**Undergraduate Study**

Agronomy is the science and technology of producing plants that serve humans, using practices essential for maintaining and improving life. The Department of Agronomy offers a major leading to a degree of Bachelor of Science (B.S.) in agronomy. Graduates have the theoretical and practical knowledge needed for efficient and sustainable crop production. They are skilled in critical thinking, problem solving, communicating, and working effectively with others. They understand the ethical, cultural, and environmental dimensions of issues facing agronomists globally.

An agronomy major prepares students for employment in crop production and soil management, yield forecasting, precision farming, plant breeding, agricultural business and industry, agricultural service organizations, 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, grain inspectors, integrated pest managers, land appraisers, agricultural lenders, and other science-based professionals.

An agronomy major also prepares students for graduate school. We offer a concurrent B.S./MBA degree. About a quarter of our students immediately continue into research-based M.S. and Ph.D. programs. As an undergraduate, there are many opportunities to be involved in research.

Department of Agronomy website - http://www.agron.iastate.edu/.

**Student Learning Outcomes**

Upon graduation, students should be able to:

**KNOWLEDGE:** Graduates of our bachelor’s degree program will demonstrate knowledge of the scientific principles and practices needed for success as an agronomist.

**INTEGRATION AND PROBLEM-SOLVING:** Graduates of our bachelor’s degree program will integrate knowledge and skills to systematically assess, critically analyze, and sustainably manage agronomic systems.

**PROFESSIONALISM AND CAREER READINESS:** Graduates of our bachelor’s degree program will demonstrate professional skills and career readiness.

**COMMUNICATION:** Graduates of our bachelor’s degree program will communicate and engage effectively with diverse audiences.

**DIVERSE WORLDVIEWS:** Graduates of our bachelor’s degree program will demonstrate knowledge of diverse worldviews that affect agronomic practices.

**ETHICAL, ENVIRONMENTAL, AND ECOCLOGICAL ASPECTS:** Graduates of our bachelor’s degree program will demonstrate knowledge of the ethical, environmental, and ecological aspects of agronomic practices.

**Curriculum in Agronomy**

**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. A minimum of 15 credits of agronomy courses must be earned at Iowa State and not transferred from other institutions.

**International Perspective: 3 cr.**

3 cr. from approved International Perspective list: http://www.registrar.iastate.edu/students/div-ip-guide/IntlPerspectives-current

**U.S. Diversity: 3 cr.**

3 cr. from approved U.S. Diversity list: http://www.registrar.iastate.edu/students/div-ip-guide/usdiversity-courses

**Communication/Library: 13 cr.**

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

- ENGL 1500 Critical Thinking and Communication 3
- ENGL 2500 Written, Oral, Visual, and Electronic Composition 3
- SPCM 2120 Fundamentals of Public Speaking 3
- or AGEDS 3110 Presentation and Sales Strategies for Agricultural Audiences

**Humanities: 3 cr.**

3 cr. from approved humanities list: http://www.cals.iastate.edu/student-services/humanities

**Department of Agronomy website - http://www.agron.iastate.edu/**
Social Sciences: 3 cr.
3 cr. from approved social sciences list: http://www.cals.iastate.edu/student-services/social-sciences/

Ethics: 3 cr.
3 cr. from approved ethics list: http://www.cals.iastate.edu/student-services/ethics/

Mathematical Sciences: 6 cr.
MATH 1400 College Algebra 3
STAT 1040 Introduction to Statistics 3

Physical Sciences: 8 cr.
CHEM 1630 College Chemistry 5
& 1630L Laboratory in College Chemistry
One of the following:
AGRON 2590 Organic Compounds in Plants and Soils 3
BBMB 2210 Structure and Reactions in Biochemical Processes 3
CHEM 2310 Elementary Organic Chemistry 4
& 2310L Laboratory in Elementary Organic Chemistry

Life and Biological Sciences: 7 cr.
BIOL 2120 Principles of Biology II 4
& 2120L and Principles of Biology Laboratory II
AGRON 3200 Genetics, Agriculture and Biotechnology 3
or BIOL 3130 Principles of Genetics

Supporting Sciences: 15 cr.
Courses cannot be used to fulfill any other university, college, or Agronomy requirements. At least 9 cr. must be in courses numbered 3000 or above.

This requirement can be met in one of three ways:

a. Complete at least 3 credits in basic or mathematics-intensive discipline (ACCT, BBMB, BIOL, CHEM, COMS, ECON, All Engineering, GEOL, GEN, MATH, MTEOR, PHYS, STAT) as well as at least 6 additional credits in AMS, BIOL, BBMB, ENSCI, ENT, GEOL, HORT, GEN, MICRO, NREM, PLP, TSM. The other 6 credits can be a combination of the above department's courses and/or AGRON.

b. Complete the courses needed to fulfill a certificate or second major that complements the student's academic and professional goals.

c. By the end of the third semester before graduation, petition the Agronomy Curriculum Committee with a specific set of courses designed around "keeper of the land," "builder of genetic diversity," "explorer of plant life," "developer of bioenergy," "confronter of world hunger," or "designer of sustainable systems."

Agronomy Core: 44 cr.
AGRON 1050 Leadership Experience
AGRON 1100 Professional Development in Agronomy: Orientation
AGRON 1800 Global Agriculture in a Changing World 3
AGRON 1810 Introduction to Crop Science 3
AGRON 1820 Introduction to Soil Science 3
AGRON 1830 Basic Skills for Agronomists 1
AGRON 2060 Introduction to Weather and Climate 3
AGRON 2100 Professional Development in Agronomy: Career Planning
AGRON 2790 Field Exploration of Agronomy 3
AGRON 2800 Crop Development, Production and Management 3
AGRON 2820 Soil Conservation and Land Use 3
AGRON 3100 Professional Development in Agronomy: Work Experience
or AGRON 3110 Professional Internship in Agronomy
AGRON 3160 Crop Structure-Function Relationships 3
AGRON 3420 World Food Issues: Past and Present
or AGRON 450 Issues in Sustainable Agriculture
AGRON 3540 Soils and Plant Growth 4
& 3540L and Soils and Plant Growth Laboratory
AGRON 3600 Environmental Soil Science 3
or AGRON 392 Systems Analysis in Crop and Soil Management
AGRON 4100 Professional Development in Agronomy: Senior Forum

Additional AGRON credits at the 3000-4000 level 6

Electives: 20 cr.
Additional free electives 20

Agronomy, B.S.

Freshman

Fall Credits
AGRON 1100 1
AGRON 1800 3
AGRON 1830 1
CHEM 1630 or 1770 4
CHEM 1630L or 1770L 1
ENGL 1500 3
LIB 1600 1
Math or Social Sciences 3

Credits
1
3
3
3
1
3
3
3
3
Sophomore

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<thead>
<tr>
<th></th>
<th>Fall Credits</th>
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<tr>
<td>AGRON 2060</td>
<td>3</td>
<td>AGRON 2820</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 2100</td>
<td>1</td>
<td>AGEDS 3110 or SPCM 2120</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 2790</td>
<td>3</td>
<td>Organic Chemistry: AGRON 2590, BBMB 2210, OR CHEM 2310 &amp; L</td>
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<tr>
<td>AGRON 2800</td>
<td>3</td>
<td>Elective</td>
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<tr>
<td>STAT 1040</td>
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<td>Supporting Sciences</td>
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<td>Humanities</td>
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Junior

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<td>AGRON 3160</td>
<td>3</td>
<td>AGRON 3200 or BIOL 3130</td>
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<td>AGRON 3540</td>
<td>3</td>
<td>AGRON 3420 or 4500</td>
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<td>AGRON 3540L</td>
<td>1</td>
<td>ENGL 3020, 3090, 3120, or 3140</td>
<td>3</td>
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<tr>
<td>Elective</td>
<td>6</td>
<td>International Perspectives</td>
<td>3</td>
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<tr>
<td>Supporting Sciences</td>
<td>3</td>
<td>Supporting Sciences (3000+)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>16</td>
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<td>15</td>
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Senior

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<td>AGRON 3600</td>
<td>6</td>
<td>AGRON 3600 or 3920</td>
<td>3</td>
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<tr>
<td>Elective</td>
<td>5</td>
<td>AGRON 4100</td>
<td>1</td>
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<tr>
<td>Ethics</td>
<td>3</td>
<td>Elective</td>
<td>6</td>
</tr>
<tr>
<td>U.S. Diversity</td>
<td>3</td>
<td>Supporting Sciences (3000+)</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

Minor - Agronomy

A minor in agronomy is earned by taking 18 credits consisting of the following:

- 6 credits of required courses;
- 3-6 credits of foundation courses;
- 6-9 credits of supporting courses.

At least 9 credits must be taken at Iowa State University with at least 6 credits numbered 3000 or above. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

A student may use up to:

- 3 credits of AGRON 4960A or AGRON 4960B;
- Or up to 2 credits from AGRON 3310 or AGRON 3700;
- Or up to 1 credit of AGRON 4900E or AGRON 4900G or AGRON 4900H or AGRON 4900Z

Required Courses (6 credits):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>AGRON 1810</td>
<td>Introduction to Crop Science</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 1820</td>
<td>Introduction to Soil Science</td>
<td>3</td>
</tr>
</tbody>
</table>

Foundation Courses - One or two courses from the list below (3-6 credits):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 1800</td>
<td>Global Agriculture in a Changing World</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 2060</td>
<td>Introduction to Weather and Climate</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 2800</td>
<td>Crop Development, Production and Management</td>
<td>3</td>
</tr>
</tbody>
</table>

Supporting Courses (6-9 credits, 6 credits of which must be 3000+ level):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 2170</td>
<td>Weed Identification</td>
<td>1</td>
</tr>
<tr>
<td>AGRON 2590</td>
<td>Organic Compounds in Plants and Soils</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 2700</td>
<td>Geospatial Technologies</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3160</td>
<td>Crop Structure-Function Relationships</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3170</td>
<td>Principles of Weed Science</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3200</td>
<td>Genetics, Agriculture and Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3340</td>
<td>Forage Crop Management</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3380</td>
<td>Seed Science and Technology</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3540</td>
<td>Soils and Plant Growth</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3600</td>
<td>Environmental Soil Science</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 3920</td>
<td>Systems Analysis in Crop and Soil Management</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4050</td>
<td>Soil-Plant-Animal-Atmosphere Physics</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4210</td>
<td>Introduction to Plant Breeding</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4500</td>
<td>Issues in Sustainable Agriculture</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4590</td>
<td>Environmental Soil and Water Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>AGRON 4630</td>
<td>Soil Formation and Landscape Relationships</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4770</td>
<td>Soil Physics</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4840</td>
<td>Organic Agricultural Theory and Practice</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4850</td>
<td>Soil and Environmental Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 4970</td>
<td>Agroecology Field Course</td>
<td>3</td>
</tr>
</tbody>
</table>

SOIL SCIENCE CERTIFICATE

Purpose

The certificate in soil science will prepare students with the skills needed for successful careers in the field of soil science. Soil science has key roles in achieving goals of sustainability as demonstrated by the functions of soil and their ecosystem services. Namely, soil is an important factor in addressing issues of food scarcity, water...
management, climate change, biodiversity loss, and human health. Students who complete the Iowa State University soil science certificate program will qualify for federal employment as a soil scientist. In addition, students completing the certificate will have met the educational component of the Soil Science Society of America's requirements for certification as a professional soil scientist and all U.S. states' educational criteria for licensure as a professional soil scientist.

Requirements
The certificate in soil science requires the completion of 31 credit hours, including a foundation course in soil science, 15 credits in supporting biological, physical, or Earth sciences, as well as 13 credits from approved categories of soil science courses.

At least 9 credits must be taken in soil science courses numbered at the 3000-level or above.

At least 9 credits used for the certificate cannot be used to meet any other department, college, or university requirement for the baccalaureate degree except to satisfy the total credit requirement for graduation and to meet credit requirements in courses numbered 3000 or above.

Courses for the certificate cannot be taken on a pass/not-pass basis.

Course Requirements for Soil Science Certificate

Foundation: 3 credits of required core course.

AGRON 1820 Introduction to Soil Science

Supporting Biological, Physical, or Earth Sciences: Choose 15 credits from approved list consisting of courses from the following designators: ABE, AGRON, AECL, BIOL, CHEM, CE, CRP, ENSCI, ENT, FOR, GEOL, HORT, LA, MTEOR, MICRO, NREM, PHYS.

Soil Science: Choose 13 credits with at least 2 credits from each of the following categories.

Soil Physical Properties or Soil Water Relationships (2 credits)

AGRON 2820 Soil Conservation and Land Use
AGRON 3600 Environmental Soil Science
AGRON 4050 Soil-Plant-Animal-Atmosphere Physics
AGRON 4770 Soil Physics
ABE 4310 Design and Evaluation of Soil and Water Conservation Systems
TSM 3240 Soil and Water Conservation Management

Soil Chemistry (2 credits)

AGRON 2590 Organic Compounds in Plants and Soils
AGRON 4590 Environmental Soil and Water Chemistry

Soil Biology (2 credits)

AGRON 3540 Soils and Plant Growth

AGRON 3540L Soils and Plant Growth Laboratory
AGRON 4850 Soil and Environmental Microbiology
AGRON 2700 Geospatial Technologies
AGRON 3700 Field Experience in Soil Description and Interpretation
AGRON 4630 Soil Formation and Landscape Relationships

The Soil Science Certificate may be earned at the same time as an ISU baccalaureate degree or after the completion of an associate of arts (AA) or associate of science (AS) degree or a baccalaureate degree from any accredited institution.

Information on the concurrent Agronomy bachelor's degree and MBA can be located here (https://www.ivybusiness.iastate.edu/full-time-concurrent-mba/).

Graduate Study

Introduction
Agronomy is the science and technology of producing plants that serve humans, using practices essential for maintaining and improving life. The Department of Agronomy administers Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degree programs in four different graduate majors that emphasize different disciplines of agronomy. These majors are: Agricultural Meteorology; Crop Production and Physiology; Plant Breeding; and Soil Science. A fifth graduate major, Agronomy, offers both an M.S. and a Graduate Certificate through distance education suitable for professionals working in industry or government, as well as a graduate minor for on-campus students.

Admission
To be fully admitted, prospective graduate students must have an undergraduate GPA of at least a 3.00 GPA (4.00 scale) or rank in the upper one-half of their undergraduate class. Non-native English speakers must take the Test of English as a Foreign Language (TOEFL). Students applying to the Agricultural Meteorology and Plant Breeding graduate majors must take the Graduate Record Examination (GRE). For all of the majors except Agronomy, a faculty member of the graduate major must agree to be the major professor before the student is admitted.

Program of Study
The academic courses used to satisfy requirements for a graduate degree compose a student's Program of Study (POS). The POS must be approved by the student's POS Committee. For the M.S. in Agronomy, the POS Committee must be composed of at least two faculty who are both members of the Graduate Major in Agronomy. For the other four majors at the M.S. degree level, at least three faculty must serve on a
POS Committee. Two of the three must be members of the major, and at least one must be a member of a different graduate major. At the Ph.D. level the POS Committee must have at least five members, of which at least three must be faculty in the major, and at least one a member of a different graduate major. If the student is pursuing a graduate minor, either as part of an M.S. or Ph.D., a graduate faculty member representing the minor must serve on the POS Committee.

**Agronomy**
The POS for the M.S. in Agronomy is fixed and consists of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 5010</td>
<td>Crop Growth and Development</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5020</td>
<td>Chemistry, Physics, and Biology of Soils</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5030</td>
<td>Climate and Crop Growth</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5110</td>
<td>Crop Improvement</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5120</td>
<td>Soil-Plant Environment</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5130</td>
<td>Data Science for Agricultural Professionals</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5140</td>
<td>Integrated Pest Management</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5310</td>
<td>Crop Ecology and Management</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5320</td>
<td>Soil Management</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5330</td>
<td>Crop Protection</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5910</td>
<td>Agronomic Systems Analysis</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5920</td>
<td>Current Issues in Agronomy</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5940</td>
<td>Agronomy MS Practicum</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5990M</td>
<td>Agronomy (3 credits total over 2 semesters: 1 credit for proposal. 2 credits for final oral exam.)</td>
<td>1-30</td>
</tr>
</tbody>
</table>

**All Other Degrees**
The courses in each student’s POS will vary depending on the major and the student’s interests. Only a maximum of three 4000–level courses or one 3000–level and two 4000–level courses may be included on the POS. If a 3000–level course is listed on the POS, it cannot be an AGRON course.

**Agricultural Meteorology**
Students with a major in Agricultural Meteorology must include AGRON 6980 in their POS. Students are encouraged to include the following courses: AGRON 5050, MTEOR 6050; a modeling course such as AGRON 5180, AGRON 5250, GEOL 5160, or MTEOR 5520; and a course in statistics.

**Crop Production and Physiology**
The Graduate Major in Crop Production and Physiology has defined five Core Areas.
Core Area 2 (growth and development): AGRON 5250, AGRON 5510, BIOL 4540, BIOL 4280, and GDCB 5280.

Core Area 3 (plant physiology and metabolism): AGRON 5080, AGRON 5160, AGRON 5190, AGRON 5380, AGRON 5530, AGRON 5560, and PLBIO 5130.
Core Area 4 (crop ecology and management): AGRON 5090, AGRON 5150, AGRON 5300, AGRON 5530, AGRON 5560, AGRON 5840, BIOL 4850, BIOL 4740, EEOB 5840, EEOB 5890, HORT 5240, PLP 5770, and PLP 5940.
Core Area 5 (statistics / quantitative methods): AGRON 5250, AGRON 5260, STAT 5870, STAT 5050, STAT 5120, STAT 5880, CRP 5510, and NREM 5460.

To major in Crop Production and Physiology, at least one course from three of the Core Areas must be included in the POS for the M.S. For the Ph.D., at least one course from each of the Core Areas must be included. A single course cannot be used for more than one Core Area. Students are also encouraged to consider AGRON 6980.

**Plant Breeding**
The Graduate Major in Plant Breeding has both a resident and distance–education MS program. The following courses are recommended for students with a major in Plant Breeding: AGRON 5210, AGRON 5220, AGRON 5230, AGRON 5240, AGRON 5280, AGRON 5610, AGRON 6000A, AGRON 6980, STAT 5870, and STAT 4710. For the distance program, the following courses are recommended: AGRON 5010, AGRON 5060, AGRON 5130, AGRON 5200, AGRON 5210, AGRON 5230, AGRON 5240, AGRON 5280, AGRON 5440, and AGRON 5990. Resident students pursuing the Ph.D. also often include AGRON 6210 and AGRON 6250 in their POS.

**Soil Science**
Students pursuing a major in Soil Science may specialize in one of six areas: soil chemistry; soil fertility; soil management; soil microbiology and biochemistry; soil morphology and genesis; or soil physics. If a specialization is chosen, the major professor must be in the designated specialty area. For the Ph.D., the POS must include one credit of AGRON 6000B. Students are also encouraged to consider including AGRON 6980 in their POS.

**Master of Science**
The general requirements for an M.S. degree include:

- A minimum of 30 credits from academic courses and research activities;
- At least 22 credits earned at ISU;
- Two–thirds or more of earned credits related to the major; and
- Completion of a final oral examination.

Both non–thesis and thesis options for an M.S. degree in Agricultural Meteorology, Crop Production and Physiology, Plant Breeding, and Soil
The general requirements for a Ph.D. degree include:

1. Register for at least two credits of AGRON 5990 that will be used to complete a creative component; and
2. Pass a comprehensive final oral examination.

The creative component is work that presents substantial evidence of individual accomplishment. The POS Committee and the student will specify the creative component, how it will be documented, and how it will be evaluated. The POS Committee also has flexibility in determining the format of the final oral examination. For Agricultural Meteorology, the final oral exam must include an evaluation of the student's mastery of the Enduring Understandings in Agricultural Meteorology.

**Creative Component**
If the non–thesis MS degree is chosen, then the student must:

1. Pursue a research project culminating in a written thesis; and
2. Pass a comprehensive final oral examination.

A minimum of three research credits of AGRON 6990 must be listed on the POS to account for work on an M.S. thesis. The thesis is submitted to the POS Committee prior to the final oral examination. During the final oral examination, the student will present and defend the thesis in the presence of the POS Committee. Students in Agricultural Meteorology must also demonstrate mastery of the Enduring Understandings in Agricultural Meteorology. The presentation (also called the "exit seminar") is open to the general public. Only POS Committee members may attend the examination that follows the presentation.

**Thesis**
In the thesis option the student must:

1. Pursue a research project culminating in a written thesis; and
2. Pass a comprehensive final oral examination.

A minimum of three research credits of AGRON 6990 must be listed on the POS to account for work on an M.S. thesis. The thesis is submitted to the POS Committee prior to the final oral examination. During the final oral examination, the student will present and defend the thesis in the presence of the POS Committee. Students in Agricultural Meteorology must also demonstrate mastery of the Enduring Understandings in Agricultural Meteorology. The presentation (also called the "exit seminar") is open to the general public. Only POS Committee members may attend the examination that follows the presentation.

**Doctor of Philosophy**
The general requirements for a Ph.D. degree include:

- A minimum of 72 credits from academic courses and research activities.
- At least 36 of these credits earned at ISU
- Completion of a preliminary oral examination;
- A written Ph.D. dissertation; and
- Completion of a comprehensive final oral examination.

The 72 credits can include the credits earned in pursuit of an M.S. degree. If an M.S. was earned at another institution, those courses earned at the other institution can be listed along with the ISU courses, but only if the POS Committee determines that the courses are appropriate. Students in Agricultural Meteorology working towards the Ph.D. must meet with their POS Committee at least three times. Besides the final oral examination and another for the preliminary exam, an additional meeting must be held near the beginning of the graduate program. At this meeting the student will introduce the area of research to be pursued, potential research questions and methods, and a proposed POS. If a student will pursue a Ph.D. without first completing an M.S., then during the first meeting of the POS Committee the student must also present a short-written report that illustrates connections between the Enduring Understandings in Agricultural Meteorology and their planned research.

**Qualification Exam**

**Agricultural Meteorology**
Students in Agricultural Meteorology must take and pass a qualification exam once they have decided to pursue a Ph.D. The qualification exam must be passed before taking the preliminary exam. The format of the qualification exam is as follows. The student will produce a written report that demonstrates their knowledge of the Enduring Understandings in Agricultural Meteorology. If the student has come from another university the report must present research completed at ISU and not at the previous institution (such as a thesis). This report will be submitted to all of the faculty in the major. The student will then make an oral presentation to faculty and other students in the major that summarizes and defends the written report. After the oral presentation, the faculty will meet to determine whether or not the student passed the exam, and whether the student can re–take the exam if the student failed. The faculty will provide written feedback to the student, suggesting areas where improvement is needed and a course of action. The qualification exam can be taken only two times during a student's graduate career at ISU. If a student who had entered the Ph.D. program without an M.S. degree takes the qualification exam and fails the exam, the student can: take the qualification exam again, if so, allowed by the faculty; or continue their graduate career in pursuit of an M.S. degree. In the latter case, the student could take the qualification exam one more time after an M.S. degree has been completed.

**All Other Majors**
A qualification exam is not required for students in the Crop Production and Physiology, Plant Breeding, or Soil Science majors.

**Preliminary Exam**
All students pursuing a Ph.D. must take and pass a preliminary oral examination.

**Agricultural Meteorology**
For students in Agricultural Meteorology the preliminary exam consists of a defense of the student's proposed dissertation research to the
POS Committee. Besides an oral defense, the student must also submit a written report on their proposed research. If the student fails the preliminary exam, the POS Committee must also decide if the student can re-take the exam. The preliminary exam can only be taken twice.

**Crop Production and Physiology**
Students in Crop Production and Physiology may be asked to take a written preliminary examination. If a student fails the written preliminary examination, the POS Committee may require the student to retake the exam, to answer additional written questions, or proceed with the oral examination. The nature of the preliminary oral exam is determined by the student’s POS Committee.

**Plant Breeding**
Students in Plant Breeding must pass a uniform written preliminary examination that consists of five questions, each from one of five topical areas. Faculty members in Plant Breeding evaluate each answer. Evaluators assign a pass or fail grade to the answer. If an evaluator assigns a failing grade to a question, the evaluator shall clearly indicate the strengths and weaknesses of the answer and provide written information (e.g., references, rationale) to the student which clearly outlines an acceptable response to the question. Failure to provide such written information may invalidate that grade and be considered sufficient cause to exclude the grade in the overall evaluation of the student’s answer. Students who receive two pass grades for a question will have successfully completed that topic, and students must pass each topic to pass the exam. If two valid grades are not in agreement (e.g., one passing grade and one failing grade), additional faculty members will evaluate the answer until there are two valid assessments that are in agreement. Students who do not pass a topic have the opportunity to repeat that topic on the next regularly scheduled exam date. The number of attempts for each topic has not been specified. The examination is offered the last Thursday and Friday of each January and September when one or more students have signed up to take the exam. The student’s responses are formally scored or ranked only by the POS Committee member who authored the question. A copy of the student’s responses to all questions is submitted to all POS Committee members at least one week before the student’s preliminary oral examination. When the student submits a request to schedule the preliminary oral examination, the student’s major professor certifies by signing the form that the student has satisfactorily completed a written preliminary exam. The nature of the preliminary oral exam is determined by the student’s POS Committee.

**Doctoral Dissertation and Final Oral Examination**
All students must include at least three AGRON 6990 credits in their POS for work on their Ph.D. dissertation. During the required final oral examination, a student presents and defends the dissertation. This presentation (also called the “exit seminar”) is open to the general public. Only POS Committee members may attend the examination that follows the presentation.

**GRADUATE CERTIFICATE IN AGRONOMY FOR DISTANCE STUDENTS**
The Graduate Certificate in Agronomy is for distance students and is comprised of the first six courses in the MS in Agronomy curriculum. All six courses are required for certificate completion.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 5010</td>
<td>Crop Growth and Development</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5020</td>
<td>Chemistry, Physics, and Biology of Soils</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5030</td>
<td>Climate and Crop Growth</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5110</td>
<td>Crop Improvement</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5120</td>
<td>Soil-Plant Environment</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5140</td>
<td>Integrated Pest Management</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

**GRADUATE MINOR**
On-campus students who wish to minor in Agronomy must include a core course from each of the other four graduate majors in their POS. These courses are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 5050</td>
<td>Soil-Plant-Animal-Atmosphere Physics</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5160</td>
<td>Crop Physiology</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5210</td>
<td>Principles of Cultivar Development</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 5530</td>
<td>Soil-Plant Relationships</td>
<td>3</td>
</tr>
</tbody>
</table>

However, one substitution is allowed with the approval of the faculty member serving as the minor representative on the POS Committee.