

Agronomy

Undergraduate Study

The Department of Agronomy has a curriculum noted for its scientific rigor and breadth in crop science, soil science, agricultural meteorology, and plant breeding. It prepares students for science-based professional positions, graduate study, or research careers across the spectrum of Agronomy.

The curriculum provides both flexibility and direction for students by offering four in-depth options: crop management and business, agroecology, soil and environmental quality and plant breeding and biotechnology. A minimum of 15 credits of Agronomy courses must be earned at Iowa State for students transferring from other institutions. The program also has many opportunities for undergraduate students to be involved in cutting edge research and international agriculture.

Graduates have the theoretical and practical knowledge needed for efficient and sustainable production of food, feed, fuel, and fiber. Graduates are skilled in communications, critical thinking, problem solving, and working effectively with others. They understand the ethical, cultural, and environmental dimensions of issues facing professionals in agriculture and natural resources.

An Agronomy major prepares students for employment in agricultural business and industry, agricultural service organizations, crop production and soil management, environmental and natural resource management, and farm management. Graduates pursue careers in the seed, fertilizer, and agricultural chemical industries as field Agronomists, crop and soil management specialists, research technicians, sales and marketing specialists, and production managers. State and federal agencies employ Agronomists as extension specialists, county extension directors, environmental and natural resource specialists, research associates, soil surveyors, soil conservationists, and in regulatory agencies as plant, food, and grain inspectors. Additional areas of work open to Agronomists include integrated pest management, land appraisal, agricultural finance, turfgrass management, and the home lawn care industry.

The department offers an international scholar program leading to a credentialed title of "Agronomy International Scholar" for agronomy majors who have distinguished themselves in global understanding and international experience. Contact the department for requirements.

Minor - Agronomy

The department offers work for a minor in Agronomy. Students are required to complete an approved minor program that includes:

AGRON 114	Principles of Agronomy	3
AGRON 154	Fundamentals of Soil Science	3
AGRON 212	Crop Growth, Productivity and Management	3
AGRON 354	Soils and Plant Growth	3
6 additional credits (3 credits must be at the 300+ level)		6
9 credits for the Agronomy minor must be earned at Iowa State.		9

Curriculum in Agronomy

Students majoring in agronomy study crop, soil, and environmental sciences under one of four options: agroecology; crop management and business; plant breeding and biotechnology; or soil and environmental quality. A minimum of 15 credits in agronomy courses must be earned at Iowa State University.

Total Degree Requirement: 128 cr.

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

International Perspective: 3 cr.

U.S. Diversity: 3 cr.

Communications Proficiency: 6 cr.

6 cr. of English composition with a C or better and 3 cr. of speech fundamentals with a C or better.

Communication/Library:

ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3

SP CM 212	Fundamentals of Public Speaking	3
or AGEDS 311	Presentation and Sales Strategies for Agricultural Audiences	
ENGL 302	Business Communication	3
ENGL 309	Report and Proposal Writing	3
or ENGL 314	Technical Communication	
LIB 160	Information Literacy	1

Humanities and Social Sciences: 6 cr.

3 cr. from approved humanities list; ECON 101 (https://nextcatalog.registrar.iastate.edu/courseleaf/js/fckeditor/editor/fckeditor.html?InstanceName=attr_undergraduate&Toolbar=PageWizard) Principles of Microeconomics

Ethics: 3 cr.

3 cr. from approved list.

Life Sciences: 6 cr.

BIOL 211	Principles of Biology I	3
3 cr. from approved list		3

Mathematical Sciences: 6 cr.

STAT 104	Introduction to Statistics	3
One of the following:		3-4
MATH 140	College Algebra	3
MATH 150	Discrete Mathematics for Business and Social Sciences	3
MATH 160	Survey of Calculus	4
MATH 165	Calculus I	4
MATH 181	Calculus and Mathematical Modeling for the Life Sciences I	4

Physical Sciences: 15 cr.

CHEM 163 & 163L	College Chemistry and Laboratory in College Chemistry	5
or		
CHEM 177	General Chemistry I	4
or CHEM 177L	Laboratory in General Chemistry I	
CHEM 231	Elementary Organic Chemistry	3
CHEM 231L	Laboratory in Elementary Organic Chemistry	1
or BBMB 221	Structure and Reactions in Biochemical Processes	
PHYS 111	General Physics	5
or PHYS 115	Physics for the Life Sciences	
GEOL 100	The Earth	3

Life and Biological Sciences: 11.0 cr.

BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
AGRON 320	Genetics, Agriculture and Biotechnology	3
or BIOL 313	Principles of Genetics	
BIOL 313L	Genetics Laboratory	1

Agronomy Core:

AGRON 105	Leadership Experience	R
AGRON 110	Professional Development in Agronomy: Orientation	0.5
AGRON 114	Principles of Agronomy	3
AGRON 154	Fundamentals of Soil Science	3
AGRON 206	Introduction to Weather and Climate	3
AGRON 210	Professional Development in Agronomy: Career Planning	1
AGRON 310	Professional Development in Agronomy: Work Experience	R
or AGRON 311	Professional Internship in Agronomy	
AGRON 316	Crop Structure-Function Relationships	3
AGRON 354	Soils and Plant Growth	3
AGRON 354L	Soils and Plant Growth Laboratory	1
AGRON 410	Professional Development in Agronomy: Senior Forum	1

1 course from agriculture issues list

Total Credits 18.5

Advising Option Choice

Complete 24 cr. from 300 level courses or above from approved list; no more than 4 cr. of AGRON 490 may count toward graduation.

Electives:

27 credits, student choice

Options

Agroecology

The Agroecology option provides the scientific foundation for understanding and managing agricultural systems with ecological and environmental perspectives. Students may pursue graduate study or careers in sustainable agriculture. More information is available from an agronomy adviser or www.agron.iastate.edu/.

Crop Management and Business

The Crop Management and Business option is designed for those individuals who seek employment as agronomists working in agribusinesses such as cooperatives, seed companies, herbicide and fertilizer dealers, or crop consulting firms. More information is available from an agronomy adviser or www.agron.iastate.edu/.

Plant Breeding and Biotechnology

The Plant Breeding and Biotechnology option is a science-oriented option recommended for those who would like to work in plant breeding or plant biotechnology. More information is available from an agronomy adviser or www.agron.iastate.edu/.

Soil and Environmental Quality

The Soil and Environmental Quality option is designed for those individuals interested in careers in environmental science, soil science, or natural resource management. More information is available from an agronomy adviser or www.agron.iastate.edu/.

Graduate Study

The department offers programs that lead to the degrees master of science and doctor of philosophy, with majors in agricultural meteorology; crop production and physiology with optional specializations in seed science and weed science; plant breeding; and soil science with specialization in soil chemistry, soil fertility, soil management, soil microbiology and biochemistry, soil morphology and genesis, or soil physics. Minor work is offered for students with majors in other departments. An M.S. nonthesis option is available for students desiring a general degree program with additional coursework and a written creative component substituting for thesis research.

Graduates have a broad knowledge base germane to their area of study. They are trained to integrate and apply knowledge to different situations. Students develop skills in scientific reasoning, organization, and logical presentation of ideas.

The department offers a Master of Science degree in Agronomy designed for the continuing education of professional Agronomists. The program is taught at a distance using computer-based instructional media. It is a nonthesis degree requiring completion of a written creative component.

The department cooperates in the interdepartmental program in professional agriculture; interdepartmental majors in ecology and evolutionary biology; genetics; MCDB (molecular, cellular, and developmental biology); plant physiology; sustainable agriculture; and environmental science.

Prerequisite to major work in this department is completion of an undergraduate degree program with emphasis on agronomic, biological, and physical sciences.

Courses primarily for undergraduates:

AGRON 105. Leadership Experience.

Cr. R. F.S.SS.

A participatory experience in activities or completion of a course that enhances the development of leadership and group-dynamic skills. See adviser for departmental requirements.

AGRON 110. Professional Development in Agronomy: Orientation.

(0.5-0) Cr. 0.5. F.

Orientation to college life, the profession of agronomy, and the agronomy curriculum.

AGRON 114. Principles of Agronomy.

(2-3) Cr. 3. F.S.

Mullen. A foundation course in agronomy applying crop, soil, and environmental sciences in understanding agricultural systems in the world. Includes introductory concepts of plant, soil, tillage, pest, environmental, and sustainable aspects of crop production. Off-campus version offered through internet by interactive computer courseware.

AGRON 120. Introduction to Renewable Resources.

(Cross-listed with NREM, ENV S). (3-0) Cr. 3. F.S.

Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

AGRON 154. Fundamentals of Soil Science.

(2-2) Cr. 3. F.S. Prereq: CHEM 163

Manu. Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Use of soil survey and computer databank information in balancing agronomic, economic, and environmental concerns in soil management. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

AGRON 155. Soils for Horticultural Scientists.

(2-2) Cr. 3. F.S. Prereq: CHEM 163

Restricted to students in Horticulture. Manu. Physical, chemical and biological properties of natural and manufactured soils. Use of soil information when producing plants on natural and manufactured soils. Credit for only one of Agron 154, 155, or 156 may be applied toward graduation.

AGRON 156. Soils for Urban Use.

(2-2) Cr. 3. F.S.

Restricted to students outside the College of Agriculture. Manu. Fundamental properties of soils and their application to urban settings. Development of a site plan for area of land using data from soil survey and computerized data bank information. Field trip. Credit for only one of Agron 154, 155 or 156 may be applied toward graduation.

AGRON 160. Water Resources of the World.

(Cross-listed with GEOL, ENV S, MTEOR). (3-0) Cr. 3. S.

Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

AGRON 206. Introduction to Weather and Climate.

(Cross-listed with MTEOR). (3-0) Cr. 3. F.S.

Basic concepts in weather and climate, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety.

AGRON 210. Professional Development in Agronomy: Career Planning.

(1-0) Cr. 1. F. Prereq: Sophomore classification

Career planning, résumé and cover letter preparation, and interviewing techniques. Career orientation through invited speakers.

AGRON 212. Crop Growth, Productivity and Management.

(3-0) Cr. 3. F.S. Prereq: AGRON 114

Production and management practices for corn, soybean, small grain, and forage crops common to Midwestern U.S. agriculture. Emphasis on growth and development, plant characteristics, management practices, crop use, quality, and problem-solving.

AGRON 212L. Field Application and Problem Solving in Crop Production.

(0-2) Cr. 1. F.S. Prereq: AGRON 154, credit or enrollment in AGRON 212

Problem solving in crop production. Integration and application of concepts introduced in Agron 212. Agronomic field skills such as crop and pest identification, integrated management strategies, staging crop growth, agricultural math and site specific management related to crop production will be emphasized.

AGRON 217. Weed Identification.

(0-3) Cr. 1. F.S. Prereq: BIOL 101 or equivalent

Identification of important weeds of agricultural, horticultural and native ecosystems. Principles of plant taxonomy and classification. Field trips.

AGRON 259. Organic Compounds in Plant and Soil Environments.

(3-0) Cr. 3. S. *Prereq:* Chem 163, 167, or 177; 6 credits in Agronomy or Environmental Sciences; Math 140 recommended.

Structure, function, and transformations of organic compounds significant in plant and soil environments.

AGRON 260. Soils and Environmental Quality.

(Cross-listed with ENV S). (3-0) Cr. 3. F.S.

Burras. Role of soils in environmental quality and natural resources management. Emphasis on soil erosion and conservation, water quality, and environmental planning. Saturday field trip.

AGRON 283. Pesticide Application Certification.

(Cross-listed with ENT, FOR, HORT). (2-0) Cr. 2. S.

Holscher. Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

AGRON 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq:* Permission of department cooperative education coordinator, sophomore classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AGRON 310. Professional Development in Agronomy: Work Experience.

Cr. R. F.S.SS.

Professional work experience in agronomy. See adviser for departmental requirements. Offered on a satisfactory-fail basis only.

AGRON 311. Professional Internship in Agronomy.

(1-0) Cr. 1. Repeatable. F.S. *Prereq:* AGRON 110, agronomy majors only, permission of instructor before internship begins

Wiedenhoef. A supervised learning experience in a professional setting related to crop production, plant breeding, soil science or environmental science.

AGRON 316. Crop Structure-Function Relationships.

(3-0) Cr. 3. F.S. *Prereq:* BIOL 212 Recommended

Knapp. Basic principles concerning the growth, development, and production of crop communities in relation to their environment.

AGRON 317. Principles of Weed Science.

(2-2) Cr. 3. F.

Hartzler. Biology and ecology of weeds. Interactions between weeds and crops. Principles and practices of integrated weed management systems. Herbicide mechanisms, classification, and fate in plants and soils.

AGRON 320. Genetics, Agriculture and Biotechnology.

(Cross-listed with GEN). (3-0) Cr. 3. F.S. *Prereq:* BIOL 212

Lee and Salas. Transmission genetics with an emphasis on applications in agriculture, the structure and expression of the gene, how genes behave in populations and how recombinant DNA technology can be used to improve agriculture. Credit for graduation will not be allowed for more than one of the following: Gen 260, 313, 320 and Biol 313 and 313L.

AGRON 325. Biorenewable Systems.

(Cross-listed with A E, TSM, AN S, BSE, BUSAD, ECON). (3-0) Cr. 3. F. *Prereq:* ECON 101, CHEM 163 or higher, MATH 140 or higher

Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, and transportation/logistics.

AGRON 330. Crop and Seed Identification Laboratory.

(0-4) Cr. 2. S. *Prereq:* AGRON 114

Identification, agronomic and binomial classification of crops, weeds, and diseases. Analysis of crop seed samples for contaminants of weed and other crop seeds.

AGRON 331. Intercollegiate Crops Team.

(0-6) Cr. 2. Repeatable. F.S. *Prereq:* Permission of instructor

Intensive training in preparation for intercollegiate competition in national crops contests.

AGRON 334. Forage Crop Management.

(3-0) Cr. 3. F.S. *Prereq:* AGRON 114

Barnhart. Production and management of forage crops; concepts applied to yield, quality, and stand persistence; systems of forage utilization including grazing, hay, and silage. Students enrolling for graduate credit will be expected to complete an additional class project. Nonmajor graduate credit.

AGRON 338. Seed Science and Technology.

(Cross-listed with HORT). (2-3) Cr. 3. F. *Prereq:* AGRON 114 or HORT 221, BIOL 211

Goggi. Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

AGRON 342. World Food Issues: Past and Present.

(Cross-listed with ENV S, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq:* Junior classification

Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit. Meets International Perspectives Requirement.

AGRON 342H. World Food Issues: Past and Present, Honors.

(Cross-listed with ENV S, FS HN, T SC). (3-0) Cr. 3. F.S. *Prereq:* Junior classification

Zdorkowski, Ford. Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects. Nonmajor graduate credit. Meets International Perspectives Requirement.

AGRON 351. Turfgrass Establishment and Management.

(Cross-listed with HORT). (3-0) Cr. 3. F. *Prereq:* HORT 221 or AGRON 114 or BIOL 211

Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests. Nonmajor graduate credit.

AGRON 351L. Turfgrass Establishment and Management Laboratory.

(Cross-listed with HORT). (0-3) Cr. 1. F. *Prereq:* Credit or enrollment in HORT 351

Those enrolled in the horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor. Nonmajor graduate credit.

AGRON 354. Soils and Plant Growth.

(Cross-listed with HORT). (3-0) Cr. 3. F.S. *Prereq:* AGRON 154 and BIOL 101 or BIOL 211

Loynachan. Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development. Nonmajor graduate credit.

AGRON 354L. Soils and Plant Growth Laboratory.

(Cross-listed with HORT). (0-3) Cr. 1. F.S. *Prereq:* Agron or Hort major with credit or enrollment in AGRON 354

Laboratory exercises in soil testing that assess a soil's ability to support nutritive requirements for plant growth.

AGRON 356. Site-Specific Crop and Soil Management.

(3-3) Cr. 4. F. *Prereq:* AGRON 114 and AGRON 354

Polito. Development of solutions to crop and soil management problems in consultation with a producer-client. Identification of client needs, gathering technical information, and use of geographic information systems as a tool for making crop and soil management decisions. Development and presentation of solutions for crop and soil management issues confronting the client. Emphasis will be placed on identifying and solving complex problems that require integration of biological, physical, chemical, and economic components within a crop and soil management system. Nonmajor graduate credit.

AGRON 360. Environmental Soil Science.

(Cross-listed with ENSCI). (2-3) Cr. 3. S. *Prereq:* AGRON 154 or ENSCI 250 or GEOL 201

Burras. Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities.

AGRON 370. Field Experience in Soil Description and Interpretation.

(0-3) Cr. 1. Repeatable, maximum of 4 times. F.S. *Prereq:* AGRON 154 and permission of instructor

Description and interpretation of soils in the field and laboratory, emphasizing hands-on experience. Evaluation of soil information for land use. Students may participate in intercollegiate judging contests.

AGRON 392. Systems Analysis in Crop and Soil Management.(2-3) Cr. 3. F.S. *Prereq:* AGRON 316 and AGRON 354

Wiedenhoft. Management strategies at the level of the farm field. Emphasis will be on participatory learning activities.

AGRON 398. Cooperative Education.Cr. R. F.S.SS. *Prereq:* Permission of department cooperative education coordinator; junior classification

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

AGRON 402I. Watershed Hydrology and Surficial Processes.(Cross-listed with IA LL, ENSCI). Cr. 4. SS. *Prereq:* Four courses in physical or biological sciences or engineering

Effects of geomorphology, soils, and land use on transport of water and materials (nutrients, contaminants) in watersheds. Fieldwork will emphasize investigations of the Iowa Great Lakes watershed. Nonmajor graduate credit.

AGRON 404. Global Change.

(Dual-listed with AGRON 504). (Cross-listed with MTEOR, ENSCI, ENV S). (3-0)

Cr. 3. S. *Prereq:* Four courses in physical or biological sciences or engineering; junior standing

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

AGRON 405. Environmental Biophysics.

(Dual-listed with AGRON 505). (Cross-listed with MTEOR, ENSCI). (3-0) Cr. 3.

Alt. S., offered 2013. *Prereq:* MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)

Hornbuckle. A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities. Nonmajor graduate credit.

AGRON 406. World Climates.(Cross-listed with MTEOR, ENSCI). (3-0) Cr. 3. F. *Prereq:* AGRON 206/MTEOR 206

Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit. Meets International Perspectives Requirement.

AGRON 407. Mesoscale Meteorology.(Dual-listed with AGRON 507). (Cross-listed with MTEOR). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq:* Math 166 and Mteor 443

Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

AGRON 410. Professional Development in Agronomy: Senior Forum.(1-0) Cr. 1. F.S. *Prereq:* Senior classification

Development of an appropriate content for professionalism. Topics include professional certification, ethics, and maintaining an active network of information sources and professional contacts in support of lifelong learning. Student interpretation, writings, presentations, and discussions.

AGRON 417. Evolutionary Ecology of Weeds.(Dual-listed with AGRON 517). (3-0) Cr. 3. *Prereq:* AGRON 317

Dekker. Ecology and evolution of invasive plants and weeds in habitats disturbed by humans. Life history trait evolution and adaptation to agricultural opportunities and the consequent processes of invasion, colonization, enduring occupation and population shifts. Roles played by mating systems and biodiversity, soil seed pools and community assembly, competitive interactions with neighbors and fitness.

AGRON 421. Introduction to Plant Breeding.(Cross-listed with HORT). (3-0) Cr. 3. F. *Prereq:* GEN 320 or BIOL 313

Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing agronomic and horticultural crops. Applications of biotechnology techniques in the development of improved cultivars. Nonmajor graduate credit.

AGRON 446. International Issues and Challenges in Sustainable Development.(Cross-listed with GLOBE, INTST). Cr. 4. S. *Prereq:* 3-credit biology course, Sophomore or higher classification, permission of Instructor

Mullen. Interdisciplinary study and analysis of agricultural, biophysical, environmental, sociological, economical, political, and historical factors affecting sustainable development of communities and countries from art and science perspectives. International field experience with foreign language training required. A program fee is charged to students for international study abroad. Meets International Perspectives Requirement.

AGRON 450. Issues in Sustainable Agriculture.

(Cross-listed with ENV S). (3-0) Cr. 3. F.

Zdorkowski. Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices. Nonmajor graduate credit.

Meets International Perspectives Requirement.

AGRON 452. GIS for Geoscientists.(Dual-listed with AGRON 552). (Cross-listed with GEOL). (2-2) Cr. 3. F. *Prereq:* GEOL 100, GEOL 201 or equivalent

Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses. Nonmajor graduate credit.

AGRON 459. Environmental Soil and Water Chemistry.(Dual-listed with AGRON 559). (Cross-listed with ENSCI). (3-3) Cr. 4. F. *Prereq:*

Two semesters of college-level chemistry, MATH 140, AGRON 154 or AGRON 360; GEOL 100 and AGRON 354 recommended.

Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues. Nonmajor graduate credit.

AGRON 463. Soil Formation and Landscape Relationships.(Dual-listed with AGRON 563). (Cross-listed with ENSCI). (2-4) Cr. 4. S. *Prereq:* AGRON 154 or AGRON 260

Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Nonmajor graduate credit. Credit for one of AGRON 463 or AGRON 463I may be applied for graduation.

AGRON 463I. Soil Formation and Landscape Relationships.(Dual-listed with AGRON 563I). (Cross-listed with IA LL, ENSCI). Cr. 4. Alt. SS., offered 2012. *Prereq:* AGRON 154 or AGRON 260

Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

AGRON 477. Soil Physics.(Dual-listed with AGRON 577). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq:* Recommended: AGRON 154 MATH 166

Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

AGRON 484. Organic Agricultural Theory and Practice.

(Dual-listed with AGRON 584). (Cross-listed with HORT). (3-0) Cr. 3. Alt. S.,

offered 2014. *Prereq:* 9 cr. in biological or physical sciences

Delate. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

AGRON 485. Soil and Environmental Microbiology.

(Dual-listed with AGRON 585). (Cross-listed with ENSCI, MICRO). (2-3) Cr. 3. F.

Prereq: AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)

Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues. Nonmajor graduate credit.

AGRON 488. GIS for Geoscientists II.

(Dual-listed with AGRON 588). (Cross-listed with GEOL, ENSCI). (2-2) Cr. 3. Alt. S., offered 2013. *Prereq: GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent*

GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project. Nonmajor graduate credit.

AGRON 490. Independent Study.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*

Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490E. Entrepreneurship.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*

Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490G. General.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*

Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490H. Independent Study, Honors.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*

Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 490Z. Service Learning.

Cr. 1-3. Repeatable, maximum of 4 credits. F.S.SS. *Prereq: Junior or senior classification with at least 8 credits in agronomy; permission of instructor in specialty area after consultation*

Selected studies in crops, soils, or agricultural meteorology according to the needs and interests of the student.

AGRON 491. Seed Science Internship Experience.

(Cross-listed with HORT). Cr. 1-2. Repeatable, maximum of 1 times. F.S.SS. *Prereq: Agron 338, advanced approval and participation of employer and instructor*

A professional work experience and creative project for seed science secondary majors. The project requires the prior approval and participation of the employer and instructor. The student must submit a written report.

AGRON 493. Workshop in Agronomy.

Cr. arr. Repeatable, maximum of 4 times. *Prereq: Permission of instructor Staff.* Workshop experience in crops, soils, or agricultural meteorology. Nonmajor graduate credit.

AGRON 495. Agricultural Travel Course Preparation.

Cr. R. Repeatable. F.S. *Prereq: Permission of instructor*
Limited enrollment. Students enrolled in this course intend to register for Agron 496 the following term. Topics will include the agricultural industries, climate, crops, culture, economics, geography, history, livestock, marketing, soils, and preparation for travel to locations to be visited.

AGRON 496. Agricultural Travel Course.

Cr. arr. Repeatable. *Prereq: Permission of instructor*
Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.

AGRON 496A. International Tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor*
Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.
Meets International Perspectives Requirement.

AGRON 496B. Domestic Tour.

Cr. arr. Repeatable. *Prereq: Permission of instructor*
Limited enrollment. Tour and study of production methods in major crop and livestock regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, and other factors on crop and livestock production. Location and duration of tours will vary. Tour expenses paid by students. Check with department for current offerings.

AGRON 497. Agroecology Field Course.

(3-0) Cr. 3. F. *Prereq: Jr. or Sr. classification with at least 8 credits in Agronomy*
A one-week intensive class, offered off-campus. Student will visit farms within the Midwest and analyze the sustainability of each farm.

AGRON 498. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of department cooperative education coordinator; senior classification*
Required of all cooperative education students. Students must register for this course prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:**AGRON 500. Orientation Seminar.**

(2-0) Cr. 1. F. *Prereq: International agronomy graduate students only*
Loynachan. An introduction to Iowa and U.S. agriculture for international scholars in agronomic majors. Field trips when possible. Departmental role in the functioning of research, teaching, and extension in fulfilling the charge given the land-grant university.

AGRON 501. Crop Growth and Development.

(3-0) Cr. 3. F.S. *Prereq: AGRON 114, MATH 140, CHEM 163, BIOL 101*
Physiological processes in crop growth, development and yield: photosynthesis, respiration, water relations, mineral nutrition, assimilate partitioning, seedling vigor, light interception and canopy growth, root growth, reproduction and yield. Required course for the Master of Science in Agronomy degree program.

AGRON 502. Chemistry, Physics, and Biology of Soils.

(3-0) Cr. 3. F. *Prereq: AGRON 114, AGRON 154, BIOL 101, CHEM 163, and MATH 140*
Soil chemical, physical, and biological properties that control processes within the soil, their influence on plant/soil interactions, and soil classification. Basic concepts in soil science and their applications. Required course for the Master of Science in Agronomy degree program.

AGRON 503. Climate and Crop Growth.

(3-0) Cr. 3. F.S.SS. *Prereq: AGRON 114 and MATH 140*
Applied concepts in climate and agricultural meteorology with emphasis on the climate-agriculture relationship and the microclimate-agriculture interaction. Basic meteorological principles are also presented to support these applied concepts. Required course for the Master of Science in Agronomy degree program.

AGRON 504. Global Change.

(Dual-listed with AGRON 404). (Cross-listed with MTEOR, ENSCI, ENV S). (3-0) Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing*
Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

AGRON 505. Environmental Biophysics.

(Dual-listed with AGRON 405). (Cross-listed with MTEOR, ENSCI). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)*
Hornbuckle. A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities. Nonmajor graduate credit.

AGRON 507. Mesoscale Meteorology.

(Dual-listed with AGRON 407). (Cross-listed with MTEOR). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: Math 166 and Mteor 443*
Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

AGRON 508. Biophysical Crop Ecology.(3-0) Cr. 3. F. *Prereq:* AGRON 505

Taylor. Physical modeling of bio-response and crop adaptation to climate. Principles of resource capture (light and water) applied to growth and development. Ecological implications of radiation, temperature, moisture, and the biological properties of size, shape, resistance to water vapor loss, and absorptivity to solar and thermal radiation. Physiological stress in the soil, plant, atmosphere continuum.

AGRON 509. Agroecosystems Analysis.(Cross-listed with SUSAG, SOC). (3-4) Cr. 4. F. *Prereq:* Senior or above classification

Experiential, interdisciplinary examination of Midwestern agricultural and food systems, emphasizing field visits, with some classroom activities. Focus on understanding multiple elements, perspectives (agronomic, economic, ecological, social, etc), and scales of operation.

AGRON 510. Crop Improvement.(Cross-listed with STB). (3-0) Cr. 3. *Prereq:* Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor

A study of the basic principles and methods in the genetic improvement of crop plants. Methods used in manipulating genomes through the use of biotechnology. Methods of cultivar development. Quantitative procedures for describing response to selection. Analysis of the relationship of reproductive characters and growth characteristics to response to selection.

AGRON 511. Crop Improvement.(3-0) Cr. 3. S. *Prereq:* AGRON 114, MATH 140, CHEM 163, BIOL 101

Basic principles in the genetic improvement of crop plants. Methods of cultivar development in self-pollinated and cross-pollinated crop species. Required course for the Master of Science in Agronomy degree program.

AGRON 512. Soil-Plant Environment.(3-0) Cr. 3. S. *Prereq:* AGRON 502. *Recommended* AGRON 501

Loynachan. Soil properties and their impact on soil/plant relationships. Soil structure, aeration, moisture, and nutrients will be discussed in the context of soil fertility and environmental quality management. Required course for the Master of Science in Agronomy degree program.

AGRON 513. Quantitative Methods for Agronomy.(3-0) Cr. 3. F.S. *Prereq:* AGRON 114, MATH 140, STAT 104

Quantitative methods for analyzing and interpreting agronomic information. Principles of experimental design, hypothesis testing, analysis of variance, regression, correlation, and graphical representation of data. Use of SAS and Excel for organization, analyzing, and presenting data. Required course for the Master of Science in Agronomy degree program.

AGRON 514. Integrated Pest Management.(3-0) Cr. 3. SS. *Prereq:* AGRON 114, 501, MATH 140, CHEM 163, BIOL 101. *Recommended:* AGRON 502, AGRON 503

Principles and practices of weed science, entomology, and plant pathology applied to crop production systems. Biology, ecology and principles of integrated crop pest management. Required course for the Master of Science in Agronomy degree program.

AGRON 515. Integrated Crop and Livestock Production Systems.(Cross-listed with A E, SUSAG, AN S). (3-0) Cr. 3. Alt. F., offered 2011. *Prereq:* SUSAG 509

Methods to maintain productivity and minimize the negative ecological effects of agricultural systems by understanding nutrient cycles, managing manure and crop residue, and utilizing multispecies interactions. Crop and livestock production within landscapes and watersheds is also considered. Course includes a significant field component, with student teams analyzing Iowa farms.

AGRON 516. Crop Physiology.

(3-0) Cr. 3. S.

Westgate. Investigation of Molecular, whole plant, and plant community processes essential to biomass production and seed formation, and analysis of molecular approaches to overcome the limitations imposed on these processes by the environment.

AGRON 517. Evolutionary Ecology of Weeds.(Dual-listed with AGRON 417). (3-0) Cr. 3. S. *Prereq:* AGRON 317

Dekker. Ecology and evolution of invasive plants and weeds in habitats disturbed by humans. Life history trait evolution and adaptation to agricultural opportunities and the consequent processes of invasion, colonization, enduring occupation and population shifts. Roles played by mating systems and biodiversity, soil seed pools and community assembly, competitive interactions with neighbors and fitness.

AGRON 518. Microwave Remote Sensing.(Cross-listed with E E, MTEOR). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq:* Math 265 or equivalent

Microwave remote sensing of Earth's surface and atmosphere using satellite-based or ground-based instruments. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, ocean salinity, and soil moisture.

AGRON 519. Herbicide Physiology and Biochemistry.(2-0) Cr. 2. Alt. S., offered 2012. *Prereq:* AGRON 317; BIOL 330

Owen. Herbicide mechanisms of action, selectivity, uptake, and translocation. Specific sites of herbicide action as they affect plant physiology. Herbicide resistance in weeds and crops. Implications of herbicides on weed management.

AGRON 521. Principles of Cultivar Development.(3-0) Cr. 3. F. *Prereq:* AGRON 421; STAT 401

Theoretical and practical analysis of alternative breeding methods to improve crop plants. Strategies to incorporate germplasm resources, develop populations, maximize genetic gain, and use marker-assisted selection. Relationship of breeding methods to commercial seed production.

AGRON 522. Field Methods in Plant Breeding.(0-6) Cr. 1-2. Alt. SS., offered 2012. *Prereq:* AGRON 521

Field experience in planning and conducting plant breeding research for germplasm and cultivar development. Offered on a satisfactory-fail basis only.

AGRON 523. Molecular Plant Breeding.(2-2) Cr. 3. S. *Prereq:* AGRON 421 or AGRON 521, GDCB 542A

Plant breeding in the era of sequenced genomes and transformation. High throughout genomic technologies will be presented in relation to various applications in plant breeding.

AGRON 526. Field Plot Technique.(3-0) Cr. 3. Alt. S., offered 2013. *Prereq:* STAT 401

Moore. Planning experiments for agricultural research, analysis of data, and concepts in data interpretation.

AGRON 527. Plant Genetics.(3-0) Cr. 3. S. *Prereq:* GEN 410

Bhattacharyya. Fundamental genetic and cytogenetic concepts from plant perspective including recombination, linkage analysis, genetic and molecular mapping, male sterility, self incompatibility, apomixis, and polyploid evolution.

AGRON 529. Publishing in Biological Sciences Journals.(Cross-listed with HORT, NREM). (3-0) Cr. 3. S. *Prereq:* Permission of instructor; evidence of a publishable unit of the student's research data

Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

AGRON 530. Ecologically Based Pest Management Strategies.

(Cross-listed with SUSAG, ENT, PL P). (3-0) Cr. 3. Alt. F., offered 2014.

Durable, least-toxic strategies for managing weeds, pathogens, and insect pests, with emphasis on underlying ecological processes.

AGRON 531. Crop Ecology and Management.(3-0) Cr. 3. F. *Prereq:* AGRON 501, AGRON 502, AGRON 503. *Recommended:* AGRON 512, AGRON 514

Ecological principles underlying crop production systems. Crop production in the context of management approaches, system resources and constraints, and interactions. Emphasis on the ecology of row and forage crops common to the Midwest. Required course for the Master of Science in Agronomy degree program.

AGRON 532. Soil Management.(3-0) Cr. 3. F. *Prereq:* AGRON 501, AGRON 503, AGRON 512. *Recommended* AGRON 513

Evaluates the impact of various soil management practices on soil and water resources. Combines and applies basic information gained in Agron 502 and Agron 512. Emphasizes the agronomic, economic, and environmental effects of soil management strategies. Required course for the Master of Science in Agronomy degree program.

AGRON 533. Crop Protection.(3-0) Cr. 3. F. *Prereq:* AGRON 514

Integrated management systems for important crop pests. Cultural, biological and chemical management strategies applicable to major crops grown in the Midwest. Required course for the Master of Science in Agronomy degree program.

AGRON 534. Seed and Variety, Testing and Technology.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor*
The components of seed quality and how they are assessed in the laboratory, including traits derived from modern biotechnology. The impact of new technologies on seed quality testing. Variety maintenance procedures and breeder seed. Variety identification: phenotype and grow-out trials, isozyme testing, and DNA marker testing. Procedures for evaluating varieties. The variance tests appropriate for fixed effects analysis of variance. Statistical inference and stratification for yield trials. Use of strip plot testing.

AGRON 535. Introduction to the Seed Industry.

(Cross-listed with STB). Cr. 1. *Prereq: Admission to MS in Seed Technology and Business program or by special arrangement with the instructor*
An analysis of the defining characteristics of the seed industry and introduction to the Master in Seed Technology and Business curriculum. The tasks of crop improvement and seed production will be analytically related to basic management functions and classifications of management activities that are used in the study of business administration. Management tasks and roles will be analyzed in related to the public policy issues that shape the seed industry, including ethical and economical approaches to biotechnology, intellectual property, and corporate responsibility.

AGRON 536. Quantitative Methods for Seed.

(Cross-listed with STB). (1-0) Cr. 1. F. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor*
Quantitative Methods for analyzing and interpreting agronomic and business information for the seed industry. Principles of experimental design and hypothesis testing, regression, correlation and graphical representation of data. Use of spreadsheets for manipulating, analyzing and presenting data.

AGRON 538. Seed Physiology.

(2-0) Cr. 2. Alt. F., offered 2014. *Prereq: AGRON 316, CHEM 231 or CHEM 331 Goggi.* Physiological aspects of seed development, maturation, longevity, dormancy, and germination. Emphasis on current literature and advanced methodology.

AGRON 539. Seed Conditioning and Storage.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor*
The technical operations which may be carried out on a seed lot from harvest until it is ready for marketing and use. The opportunities for quality improvement and the risks of deterioration which are present during that time. Analysis of the costs of and benefits of operations. Evaluation of equipment based on benefits to the customer and producer. Interpretation of the role of the conditioning plant and store as a focal points within the overall operations of a seed company.

AGRON 541. Applied Agricultural Meteorology.

Cr. 2-3. F.S.SS. *Prereq: AGRON 206 or upper division Biological Science Taylor.* Applied concepts in agricultural meteorology. Basic concepts of weather and of crop/climate relationships influencing production, protection, yield and associated production risk factors. Self study sections are available to resident and to distant education students all semesters. Credit for only one of Agron 503 or 541 may be applied toward graduation.

AGRON 546. Strategies for Diversified Food and Farming Systems.

(Cross-listed with SUSAG, HORT). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: SUSAG 509*
Project-focused engagement in food and farming systems using tools and perspectives drawn from multiple disciplines. Includes a field component.

AGRON 547. Seed Production.

(Cross-listed with STB). (2-0) Cr. 2. *Prereq: Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor*
Survey of crop production; including management of soil fertility, planting dates, populations, weed control, and insect control. Analysis of the principles of seed multiplication and the key practices which are used to ensure high quality in the products. Field inspection procedures and production aspects that differ from other crop production. Foundation seed production. Analysis of the typical organization of field production tasks. Resources and capabilities required. Survey of differences in seed production strategies between crops and impact of differences on management of seed production.

AGRON 551. Growth and Development of Perennial Grasses.

(Cross-listed with HORT). (2-0) Cr. 2. Alt. S., offered 2014. *Prereq: Junior or senior or graduate classification or permission of instructor*
Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

AGRON 552. GIS for Geoscientists.

(Dual-listed with AGRON 452). (Cross-listed with GEOL). (2-2) Cr. 3. F. *Prereq: GEOL 100, GEOL 201 or equivalent*
Introduction to geographic information systems (GIS) with particular emphasis on geoscientific data. Uses ESRI's ArcGIS Desktop Software and extension modules. Emphasizes typical GIS operations and analyses in the geosciences to prepare students for advanced GIS courses.

AGRON 553. Soil-Plant Relationships.

(Cross-listed with ENSCI). (3-0) Cr. 3. F. *Prereq: AGRON 354*
Composition and properties of soils in relation to the nutrition and growth of plants.

AGRON 554. Advanced Soil Management.

(2-0) Cr. 2. Alt. F., offered 2011. *Prereq: AGRON 354; MATH 165*
Cruse. Implications of soil management on the soil environment and root activity. Effect of soil physical properties on soil erosion.

AGRON 555. Environmental Soil Mineralogy.

(Cross-listed with GEOL). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: AGRON 473, CHEM 178. Recommend: GEOL 311*
Structure and behavior of clay minerals, humic substances and biochar in soil environments, with emphasis on reactions and environmental implications.

AGRON 555L. Soil Clay Mineralogy Laboratory.

(Cross-listed with GEOL). (0-3) Cr. 1. Alt. S., offered 2013. *Prereq: Credit or enrollment in AGRON 555*
Laird. Application of X-ray diffraction, thermal analysis, infrared spectroscopy, and chemical analyses to identification and behavior of clay minerals in soils.

AGRON 558. Laboratory Methods in Soil Chemistry.

(Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered 2012. *Prereq: AGRON 354 and CHEM 211*
Experimental and descriptive inorganic and organic analyses. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and ion-selective electrodes.

AGRON 559. Environmental Soil and Water Chemistry.

(Dual-listed with AGRON 459). (Cross-listed with ENSCI). (3-3) Cr. 4. F. *Prereq: Two semesters of college-level chemistry, MATH 140, AGRON 154 or AGRON 360; GEOL 100 and AGRON 354 recommended.*
Thompson. An introduction to the chemical properties of soils, chemical reactions and transformations in soils and surface waters, and their impact on the environment. Topics include solution chemistry in soils and surface waters, solid-phase composition of soils, reactions at the solid-solution interface, and applications to contemporary environmental issues. Nonmajor graduate credit.

AGRON 561. Population and Quantitative Genetics for Breeding.

(Cross-listed with AN S). (4-0) Cr. 4. F. *Prereq: STAT 401*
Population and quantitative genetics for plant and animal genetics. Study of the genetic basis and analysis of variation in quantitative traits in domestic or experimental populations using phenotypic and molecular marker data, including estimation of heritability and other genetic parameters, linkage analysis and mapping of quantitative trait loci, and the impact of inbreeding, heterosis, and genotype-by-environment interaction.

AGRON 563. Soil Formation and Landscape Relationships.

(Dual-listed with AGRON 463). (Cross-listed with ENSCI). (2-4) Cr. 4. S. *Prereq: AGRON 154 or AGRON 260*
Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Two weekend field trips. Credit for one of Agron 563 or 563I may be applied for graduation.

AGRON 563I. Soil Formation and Landscape Relationships.

(Dual-listed with AGRON 463I). (Cross-listed with IA LL, ENSCI). Cr. 4. Alt. SS., offered 2012. *Prereq: AGRON 154 or AGRON 260*
Burras. Relationships between soil formation, geomorphology, and environment. Soil description, classification, geography, mapping, and interpretation for land use. Credit for only Agron 563 or 563I may be applied for graduation.

AGRON 570. Risk Assessment for Food, Agriculture and Veterinary Medicine.

(Cross-listed with VDPAM, TOX). (3-0) Cr. 3. F. *Prereq:* STAT 104 or consent of instructor

Wolt, Hurd. Risk assessment principles as applied to biological systems. Exposure and effects characterization in human and animal health and ecological risk assessment. Risk analysis frameworks and regulatory decision-making. Introduction to quantitative methods for risk assessment using epidemiological and distributional analysis. Uncertainty analysis. This course is available on campus and by distance.

AGRON 575. Soil Formation and Transformation.

(Cross-listed with ENSCI). (3-0) Cr. 3. Alt. F., offered 2012. *Prereq:* AGRON 463 or equivalent

Advanced study of soil formation, emphasizing relationships among soils, landscapes, environment, humans, and land use.

AGRON 577. Soil Physics.

(Dual-listed with AGRON 477). (Cross-listed with ENSCI). (3-0) Cr. 3. S. *Prereq:* Recommended: AGRON 154 and MATH 166

Horton. The physical soil system: the soil components and their physical interactions; transport processes involving water, air, and heat.

AGRON 578. Laboratory Methods in Soil Physics.

(Cross-listed with ENSCI). (0-3) Cr. 1. S. *Prereq:* concurrent enrollment in AGRON 477 or 577

Horton. Methods of measuring soil physical properties such as texture, density, and water content, and transport of heat, water, and gases.

AGRON 584. Organic Agricultural Theory and Practice.

(Dual-listed with AGRON 484). (Cross-listed with HORT). (3-0) Cr. 3. Alt. S., offered 2014. *Prereq:* 9 cr. in biological or physical sciences

Delate. Understanding of the historical origins and ecological theories underpinning the practices involved in organic agriculture. Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

AGRON 585. Soil and Environmental Microbiology.

(Dual-listed with AGRON 485). (Cross-listed with ENSCI, MICRO). (2-3) Cr. 3. F. *Prereq:* AGRON 154 or AGRON 402, MICRO 201 (MICRO 201L recommended)

Loynachan. The living organisms in the soil and what they do. Emphasis on soil biota composition, the carbon cycle and bioremediation, soil-plant-microbial relationships, and environmental issues.

AGRON 588. GIS for Geoscientists II.

(Dual-listed with AGRON 488). (Cross-listed with GEOL, ENSCI). (2-2) Cr. 3. Alt. S., offered 2013. *Prereq:* GIS course, such as GEOL 452, CRP 451, CRP 452, NREM 345, NREM 446, AE 408 or equivalent

GIS course with focus on the spatial analysis and modeling of raster data and triangulated irregular network (TIN) data. Uses ArcGIS and various extensions, such as Spatial Analyst, 3D Analyst, and ArcScene. Includes practical exercises during lectures, lab exercises, homework assignments, and (for GEOL 588) a class project.

AGRON 590. Special Topics.

Cr. arr. Repeatable. *Prereq:* 15 credits in agronomy

Literature reviews and conferences on selected topics in crops, soils, or agricultural meteorology according to needs and interest of student.

AGRON 591. Agronomic Systems Analysis.

(3-0) Cr. 3. S. *Prereq:* AGRON 511, AGRON 513, AGRON 531, AGRON 532, AGRON 533

Analysis of cropping systems from a problem-solving perspective. Case studies will be used to develop the students' ability to solve agronomic problems. Required course for the Master of Science in Agronomy degree program.

AGRON 592. Current Issues in Agronomy.

(3-0) Cr. 3. S. *Prereq:* AGRON 501, AGRON 503, AGRON 511, AGRON 512, AGRON 513, AGRON 514

Study and discussion of topics of current interest to the field of agronomy. While Agron 591 deals with agronomics at the farm and landscape level, Agron 592 seeks to address issues on a broader scale including off-farm agricultural impacts. Required course for the Master of Science in Agronomy degree program.

AGRON 593. Workshop in Agronomy.

Cr. arr. Repeatable. *Prereq:* Graduate classification

AGRON 593A. Crops.

Cr. arr. Repeatable. *Prereq:* Graduate classification

AGRON 593B. Soils.

Cr. arr. Repeatable. *Prereq:* Graduate classification

AGRON 593C. Agricultural Meteorology.

Cr. arr. Repeatable. *Prereq:* Graduate classification

AGRON 593D. Seed Science.

Cr. arr. Repeatable. *Prereq:* Graduate classification

AGRON 593E. Weed Science.

Cr. arr. Repeatable. *Prereq:* Graduate classification

AGRON 594. Agronomy MS Practicum.

(1-0) Cr. 1. SS. *Prereq:* AGRON 501, AGRON 502, AGRON 503, AGRON 514 (or current enrollment. Recommended: AGRON 511, AGRON 512, AGRON 513

Practical field and laboratory experiences integrating coursework in climatology, crops, and soils. Includes lectures, labs and local agri-business tours.

AGRON 595. Seed Quality, Production, and Research Management.

(Cross-listed with STB). (3-0) Cr. 3. *Prereq:* Admission to the Seed Technology and Business Master's Degree Program or approval of the instructor

Advanced survey of the organization, staff capabilities and management characteristics typical in seed production and crop improvement in seed enterprises. Analysis of the use of quality information in the management of seed operations and sales. Process management applications for seed. Production planning for existing capacity. Analysis of the manager's tasks in the annual cycle and how the tasks of these managers relate to the general categories of business management roles. Difference in management strategies used with different situations and groups of employees.

AGRON 599. Creative Component.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599A. Agricultural Meteorology.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599B. Crop Production and Physiology.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599C. Plant Breeding.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599D. Soil Chemistry.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599E. Soil Fertility.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599F. Soil Management.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599G. Soil Microbiology and Biochemistry.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599H. Soil Morphology and Genesis.

Cr. arr. *Prereq:* Nonthesis M.S. option only

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599I. Soil Physics.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599K. Seed Science.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599L. Weed Science.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

AGRON 599M. Agronomy.

Cr. arr. *Prereq: Nonthesis M.S. option only*

A written report based on research, library readings, or topics related to the student's area of specialization and approved by the student's advisory committee.

Courses for graduate students:**AGRON 600. Seminar.**

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 600A. Plant Breeding.

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 600B. Soils. F.S..

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 600C. Crop Production and Physiology. F.S..

(1-0) Cr. 1. Repeatable, maximum of 6 times. F.S.

Reports and discussion of recent literature and research.

AGRON 609. Agricultural Meteorology Conference.

(1-0) Cr. 1. Repeatable. F.S.SS. *Prereq: Permission of instructor*

Literature reviews and conferences with instructor on special problems relating to agricultural meteorology, beyond the scope of current courses offered.

AGRON 610. Foundations of Sustainable Agriculture.

(Cross-listed with SUSAG, A E, ANTHR, SOC). (3-0) Cr. 3. F. *Prereq: Graduate classification, permission of instructor*

Historical, biophysical, socioeconomic, and ethical dimensions of agricultural sustainability. Strategies for evaluating existing and emerging agricultural systems in terms of the core concepts of sustainability and their theoretical contexts.

AGRON 616. Advanced Topics in Plant Physiology and Biochemistry.

(4-0) Cr. 4. Alt. S., offered 2012. *Prereq: Graduate classification; permission of instructor*

Westgate. An in-depth treatment of physiological, biochemical and molecular processes regulating plant growth and development. Emphasis on individual study followed by in-class presentations and discussion.

AGRON 621. Advanced Plant Breeding.

(3-0) Cr. 3. F. *Prereq: AGRON 521, AGRON 526, AGRON 561; GEN 410*

Beavis. Estimation and interpretation of genetic effects and variances of plant breeding populations, analysis of mating designs, estimation of combining ability and heritability, best linear unbiased prediction, selection indices with and without molecular information, inbreeding and heterosis.

AGRON 625. Genetic Strategies in Plant Breeding.

(3-0) Cr. 3. Alt. S., offered 2013. *Prereq: AGRON 521, GEN 510*

Lee. Evaluation of genetic, molecular, and cellular approaches to crop improvement; gene transfer methods. Application and role of basic plant biology in breeding programs and processes; genome structure and function, gene isolation, expression, regulation, and modification. Integration of molecular and cellular methods in breeding strategies; analysis of alternative breeding methods, regulatory and ethical issues.

AGRON 655. Advanced Soil Fertility.

(2-0) Cr. 2. Alt. S., offered 2013. *Prereq: AGRON 553*

Evaluation of soil fertility and fertilizers; theory and applications.

AGRON 677. Advanced Soil Physics.

(2-0) Cr. 3. Alt. F., offered 2012. *Prereq: AGRON 577; MATH 266, MATH 267.*

Recommended: COM S 207

Horton. The flow and distribution of water, chemicals, and heat in soils. Physical principles and applications.

AGRON 685. Advanced Soil Biochemistry.

(Cross-listed with MICRO, ENSCI). (2-0) Cr. 2. Alt. S., offered 2012. *Prereq:*

AGRON 585

Chemistry of soil organic matter and biochemical transformations brought about by microorganisms and enzymes in soils.

AGRON 696. Research Seminar.

(Cross-listed with PLBIO, BBMB, GDCB, HORT, FOR). Cr. 1. Repeatable. F.S.

Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

AGRON 698. Agronomy Teaching Practicum.

Cr. 1-2. Repeatable. F.S.SS. *Prereq: Graduate classification in agronomy and permission of instructor*

Graduate student experience in the agronomy teaching program. Offered on a satisfactory-fail basis only.

AGRON 699. Research.

Cr. arr. Repeatable.

AGRON 699A. Agricultural Meteorology.

Cr. arr. Repeatable.

AGRON 699B. Crop Production and Physiology.

Cr. arr. Repeatable.

AGRON 699C. Plant Breeding.

Cr. arr. Repeatable.

AGRON 699D. Soil Chemistry.

Cr. arr. Repeatable.

AGRON 699E. Soil Fertility.

Cr. arr. Repeatable.

AGRON 699F. Soil Management.

Cr. arr. Repeatable.

AGRON 699G. Soil Microbiology and Biochemistry.

Cr. arr. Repeatable.

AGRON 699H. Soil Morphology and Genesis.

Cr. arr. Repeatable.

AGRON 699I. Soil Physics.

Cr. arr. Repeatable.

AGRON 699J. Plant Physiology.

Cr. arr. Repeatable.

AGRON 699K. Seed Science.

Cr. arr. Repeatable.

AGRON 699L. Weed Science.

Cr. arr. Repeatable.