season N fertilization using an in-season estimate of potential yield. In 5th International Conf. on Precision Agric. Minneapolis, MN.
19. Solie, J.B., M.L. Stone, W.R. Raun, G.V. Johnson, K. Freeman, R. Mullen, D.E. Needham, S. Reed, and C.N. Washmon. 2002. Real-time sensing and N fertilization with a field scale GreenSeeker applicator. In 7th International Conf. on Precision Agric. Minneapolis, MN.
20. Raun, W.R., J.B. Solie, M. Stone, I. Ortiz-Monasterio, and Randy Taylor. 2010. Application of Indirect Measures for Improved Nitrogen Fertilization Algorithms. Proc. Precision Ag. Conf. Denver CO. July 19, 2010.
21. Raun, W.R., B. Arnall, R.K. Taylor, I. Ortiz-Monasterio, J. Solie, and M. Stone. 2012. Sensor based management of nitrogen for cereal crop production. FERTBIO-2012 Conference, September 20, 2012, Maceio, Brazil.
22. Bijay Singh, R.K. Sharma, Jaspreet-Kaur, M.L. Jat, K.L. Martin, Yadvinder-Singh, Varinderpal-Singh, H.S. Thind, H.S. Khurana. M. Vashista, W.R. Raun and R. Gupta. 2012. Optical sensor-based nitrogen management for irrigated wheat in the indo-gangetic plains. Better Crops. 96(3). 18-20.

**TECHNICAL EXPERIENCE**

User experience with more than 30 different software packages for data management, data analysis, desktop publishing and graphics. 39 years of operational experience with SAS (Statistical Analysis System).

Operational experience with various colorimeters, x-ray diffraction and atomic absorption spectrophotometers, dry combustion for total N and organic C in soil and plant tissue, automated flow injection analyses systems for determination of NH4-N, and NO3-N, inductive coupled plasma spectrometers and stable isotope ratio mass spectrometry.

**FUNDS RAISED SPECIFICALLY FOR INTERNATIONAL EXPERIENCE FOR OSU GRADUATE STUDENTS AND FACULTY**

|  |  |  |  |
| --- | --- | --- | --- |
| Graduate Students who have been and short (1 to 2 week) and long-term (4-month) study at the International Maize and Wheat Improvement Center (CIMMYT), and other regions in the world, 1995-present. | | | |
| **Date** | **Location** | **Personnel** | **Purpose** |
| Jan-1995 | Ciudad Obregon, MX | Bill Raun | Initial discussions for collaborative sensor work |
| Feb-1997 | Ciudad Obregon, MX | Bill Raun | Long-term student involvement |
| Jan-1999 | Ciudad Obregon and Texcoco, MX | Steve Phillips, Joanne LaRuffa, Wade Thomason, Sherry Britton, Joe Vadder, Gordon Johnson, John Solie, Dick Whitney | IRSP 98, 2-wheel tractor, refine INSEY, wheat bed planter |
| Sep-1999 | Texcoco, MX | Erna Lukina | IRSP 98, use of EY |
| Aug-2000 | Texcoco, MX | Marvin Stone, Kyle Freeman, Robert Mullen, Roger Teal, Dwayne Needham, Kathy Wynn, Carly Washmon | IRSP 99, refine INSEY, sensor design for plant breeding |
| Jan-Apr-2001 | Ciudad Obregon, MX | Kyle Freeman | 4-month OSU representation, NRI grant 200-03530 |
| Apr-2001 | Ciudad Obregon, MX | Kyle Freeman | Wheat Harvest |
| Jul-2001 | El Batan, MX | Jagadeesh Mosali, Shambel Moges, Micah Humphreys, Paul Hodgen, Carly Washmon | IFAFS Grant |
| Jan-Apr-2002 | Ciudad Obregon, MX | Paul Hodgen | 4-month OSU representation for IFAFS Grant |
| Jun-2002 | El Batan, Tlaltizapan, MX | Robert Mullen, Kyle Freeman | Deliver hand-held sensor, initiate corn sensing program |
| Aug-2002 | Texcoco, MX | Bill Raun | Work for 5-months on the development of a corn algorithm for N |
| Nov-2002 | El Batan, MX | Keri Brixey, Jason Lawles, Kyle Freeman | Corn harvest, sensed earlier in June by Kyle Freeman and Robert Mullen, delivery of 3 new Greenseeker sensors. |
| Jan-2004 | Ciudad Obregon, MX | Kyle Freeman, Brian Arnall, and Kody Featherston | Collect by-plot CV data for improved prediction of yield potential |
| July-2004 | New Delhi, India | Kent Martin | Train CIMMYT Rice-Wheat Consortium staff in the use of hand-held sensors for improved N fertilization |
| July 2004 | Beijing, China | Kyle Freeman | Training of Chinese National Academy of Sciences Personnel in the use of hand-held sensors |
| July 2005 | New Delhi, India | Kent Martin, Brian Arnall | Workshop for CIMMYT and National Program scientists |
| July 2005 | Esperance, Australia | Kyle Freeman | Work with David and Sally Cox on the extension of Sensor Based N Rate Technologies for Wheat in South West Australia |
| Sep 2005 | El Batan, MX | Olga Walsh, Brenda Tubana, Starr Holtz, Chung Byungkyun, Clint Mack, Kyle Lawles, D. Zavodny | Sensor Based N Workshop for CIMMYT and National Program Staff |
| Oct 2005 | Ankara, Turkey | Kyle Freeman, Roger Teal | Sensor Based N Workshop for CIMMYT and National Program Staff |
| Sep 2005 | Beijing, China | Brian Arnall, Carol Jones, Hailin Zhang | Sensor Based N Workshop for CIMMYT and National Program Staff |
| Nov 2005 | Mar de Plata, Argentina | Kyle Freeman | Invited Presentation, 7th International Wheat Conference |
| Jan 2006 | El Batan, MX | Brian Arnall, Joe Biggerstaff | Workshop with PATRONATO Farmers and Ivan Ortiz-Monasterio |
| Mar 2006 | Ciudad Obregon, Mexico | Kefyalew Girma | Yield Potential Symposium |
| Jul 2006 | New Delhi, India | Kent Martin | Follow up work with CIMMYT and NARS on Greenseeker Technology |
| Aug 2006 | Beijing, China, and Urgench, Uzbekistan | Brian Arnall, Starr Holtz | Sensor Based Nitrogen Workshop using Greenseeker |
| Aug 2006 | Adelaide, Australia | Brenda Tubana | Sensor Based Nitrogen Workshop using Greenseeker Technology |
| Jan 2007 | Ciudad Obregon, MX | Brenda Tubana, Starr Holtz, Pam Turner, Clint Dotson, Luke Hanks | SBNRC workshop with Ivan-Ortiz Monasterio, CIMMYT and the Patronato |
| Apr 2007 | Ciudad Obregon, MX | John Solie, Bill Raun | Dr. Norman Borlaug endorses GreenSeeker N management approach for Mexico |
| Jan 2008 | Harare, Zimbabwe | Daniel Edmonds, Cody Daft | GreenSeeker Sensor N workshop with CIMMYT |
| Feb 2008 | Tashkent, Uzbekistan | Daniel Edmonds | ICARDA, CIMMYT Sensor N workshop |
| Feb 2008 | Ciudad Obregon, MX | Brian Arnall, Randy Taylor | Installation of a GreenSeeker RT200 system for spring wheat |
| Mar 2008 | Samara, Russia | Daniel Edmonds | GreenSeeker Sensor Training |
| Nov 2008 | Harare, Zimbabwe | Daniel Edmonds, Cody Daft | GreenSeeker Training and Extension |
| Jan 2009 | Ciudad Obregon | Yumiko Kanke, Daniel Edmonds, Jared Crain | Side-view sensor readings |
| Feb 2009 | Nairobi, Kenya | Jake Vossenkemper, Jerry May, Yumiko Kanke | GreenSeeker Training and Extension |
| Jan 2010 | Ciudad Obregon, MX | Jonathan Kelly, Guilherme Torres | Collaborative work with Ivan Ortiz-Monasterio on spectral readings in wheat and corn |
| Jan 2011 | Ciudad Obregon, MX | Bee Khim, Jeremiah Mullock, Kevin Waldschmidt, Katy Butchee, Dillon Butchee | Collaborative work with Ivan Ortiz-Monasterio on spectral readings in wheat and corn |
| March 2012 | Ciudad Obregon, MX | Michael Reinert, Jake Bushong, Jorge Rascon, Jared Crain, Wesley Porter | Greenseeker 2 evaluation versus the pocket sensor, with CIMMYT |
| Jan 2013 | Ciudad Obregon, MX | Jeremiah Mullock, Eric Miller, Jacob Bushong, Natasha Macnack, Sulochana Dhital, Candi Byani, Ethan Wyatt | Sensor testing, Hand Planter delivery |
| January 2016 | Ciudad Obregon, MX | Katie McCauley, Jagmandeep Dhillon, Eva Nambi, Daniel Aliddeki, Ethan Driver, Bruno Figueiredo,  Gwen Wehmeyer, Andi Nichols | Collection of CV data, Greenseeker, variety evaluation |
| March 2018 | Ciudad Obregon, MX | Tyler Lynch, Elizabeth Eickhoff, Peter Omara, Robert Lemings, Everett Hrbacek, Alimamy Fornah | Visitors Weeks, CIMMYT, Sensor Based N Training |
|  |  |  |  |
| **Total** | **41** | **117** |  |

**November 21-December 6, 1998:** OSU-Team member, Sanliurfa, Turkey.  Su-Yapi, GAP, World Bank irrigation development project.  Assessment of crop production practices combined with established irrigation, resulting in a crop system recommendation.

**Extension 2008**  
  
January 17, 2008. Stillwater, OK. “Myths and Facts associated with Nitrogen Use Efficiency.” In Service Training, Stillwater Fair Grounds.

January 25, 2008. Salina, KS. “By-Plant N Management Strategies.” Presented to the KARI.

March 4, 2008. Norman, OK. Use of soil moisture for improved yield prediction, presented to the Oklahoma Mesonet Group.

April 24, 2008. Stillwater, OK. Presentation to Calvin Burgess and Dominion Farms on the use of sensor based N technologies for Kenya.

May 14-15, 2008. Vernon TX, Agri-Pro Field Day, “Nitrogen rich strips for improved N management in Cereals.

May 16, 2008. Lahoma, OK, “Improving your bottom line in wheat N management”, Lahoma Field Tour.

June 26, 2008. Guest lecture on Precision Agriculture in Oklahoma to Chapingo undergraduates visiting Dr. David Henneberry. Approximately 110 in attendance.

July 22, 2008. No-till Rotation Crops and Fertilizer Informational Workshop, Weatherford, OK. GreenSeeker program and the benefits that can be gained.

July 30-Aug 2, 2008. NUE Conference, Manhattan, KS. 75 Attendees for a meeting addressing university and industry needs in precision agriculture to improve N rate recommendations.

August 19, 2008. Estes Chemical Training Session, Stillwater, OK. Comprehensive GreenSeeker sensor training for 9 Estes Chemical employees.

September 11, 2008. Guest Lecture, AGED 4713, International Agriculture and Poverty in Today’s World. 40 in attendance

October 14, 2008. Departmental Seminar, “Cereal Nitrogen Use Efficiency in Sub Saharan Africa. 25 in attendance.

October 21-25, 2008. Taught all lectures for SOIL 2224 due to Dr. Hattey’s trip to Kenya.

November 5-6, 2008. Exhibitor and OSU representative, OARA meetings, Oklahoma City, OK.  
  
**Extension 2009**

Made all contacts with Hans Braun (Director of the Wheat Program, CIMMYT) and Mahmood Ozmanzai (CIMMYT wheat breeder located in Afghanistan). They will now be working with the Oklahoma National Guard on a seed dissemination project partially funded by USAID.

August 16, 2009. Adoption of new technologies in the 3rd World. Presented to the Oklahoma Army National Guard, Deployment to Afghanistan.

August 26, 2009. PaSS update for area agronomists.

November 6, 2009, OARA Meetings, Oklahoma City, OK. GreenSeeker Sensor update, OSU exhibitor

December 5, 2009. Soil [fertility and N Rich Strips for Wheat](http://sunup.okstate.edu/video/12-5-09/seg1.html). Aired on SUNUP

December 16, 2009. S, Micronutrients and K, presented at the OSU 2009 Crops School, Stillwater, OK.

**Extension 2010**

June 21, 2010. Sensor Based Technology Developed at OSU, ASFFPCO Conference, Oklahoma City, OK (downtown Sheraton)

June 25, 2010. Precision Agriculture at OSU, Chapingo Student Program, Mexico, Stillwater, OK.

Raun, Bill, John Solie, Jerry May, Hailin Zhang, Jonathan Kelly, Randy Taylor, Brian Arnall, and Ivan Ortiz-Monasterio. 2010. Nitrogen Rich Strips for wheat, corn, and other crops. E-1022. Oklahoma State University, Stillwater, OK.

November 4, 2010, Improved Sensor Based N Management. OARA Annual Meetings, Oklahoma City, OK.  
December 15, 2010. Optimizing winter wheat grain protein. OSU Winter Crops School.

**Extension 2011**

February 9, 2011. OSU N Rate Algorithm. Presented at the NeATA conference, Grand Island, NE.

February 10, 2011. Making a case for by-plant N management. Presented at the NeATA conference, Grand Island, NE.

November 8-9. OARA meetings, Oklahoma City.

December 13, 2011. Winter Crops School, Stillwater, OK.

**Extension 2012**  
December 12, 2012. Presentation, Winter Crops School, Stillwater, OK

**Extension 2013**  
December 16, 2012. Presentation, Winter Crops School, Stillwater, OK

**Extension 2014**October 7, 2014. Hand Planter Presentation, Agricultural Entrepreneurs 2014

November 6, 2014, Global Horticulture Workshop, Wes Watkins Center

**Extension 2015**

February 6, 2015, Value of the “Nitrogen Cycle Ninja” exercise, 1996-pres., Growmark, Bloomington, IN.

July 30, 2015, Hunger and Horticulture, Invited speaker, FAPC, Stillwater, OK

December 5, 2015, New Age Hand Planter for the Developing World. OSU Soil Biology Symposium, Stillwater, OK

**Extension 2016**  
October 17, 2016, Ohio State University student presentation on Central America, specifically Nicaragua. Focus on the volcanic ash soils present, and the OSU hand planter. Stillwater, OK –Columbus, OH.

December 13, 2016. CCA Crops School, Nitrogen demand in the Central Great Plains. Stillwater, OK.

**Extension 2017**January 19, 2017. Redlands Community College: Value and Use of the Nitrogen Rich Strip in the World. Sponsored by USDA-ARS. El Reno, OK.  
July 12, 2017. Sub-Saharan Africa/Mandela Fellows Program, field and lab demonstration of the OSU Hand Planter. Final delivery of 5 hand planters to Janvier Uwayezu, Rwanda; Sini Yalcubu, Nigeria; Raphael Mambo, DR Congo; Raphaly Gama, Tanzania; Usman Ali, Nigeria;  
July 26, 2017. Hand Planter Presentation/Demonstration, Dr. Jeff Sallee, 4H Roundup Week.  
September 5, 2017. Landscape Architecture, Publishing in the Digital Age. Requested by Dr. Neils Maness

September 20, 2017. MIAP Seminar, AGIN 5312. OSU Hand Planter Past & Present, Dr. Shida Henneberry

**Extension 2018**

‘Dicamba Restricted USE’, Applicator Training (62 slides translated into Spanish) + audio and delivery in Spanish

December 7, 2018, Winter Crops School, Value of the OSU Long Term Experiments.

November 6-7, 2018. Exhibitor and OSU representative, OARA meetings, Norman, OK.

**Extension 2019**

December 18, 2019, OSU Winter Crops School, Comprehensive Theory of the OSU Approach

November 6-7, 2019, Exhibitor and OSU representative, OARA meetings, Norman, OK.

November 15, 2019, Malawi Visitors, Extension and Education, Dr. Jim Trapp

October 29, 2019, AGED 4713 Lecture, Global Food Security, Equipment Demonstration

**2010 Safety Training**

2nd quarter, May 6, 2010, Tornado Safety Tips

2nd quarter, July 1, 2010, Tornado Safety Tips

3rd quarter, August 12, 2010, Safety Training Module

4th quarter, October 11, 2010, Safety Training Module (suspicious package)

**2011 Safety Training**

1st quarter, February 4, 2011, Crime Prevention

2nd quarter, April 25, 2011, Back Safety Module

3rd quarter, July 28, 2011, Hazard Communication  
4th quarter, November 3, 2011, Asbestos Awareness

**2012 Safety Training**  
1st quarter, February 28, 2012, How did that accident happen?

2nd quarter, April 11, 2011, Bicycle Safety for All of us (attended Scott Nutt seminar).

2nd quarter, April 18, 2011, Bicycle Safety for All of us

3rd quarter, July 23, 2012, Hazard Communication Safety Training

4th quarter, November 7, 2012, Safety is Everybody’s Business

4th quarter, December 13, 2012, Safety is Everybody’s Business

**2013 Safety Training**

1st quarter, February 28, 2013, Hazard Communication, Your Right to Know

2nd quarter, May 21, 2013, Why Back Safety is Important

3rd quarter, August 8, 2013, Bites, Stings, Burns

4th quarter, October 17, 2013, Hazard Communication, Your Right to Know Quiz

**2014 Safety Training**

1st quarter, February 13, 2014, Shop Safety Training

2nd quarter, May 13, 2014, How did that Accident Happen?

3rd quarter, August 14, 2014, New Employee Safety Training  
4th quarter, November 12, 2014, Why Back Safety is Important

**2015 Safety Training**

1st quarter, February 12, 2015, Farm and Field Labeling

2nd quarter, May 21, 2015, Tornado’s

3rd quarter, August 7, 2015, Your Right to Know

4th quarter, October 29, 2015, Walking on Ice

**2016 Safety Training**

1st quarter, January 13, 2016, Electrical Safety Module

2nd quarter, May 4, 2016, Tractor Safety Module

3rd quarter, September 26, 2016, Hazard Communication

4th quarter, October 25,2016, Back Safety

**2017 Safety Training**

1st quarter, February 16, 2017, Fire Extinguisher Training

2nd quarter, April 28, 2017, Office Ergonomics

3rd quarter, July 21, 2017, Sun Safety

4th quarter, Safety Training, November 1, 2017

Title IX Training, December 12, 2017 (Student Union, Room 417)

**2018 Safety Training**

1st quarter, January 10, 2018, Asbestos

2nd quarter, April 25, 2018, Personal Protective Equipment

3rd quarter, August 2, 2018, Active Shooter Training

4th quarter, October 22, 2018, Hazard Communication

Title VII and IX Training, 106B, Whitehurst, April 10, 2018, 10 to 11 am

**2019 Safety Training**

2019 Clery Act CSA and Incident Report training, January 22, 2019

2019 OSU Title VII & Title IX Online Course, January 22, 2019

2019 1st quarter, January 31, 2019, Cold Stress and Back Safety  
2019 2nd quarter, April 10, 2019, Office Safety

2019 3rd quarter, July 16, 2019, Hazcom Safety Training

2019 4th quarter, October 23, 2019, Compressed Gas Cylinder Safety.

**INTERNATIONAL and OSU AWARD NOMINATIONS**

Candidate Award Year(s) nominated Received

Gordon V. Johnson Fellow, SSSA 1995 1995

Gordon V. Johnson Werner L. Nelson, ASA 1997, 1998 1998

Gordon V. Johnson Soil Science, App. Res SSSA 2001, 2002, 2003

James R. Brown Fellow, SSSA 1998 1998

Nicholas T. Basta James Whatley Award, OSU 1997, 1998 1998

Nicholas T. Basta Environmental Quality-ASA 2000- 2007

Nicholas T. Basta Fellow, ASA 2002, 2003 2003

Nicholas T. Basta Fellow, SSSA 2002, 2003, 2004 2004

R. L. Westerman Soil Science, App. Res SSSA 1997-2000

Jefforey Jacobsen Fellow, ASA 1998-2000 2000

Jefforey Jacobsen Fellow, SSSA 2001-2005 2005

Charles Taliaferro Fellow, ASA 1999 1999

Charles Taliaferro Fellow, CSSA 1999, 2000 2000

John Caddel Fellow, ASA 1999-2002

John Caddel Fellow, CSSA 1999, 2000

Jeffory A Hattey Merrick Found. Teaching 1997, 1998

Jeffory A. Hattey AMOCO Teaching Award 1998

Jeffory A. Hattey GSD Award, OSU 1999 1999  
Jeffory A. Hattey NACTA Teacher Fellow 2000 2000  
Jeffory A. Hattey SSSA Soil Science Educ. 2007-2010 2010

Arthur Klatt International Service ASA 1999-2012

Steven B. Phillips Emil Truog Award, SSSA 2000

Eugene Krenzer Agronomic Extension ASA 2000, 2001

Ken Sayre Fellow, ASA 2001, 2002

Gyles Randall Werner L. Nelson, ASA 2001, 2002 2002

Sam Fuhlendorf James Whatley Award, OSU 2000, 2001 2001

Shiping Deng James Whatley Award, OSU 2001-2004 2004

Hailin Zhang Agronomic Extension ASA 2002-2018 2018

Hailin Zhang Fellow, ASA 2006, 2007, 2008 2008  
Hailin Zhang Fellow, SSSA 2007, 2008, 2009 2009

Hailin Zhang Sarkeys Distinguished Prof 2004

Hailin Zhang James Whatley Award, OSU 2005 2005

Brian Carter ASA, Fellow 2002

Brian Carter SSSA, Fellow 2002

Robert Mullen SSSA, Clark Soil Biology 2002

Robert Mullen SSSA Emil Truog Award 2004 2004

James Schepers SSSA Professional Service 2003 2003  
James Schepers SSSA Intl. Soil Science 2005-2015 2015  
John Lamb ASA Fellow 2005-2007 2007

John Lamb SSSA Fellow 2005-2013

Kyle Freeman SSSA Emil Truog Award 2006  
Brian Arnall ASA Larsen Memorial 2006, 2007  
Newell Kitchen ASA Fellow 2006, 2007 2007  
Newell Kitchen SSSA Fellow 2008 2008  
Kefyalew Girma Syngenta ASA 2006  
Kefyalew Girma ASA Young Crop Scientist 2007  
Jeff Edwards ASA Early Career Award 2007 2007  
Richard Ferguson ASA Werner Nelson 2007-2010 2010  
Mike Stewart ASA Fellow 2007-2009

David Porter ASA Fellow 2009 2009  
David Porter CSSA Fellow 2010 2010  
Brian Arnall Emil Truog Award 2009  
Chad Godsey Early Career Prof. Award 2009-2011 2011

Raj Khosla ASA Fellow 2011 2011  
Raj Khosla SSSA Fellow 2011 2011

Peter Scharf ASA Fellow 2012-2015

Peter Scharf SSSA Fellow 2012

Dave Franzen ASA Fellow 2012, 2013 2013

Dave Franzen SSSA Fellow 2012

Jeff Edwards Young Crop Scientist 2012 2012

Brian Arnall Young Crop Scientist 2014 2014

Wade Thomason Carl Sprengel ASA 2015  
Jeremiah Mullock Emil Truog SSSA 2015

Randy Taylor OSU Regents Professor 2015

Brian Arnall Pierre Robert ISPA 2016 2016  
Wade Thomason ASA Fellow 2017 2017

Kyle Freeman Agronomic Industry Award 2017, 2018, 2019

Brian Arnall OSU Land Grant Award 2017 2017

Kyle Freeman Agronomic Industry Award 2018, 2019

Brian Arnall Crop Sci. Extension Award 2018 2018

Lakesh Sharma ASA Early Career Award 2018, 2019

Joshua McGrath Agronomic Education and Extension Award 2019 2019

James Schepers ASA Distinguished Service 2019

Brenda Tubana Carl Sprengel Agronomic Research 2019

Brian Krienke CSSA Early Career Award 2019

Tyson Ochsner SSSA Fellow 2018, 2019 2019

Jagmandeep Dhillon Gerald Mott Award 2019 2019  
Jagmandeep Dhillon Nelson Yield Limiting Factors 2019 2019

**TOTAL 181 44**

6th most cited paper all time, Agronomy Journal, 1897 - 2020, Agron. J. 91:357-363. (<https://www.soils.org/publications/aj/most-cited>)

**2017:**

**American Society of Agronomy, Soil Science Society of America**

Letters of reference: 4 Peter Kyveryga ASA Fellow  
Carl Crozier ASA Fellow

Dan Sweeney Carl Sprengel Agronomic Research  
Raj Khosla Werner Nelson Award

Nominations: 3 Hailin Zhang Agronomic Education/Extension Award

Kyle Freeman Agronomic Industry Award  
Wade Thomason ASA Fellow

**2018:**

**American Society of Agronomy, Soil Science Society of America**

Letters of reference: 9 Wade Thomason Agronomic Education and Extension Award  
Calvin Pearson ASA Distinguished Service Award  
David Mengel ASA Distinguished Service Award  
Dan Sweeney Carl Sprengel Agronomic Research Award

Jagmandeep Dhillon Nelson Yield-Limiting Factors Scholarship

Dan Sweeney Soil Science Applied Research Award

Ken Barbarick Soil Science Distinguished Service Award

Newell Kitchen Soil Science Research Award

Kevin Bronson Werner Nelson Award

Nominations: 4 Hailin Zhang Agronomic Education/Extension Award

Kyle Freeman Agronomic Industry Award  
Brian Arnall Crop Science Extension Education Award  
Lakesh Sharma Early Career Award

**2019:**

**American Society of Agronomy, Soil Science Society of America**

Letters of reference: 7 Wade Thomason Agronomic Education and Extension Award  
Wade Thomason Crop Science Extension Education Award  
Jagmandeep Dhillon Nelson Yield-Limiting Factors Scholarship

Hailin Zhang Soil Science Applied Research Award  
Hailin Zhang Soil Science Education and Extension Award

Newell Kitchen Soil Science Research Award

Newell Kitchen Werner L. Nelson Award, Yield Limiting Factors

Nominations: 7 Joshua McGrath Agronomic Education/Extension Award

Kyle Freeman Agronomic Industry Award  
James Schepers ASA Distinguished Service

Brenda Tubana Carl Sprengel Agronomic Research Award  
Brian Krienke CSSA Early Career Award  
Jagman Dhillon Gerald O. Mott Award  
Jagman Dhillon Nelson Yield Limiting Factors

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January 2020

