AGRONOMY

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 (BS) 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 BS/MBA degree. About a quarter of our students immediately continue into research-based MS and PhD programs. As an undergraduate, there are many opportunities to be involved in research.

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

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<tr>
<th>Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition</td>
<td>3</td>
</tr>
<tr>
<td>SP CM 212</td>
<td>Fundamentals of Public Speaking</td>
<td>3</td>
</tr>
<tr>
<td>or AGEDS 311</td>
<td>Presentation and Sales Strategies for Agricultural Audiences</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Introduction to College Level Research</td>
<td>1</td>
</tr>
<tr>
<td>One of the following:</td>
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<tr>
<td>ENGL 302</td>
<td>Business Communication</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 309</td>
<td>Proposal and Report Writing</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 312</td>
<td>Communicating Science and Public Engagement</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 314</td>
<td>Technical Communication</td>
<td>3</td>
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</table>

Humanities: 3 cr.

3 cr. from approved humanities list: http://www.cals.iastate.edu/student-services/humanities (http://www.cals.iastate.edu/student-services/humanities/)
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 140  College Algebra  3
STAT 104  Introduction to Statistics  3

Physical Sciences: 8 cr.
CHEM 163  College Chemistry  & 163L  and Laboratory in College Chemistry  5
One of the following:
AGRON 259  Organic Compounds in Plants and Soils  3
BBMB 221  Structure and Reactions in Biochemical Processes  3
CHEM 231  Elementary Organic Chemistry  & 231L  and Laboratory in Elementary Organic Chemistry  4

Life and Biological Sciences: 7 cr.
BIOL 212  Principles of Biology II  & 212L  and Principles of Biology Laboratory II  4
AGRON 320  Genetics, Agriculture and Biotechnology  or BIOL 313  Principles of Genetics  3

Supporting Sciences: 15 cr.
Courses cannot be used to fulfill any other agronomy requirements. At least 9 cr. must be in courses numbered 300 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, COM S, ECON, All Engineering, GEOL, GEN, MATH, MTEOR, PHYS, STAT) as well as at least 6 additional credits in BIOL, BBMB, ENSCI, ENT, GEOL, HORT, GEN, MICRO, NREM, PL P, 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 bio-energy," "confronter of world hunger," or "designer of sustainable systems.”

Agronomy Core: 46 cr.
AGRON 105  Leadership Experience  R
AGRON 110  Professional Development in Agronomy: Orientation  1
AGRON 180  Global Agriculture in a Changing World  3
AGRON 181  Introduction to Crop Science  3
AGRON 182  Introduction to Soil Science  3
AGRON 183  Basic Skills for Agronomists  1
AGRON 206  Introduction to Weather and Climate  3
AGRON 210  Professional Development in Agronomy: Career Planning  R
AGRON 279  Field Exploration of Agronomy  3
AGRON 280  Crop Development, Production and Management  3
AGRON 281  Crop Physiology  3
AGRON 282  Soil Conservation and Land Use  3
AGRON 310  Professional Development in Agronomy: Work Experience  R
or AGRON 311  Professional Internship in Agronomy
AGRON 316  Crop Structure-Function Relationships  3
AGRON 342  World Food Issues: Past and Present  3
or AGRON 450  Issues in Sustainable Agriculture
AGRON 354  Soils and Plant Growth  & 354L  and Soils and Plant Growth Laboratory  4
AGRON 360  Environmental Soil Science  3
or AGRON 392  Systems Analysis in Crop and Soil Management
AGRON 410  Professional Development in Agronomy: Senior Forum  1

Additional AGRON credits at the 300-400 level  6

Electives: 18 cr.
Additional free electives  18

Agronomy, B.S.

Freshman

Fall  Credits  Spring  Credits
AGRON 110  1  AGRON 181  3
AGRON 180  3  AGRON 182  3
AGRON 183  1  BIOL 212  3
CHEM 163 or 177  4  BIOL 212L  1
CHEM 163L or 177L  1  ENGL 250  3
ENGL 150  3  Math or Social Sciences  3
LIB 160  1
Math or Social Sciences  3

17  16
Sophomore

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<th>Fall</th>
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<th>Spring</th>
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<td>AGRON 206</td>
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<td>AGRON 210</td>
<td>R</td>
<td>AGRON 282</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 279</td>
<td>3</td>
<td>AGEDS 311 or SP CM 212</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 280</td>
<td>3</td>
<td>Organic Chemistry: AGRON 259, BBMB 221, OR CHEM 231 &amp; L</td>
<td>3-4</td>
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<tr>
<td>STAT 104</td>
<td>3 Elective</td>
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<td>Humanities</td>
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<th>Credits</th>
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<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
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<tr>
<td>AGRON 217</td>
<td>Weed Identification</td>
<td></td>
<td>1</td>
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<tr>
<td>AGRON 259</td>
<td>Organic Compounds in Plants and Soils</td>
<td></td>
<td>3</td>
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<tr>
<td>AGRON 270</td>
<td>Geospatial Technologies</td>
<td></td>
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<tr>
<td>AGRON 316</td>
<td>Crop Structure-Function Relationships</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>AGRON 317</td>
<td>Principles of Weed Science</td>
<td></td>
<td>3</td>
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<tr>
<td>AGRON 320</td>
<td>Genetics, Agriculture and Biotechnology</td>
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<td>AGRON 330</td>
<td>Crop and Seed Identification Laboratory</td>
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<td>AGRON 334</td>
<td>Forage Crop Management</td>
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<td>AGRON 338</td>
<td>Seed Science and Technology</td>
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<td>AGRON 354</td>
<td>Soils and Plant Growth</td>
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<td>AGRON 360</td>
<td>Environmental Soil Science</td>
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<td>AGRON 392</td>
<td>Systems Analysis in Crop and Soil Management</td>
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<td>AGRON 405</td>
<td>Environmental Biophysics</td>
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<td>AGRON 421</td>
<td>Introduction to Plant Breeding</td>
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<td>AGRON 450</td>
<td>Issues in Sustainable Agriculture</td>
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<td>AGRON 459</td>
<td>Environmental Soil and Water Chemistry</td>
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<td>AGRON 463</td>
<td>Soil Formation and Landscape Relationships</td>
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<td>AGRON 477</td>
<td>Soil Physics</td>
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<td>AGRON 484</td>
<td>Organic Agricultural Theory and Practice</td>
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<tr>
<td>AGRON 485</td>
<td>Soil and Environmental Microbiology</td>
<td></td>
<td>3</td>
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<tr>
<td>AGRON 497</td>
<td>Agroecology Field Course</td>
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Junior

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<th>Fall</th>
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<tr>
<td>AGRON 316</td>
<td>3</td>
<td>AGRON 320 or BIOL 313</td>
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<tr>
<td>AGRON 354</td>
<td>3</td>
<td>AGRON 342 or 450</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 354L</td>
<td>1 ENGL 302, 309, or 314</td>
<td></td>
<td>3</td>
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<td>Elective</td>
<td>3</td>
<td>International Perspectives</td>
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<td>Supporting Sciences</td>
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Senior

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<tr>
<th>Fall</th>
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<th>Spring</th>
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<tr>
<td>Agronomy Electives</td>
<td>6 AGRON 360 or 392</td>
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<td>3</td>
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<td>Elective</td>
<td>6</td>
<td>AGRON 410</td>
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<tr>
<td>Ethics</td>
<td>3</td>
<td>Elective</td>
<td>6</td>
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<tr>
<td>U.S. Diversity</td>
<td>3 Supporting Sciences</td>
<td></td>
<td>6</td>
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<td><strong>Total</strong></td>
<td><strong>18</strong></td>
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<table>
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<tr>
<th>Spring</th>
<th>Credits</th>
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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 300 or above. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

Students minoring in agronomy can take the following courses: AGRON 331, AGRON 370, AGRON 490, AGRON 496; but only one (1) credit from these courses can be used in the minor program.

Required Courses (6 credits):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 181</td>
<td>Introduction to Crop Science</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 300-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 300 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 182  Introduction to Soil Science 3

**Supporting Biological, Physical, or Earth Sciences:** Choose 15 credits from approved list consisting of courses from the following designators:

A B E, AGRON, A ECL, BIOL, CHEM, C E, C R P, ENSCI, ENT, FOR, GEOL, HORT, L A, 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 282  Soil Conservation and Land Use 3
AGRON 360  Environmental Soil Science 3
AGRON 405  Environmental Biophysics 3
AGRON 477  Soil Physics 3
A B E 431  Design and Evaluation of Soil and Water Conservation Systems 3

TSM 324  Soil and Water Conservation Management 3

Soil Chemistry (2 credits)

AGRON 259  Organic Compounds in Plants and Soils 3
AGRON 459  Environmental Soil and Water Chemistry 4

Soil Biology (2 credits)

AGRON 354  Soils and Plant Growth 3
AGRON 354L  Soils and Plant Growth Laboratory 1
AGRON 485  Soil and Environmental Microbiology 3

Soil Morphology and Geography (2 credits)

AGRON 270  Geospatial Technologies 3

AGRON 370  Field Experience in Soil Description and Interpretation 1
AGRON 463  Soil Formation and Landscape Relationships 3

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

Information on the concurrent Agronomy bachelors 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 (MS) and Doctor of Philosophy (PhD) 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 MS 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 MS 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 MS 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 PhD 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 MS or PhD, a graduate faculty member representing the minor must serve on the POS Committee.
Agronomy

The POS for the MS in Agronomy is fixed and consists of the following:

- AGRON 501 Crop Growth and Development 3
- AGRON 502 Chemistry, Physics, and Biology of Soils 3
- AGRON 503 Climate and Crop Growth 3
- AGRON 511 Crop Improvement 3
- AGRON 512 Soil-Plant Environment 3
- AGRON 513 Quantitative Methods for Agronomy 3
- AGRON 514 Integrated Pest Management 3
- AGRON 531 Crop Ecology and Management 3
- AGRON 532 Soil Management 3
- AGRON 533 Crop Protection 3
- AGRON 591 Agronomic Systems Analysis 3
- AGRON 592 Current Issues in Agronomy 3
- AGRON 594 Agronomy MS Practicum 1
- AGRON 599M Agronomy arr

† Arranged with instructor.

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 400-level courses or one 300-level and two 400-level courses may be included on the POS. If a 300-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 698 in their POS. Students are encouraged to include the following courses: AGRON 505; AGRON 577; MTEOR 605; a modeling course such as AGRON 508, AGRON 518, AGRON 525, AGRON 677, GEOL 516, or MTEOR 552; and a course in statistics.

Crop Production and Physiology

The Graduate Major in Crop Production and Physiology has defined five Core Areas.

Core Area 1 (molecular biology / biochemistry): BBMB 404, BBMB 405, BBMB 542A–G, BBMB 607, and PLBIO 545.

Core Area 2 (growth and development): AGRON 525, AGRON 551, BIOL 454, BIOL 428, and GDCB 528.

Core Area 3 (plant physiology and metabolism): AGRON 508, AGRON 516, AGRON 519, AGRON 525, AGRON 538, AGRON 553, AGRON 556, BBMB 645, and PLBIO 513.

Core Area 4 (crop ecology and management): AGRON 509, AGRON 515, AGRON 530, AGRON 553, AGRON 556, BIOL 472, BIOL 474, EEOB 570, EEOB 582, EEOB 584, EEOB 589, HORT 524, PL P 577, and PL P 594.

Core Area 5 (statistics / quantitative methods): AGRON 526, STAT 587, STAT 402, STAT 407, STAT 505, STAT 512, CRP 551, and NREM 546.

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 MS. For the PhD, 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 698.

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 521, AGRON 522, AGRON 523, AGRON 524, AGRON 528, AGRON 561, AGRON 600A, AGRON 698, GEN 510, STAT 587, and STAT 402. For the distance program, the following courses are recommended: AGRON 501, AGRON 506, AGRON 513, AGRON 520, AGRON 521, AGRON 523, AGRON 524, AGRON 528, AGRON 544, and AGRON 599. Resident students pursuing the PhD also often include AGRON 621 and AGRON 625 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 PhD, the POS must include one credit of AGRON 600B. Students are also encouraged to consider including AGRON 698 in their POS.

Master of Science

The general requirements for an MS 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 MS degree in Agricultural Meteorology, Crop Production and Physiology, Plant Breeding, and Soil Science are available. Students in the Agronomy major must choose the non–thesis option.

Students in Agricultural Meteorology working towards the MS must meet with their POS Committee at least twice. Besides the final oral examination, 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. The student must also present a short written report on how the proposed research will help them master established Enduring Understandings in Agricultural Meteorology.

Creative Component

If the non–thesis MS degree is chosen, then the student must:
1. register for at least two credits of AGRON 599 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.

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 699 must be listed on the POS to account for work on an MS 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 PhD 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 PhD dissertation; and
- completion of a comprehensive final oral examination.

The 72 credits can include the credits earned in pursuit of an MS degree. If an MS 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 PhD 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 PhD without first completing an MS, 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 PhD. 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 PhD program without an MS 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 MS degree. In the latter case, the student could take the qualification exam one more time after an MS 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 PhD 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. Students may choose to attempt questions for all five topics, or for subsets of the topics. If a student decides to attempt questions for only certain topics, the student must specify which topics in writing at least one month prior to the scheduled exam date. The nature of the preliminary oral exam is determined by the student’s POS Committee.

**Soil Science**

Students in Soil Science must pass a written preliminary examination. Exam questions are authored by members of the POS Committee. The format of each question is left open and they may be formulated as open– or closed–book problems. A reasonable period for completion may be set by the author of the question. 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 699 credits in their POS for work on their PhD 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 Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 501</td>
<td>Crop Growth and Development</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 502</td>
<td>Chemistry, Physics, and Biology of Soils</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 503</td>
<td>Climate and Crop Growth</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 511</td>
<td>Crop Improvement</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 512</td>
<td>Soil-Plant Environment</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 514</td>
<td>Integrated Pest Management</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits 18

**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 Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRON 505</td>
<td>Environmental Biophysics</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 516</td>
<td>Crop Physiology</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 521</td>
<td>Principles of Cultivar Development</td>
<td>3</td>
</tr>
<tr>
<td>AGRON 553</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.