CURRICULAR INNOVATION

FOR AGRONOMY STUDENTS

AT IOWA STATE

FINAL REPORT
OF THE
AGRONOMY 2005 CURRICULUM COMMITTEE

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VISION FOR AGRONOMY CURRICULUM

We desire to shape our undergraduate curriculum in such a way as to help an already excellent program become the premier Agronomy educational program. Our plan calls for more than revamping the existing program. It calls for growth, for a new curriculum, and it calls for fundamental changes in the way we teach. We envision a professional curriculum characterized by a sound foundation in the fundamental principles of crop, soil and climate science. We also envision a curriculum that provides extensive practice in applying these principles to real-life situations, which include environmental, wildlife, and urban issues, in addition to traditional agronomic scenarios. Finally, we call for the utilization of unique multimedia approaches in an active learning environment to be a vital part of the presentation of this curriculum. By emphasizing principles and the utilization of electronic databases, we envision that a diverse array of agronomic and environmental practices will be included in our curriculum, we can expand student employment opportunities, and prepare students to excel in a rapidly changing world. The use of electronic databases and communication systems must be "second nature" to our students. The ability to communicate well in oral or written forms must be emphasized, as well as the ability to work alone or in teams. Some may feel that we have outlined unrealistic expectations of our future graduates. We, however, believe that only by our establishing high standards can our graduates achieve the leadership goals expected of an Iowa State graduate, and only by providing a challenging education can we expect to achieve the goal of being the premier land-grant university.

I. MISSION STATEMENT

Agriculture is in a state of transition. Numerous social, economic, political, and technological issues are dictating changes in how private industry and public institutions perform their mandated tasks. Of major concern, is the ability to produce highly sought after graduates in the face of changing job markets and reduced operating budgets.

This document is the result of an effort on the part of the Agronomy 2005 Undergraduate Curriculum Committee to review these issues and define areas wherein curricula revision and innovation might better serve our undergraduates in the future. One exciting aspect of the committee's work has been the ability to carry out such considerations in a department with an outstanding reputation as a leader in undergraduate education and a fine staff of professional and highly motivated teachers.

In the course of deliberation, the committee:

° consulted pertinent literature (see Bibliography, p. 16),

° surveyed students graduating within the past 5 years,

° surveyed employers of agronomy graduates,

° held round-table discussions with employer groups and with faculty from other institutions in the North Central Region,

° attended the recent symposium sponsored by the American Society of Agronomy,

II. ISSUES AND TRENDS IN AGRONOMY UNDERGRADUATE EDUCATION

Certainly, the issues and concerns facing curricula in agriculture, and education in general, have been widely discussed and reported (see Bibliography, p. 16). The following list is not exhaustive of the concerns that have been raised by the critics of agricultural curricula, nor do we necessarily agree that all apply to Agronomy at ISU. The committee believes, however, that the new curriculum must address these issues.

° Current curricula seem narrowly focused on acquisition of technical knowledge and information. Most technical information has a short "half-life."

° Basic skills need greater emphasis for the future professional: oral and written communication, problem solving, decision analysis, mathematical and computer skills, management and leadership skills.

° The current educational approach is strongly reductionist. To focus attention on disciplines, faculties have tended to expand the technical curriculum, partitioning it into more specialized units.

° Course information often fosters a narrow, state or regionalistic perspective.

- Graduates do not have an adequate appreciation of agriculture as a business.

- Conservation and sustainable management of natural resources is given inadequate attention.

- It is very likely that more students with non-farm/urban backgrounds will be recruited into agricultural programs. These people lack a basic context that, heretofore, we have been able to assume that agricultural students possessed.

- Curricula are often not flexible enough to allow individualized educational paths consistent with a student's goals and potential.

- Values development is not adequately incorporated into agricultural curricula. Graduates sometimes do not appreciate that human values and ethical concerns need to be considered in propounding scientific and technological solutions.

- Curricula are not adequately positioned to take advantage, in terms of student training and employment, of potential changes in job markets.

In addition to these specific issues, certain trends must be recognized and addressed by the curriculum.

- The trend toward fewer farms and smaller rural populations likely will continue. This will, of course, strengthen the trend toward more agronomy students without a rural/farm background and may change the types of jobs available and the services required.

- Economic conditions and technological innovations will force expansion in the number of "non-traditional' students wishing to change jobs, remain up-to-date in their current position, or advance more rapidly.

- Realignments of curricula in the more urban states may foster the enrollment of more non-Iowans.

- There will be a growing need for "environmental science" professionals--for federal and state regulatory agencies, in county and community government, as consultants, and within agri-business itself.

Fostered, in part, by these emerging trends in enrollment, and underscored by the need to provide an economic yet scientifically and technologically rigorous education, we believe that, increasingly, ISU will need to take the classroom to the students. More courses will need to be adapted for distance education. We see no reason that courses be diminished in quality in this adaptation, though emphasis may change. We foresee a partnership emerging with community and other colleges to the mutual advantage of each and to the benefit of Iowa students, and indeed, to all Iowans. More courses, thus, will be taught remotely by interactive video techniques, especially--

- Freshman and sophomore courses, which should be taught at off-campus sites.

° Specialty courses to meet the needs of people in the workforce who need to update or redirect their career, or others who, for one reason or another, are unable to come to the university.

III. GOALS AND EXPECTATIONS FOR THE NEW AGRONOMY CURRICULUM

Objectives

The general objective of the proposed agronomy curriculum is to provide students a unique education that is liberal in breadth, science-based, effective in personal skills development, and that will prepare them for entry-level positions in government or agri-business, for farm management, for graduate study, and for other positions where a problem-solving approach to issues in crops, soils and the environment is needed. This agronomy curriculum will provide graduates with the education and training necessary for them to become effective professionals and leaders in agriculture, their community, and their country. Students will accrue knowledge, grow in wisdom, and hone their skills relative to:

° ***Technical knowledge***. The curriculum will provide graduates with the theoretical and practical scientific knowledge needed for continued efficient and sustainable production of food, feed and fiber, as well as the information and subject-matter mastery required for exercise of wise judgment in dealing with complex issues in resource management and conservation. Business education is essential to effectiveness of the otherwise competent professional agronomist. And, it must be instilled that education is a life-long pursuit.

° ***Professional skills.*** Students will develop the human and technical skills needed to function in the forefront of an increasingly complex and competitive society: oral and written communication, computer and leadership skills, and the critical, integrative thinking capacity that undergirds competent problem-solving and decision-making. Skills development will be integrated into agronomy content courses.

° ***Perspective.*** The graduate should have a holistic perspective of agriculture: an appreciation of agriculture as a highly sophisticated, integrated system for food production and distribution that operates within a political environment and on a global scale. He/she must be able to visualize what makes the whole work, and understand the responsibilities of the agronomist within the system with respect to production of an abundant, safe, and nutritious food supply within the context of wise management of natural resources.

° ***Ethics/Values.*** The curriculum should lead students in development of an appreciation of ethical resource management responsibilities in regional, national and world social and economic contexts. It must instill an awareness for sustainable management of energy, soil, water, wildlife and other natural resources. Agronomy courses should provide opportunities for ethical debate and value judgment that expand one's tolerance and appreciation for the complexities of societal issues. The agronomy curriculum will foster development of a personal, professional code of ethics.

° ***Diversity.*** For society to function effectively and justly for each person, graduates must appreciate the richness that our diverse backgrounds and philosophies bring to the whole. Tolerance of the political, cultural, and religious opinions and practices of others is the

hallmark of an educated person.

Expectations of Agronomy BS graduates.

Communications

° Be able to present an effective oral report.

° Be able to answer oral questions extemporaneously and understandably.

° Be able to write a concise, grammatically correct report.

° Be able to debate issues in a professional manner.

Ethics

° Be able to deal with moral, ethical, and legal conflicts: Recognize a conflict of interest situation involving oneself and one's client or employer; differentiate between the public good and a personal goal.

° Appreciate the responsibility of the individual in sustainable management of energy, soil, water, plant, and wildlife resources.

° Adopt a professional ethics code, such as the ARCPACS Code of Ethics.

Leadership

° Possess the management skills necessary to motivate and organize a group of peers and subordinates in defining and solving a problem.

° Be able to work effectively in a team situation either as leader or participant.

° Possess high standards of achievement

Computer

° Be able to use basic software: word processing, spreadsheets, presentation software.

° Be able to use the computer effectively to organize and interpret information.

° Be competent in electronic communications, including accessing and use of databases, electronic bulletin boards, etc.

Problem solving

° Given a situation, be able to define the problem, identify the resources needed to solve it and their repositories, and propose alternative solutions based on the resources of the client.

- Be able to analyze and interpret simple research data: understand the mean, SE, F ratio, LSD, significance levels; calculate and interpret a simple ANOVA, linear regression, and correlation.

Professional

- Have a holistic perspective of the agroecosystem

- Understand basic business concepts: how to interpret a financial statement, calculate a profit or loss and return on investment, how to construct a budget.

- Be able to use libraries, electronic repositories of information, and other information sources in support of further personal and professional growth.

- Be able to perform mathematical calculations appropriate to the profession, and interpret graphical and tabular information.

- Understand and use terminology appropriate to the field of expertise.

- Understand the structure and processes of governments as they influence agricultural policy.

- Be able to interpret laws and regulations as they relate to agricultural production and products.

- Be committed to completing tasks timely.

- Be able to prepare a resume.

Technical Agronomy

- Understand the scope of agronomy and its relationships to other disciplines and professions.

- Understand basic technical principles and methods relating to production of important grain and seed crops: conservation tillage methods and seedbed preparation; population densities and plant spacings; cultivar and hybrid selection in relation to soil type and climate; seeding times and methods; cropping/rotation systems; cultivation practices; efficient and environmentally sound fertilization and weed control strategies; harvesting, storage, and marketing methods and strategies.

- Understand basic strategies for efficient and abundant production, harvest, and storage of high-quality forage and pasture crops, including pasture management for sustained production.

- Be able to recognize common biotic stressors, their potential effects on plants at various stages of crop development, and options for melioration of stresses with minimal disturbance to the environment. Understand the concepts of weed threshold populations and economic injury levels for insects, nematodes and diseases.

- Understand the soil as a resource upon which ecosystems, agriculture, and other land uses depend.

- Understand, in historical and modern perspective, the basic soil conservation and land use principles important to sustained production .

- Understand the effects of the abiotic environment on crops and soils--water, atmospheric pollutants, heat and cold--and methods that meliorate such stresses.

International

- Possess an awareness of the global extent of agriculture and of crop, soil and climate diversity in the world.

- Know the basic elements of the metric system of weights and measures.
- Recognize the interdependence of national agricultural economies, and of the effects of the national political and cultural environments on world, US and local agricultural economies.

- Have a general familiarity with agronomic practices used in other regions of the world and how, for political, cultural and economic reasons, they differ from those of the U. S. Midwest.

Values

- Appreciate that our cultural diversity, as expressed through the humanities and arts, adds richness to our lives.

- Have tolerance of different political, cultural, religious, and ethnic beliefs and practices.

- Apply fundamental concepts of economics and the social sciences to human interaction and organization. Have an appreciation of the family as an interdependent, supportive unit.

IV. THE NEW CURRICULUM

The Vision

We envision a science-based, professionally oriented curriculum designed to produce articulate, technically competent, environmentally sensitive, problem-solving agronomists who will lead agriculture in the twenty first century. To that end we recommend a core curriculum that is based on three aspects that we believe are necessary to develop a competent professional agronomist: a knowledge base of fundamental science, the ability to integrate knowledge and use it to solve problems, and an attitude of professionalism.

- The first, a basic understanding of plant, soil, water and climate principles, is the foundation (Agronomy 10 and 20; Crops 20; and Soils 10 and 20). We emphasize principles that define the study of plants, soils, water, and the climate in contrast to "how-to" information. We believe that students must understand the plant-soil-climate system before they can understand the basis of crop and soil management systems, and understanding this basis is

fundamental to effective problem-solving in agronomy.

° This basic understanding of the elements of scientific agronomy is then brought to bear on agronomic management for food and fiber production, within a context of soil, water and air resource conservation, in a problem-solving approach to learning the management of agronomic resources (Agronomy 30). In the final year, we place emphasis on problem-solving in a social and environmental context (Agronomy 40). We hope that students from other majors will find Agronomy 40 of interest in their career development.

° In parallel with the development of technical proficiency, we advocate a series of one-hour "seminars" plus a rigorous and structured internship for out future professionals (Agronomy 12, 22, 32, and 42). These should be designed to nurture an attitude of professionalism . The internship should not be confused with a "work experience." Minimally, the internship should include a creative component (e.g., a project aimed at solving a problem or improving a process) as part of the job experience, require a written report that goes beyond a diary of daily activities, and a seminar about their experience to students who are preparing for an internship.

Instructional Methods

We *strongly* recommend adoption of instructional techniques that engage students actively in the learning process. Education research tells us that students learn more and they retain it longer when they are actively involved in the learning process, as opposed to passive involvement with the lecture method. Students must be encouraged to buy-in to their own education--i.e., accept more responsibility for their learning.

° More courses should involve some practice in communications, oral as well as written. Communications practice should intensify as students progress through their college career.

° More instruction should occur through problem-solving. We disagree strongly with the idea that students should or can be taught effective problem-solving outside the content of the discipline, or that problem-solving should be taught only through a methodology course. Problem-solving should be a feature of instruction in virtually every course. Problem-solving should be introduced in freshman classes and expanded in quantity and intensity in succeeding years. Upper division, synthesis courses should rely heavily on problem-solving, using it as a method of instruction, introducing and reinforcing technical content, as well as providing practice in dealing with real-world issues.

° We also foresee extensive use of interactive, multimedia instruction in courses taught in residence as well as those taught remotely. Whereas virtually all courses could use this approach, at least in supplemental learning, it is vitally important that upper division courses employ model systems and extensive databases in problem solving.

Need for a Broader Understanding of Agriculture.

For some time now many entering Agronomy students have lacked an agricultural background. Employers of our students tell us that even those graduates who do have a traditional background in agriculture often fail to comprehend the totality of agriculture and the interactions among its components and, as a consequence, have difficulty in understanding the significance of their

work in relation to the larger picture. We assume that other disciplines are hearing similar criticisms. We believe that the College of Agriculture should establish a course designed to remedy this deficiency. Such a course might have a description somewhat like the following.

> **Agricultural Systems.** Cr. 2. The complexity of agriculture in terms of its interaction with financial systems, with government (waste and pesticide regulation, safety issues, pricing policy), with the equipment industry, with society (conservation of resources) with international trade, etc. A general course, perhaps team taught by faculty from several disciplines, required of all Ag. College majors and open to other students in the university who want an overview of agriculture. The objective of the course would be to give students an understanding of agriculture as an integrated business system that involves not only production of food (both animal and plant), feed and fiber, but also as a system of natural resource management for sustained production, recreation, and aesthetics.

Diversity of Faculty Involvement

A wider use of Agronomy faculty in undergraduate instruction than has occurred in the past is recommended. All faculty should be thought of as teaching faculty. Team teaching is strongly encouraged. This may involve different faculty in the classroom at various times; it may take the form of team development of courses, or some combination of the two. We recommend that courses, or sections of courses, be shared among faculty, especially upper division courses. This would add vitality to the course content, permit students to interact with a more diverse group of faculty, and encourage evolution of the subject matter as well as stimulate the faculty to think about their subject in different ways and from a different perspective.

Breaking Barriers

The committee firmly believes that the proposed changes will strengthen the Agronomy Curriculum significantly. The proposal does not however, completely meet the needs of the Agronomy undergraduate student. To fully accomplish our objective of creating a curriculum that will address the current and future needs of students, students must be able to select pertinent courses from other disciplines. Currently, highly specialized courses and the numerous prerequisites for these courses limit student options. The ability to minor, or in certain cases even opt for a concentration, in other disciplines is either not available or often requires an extra year of study. Modern trends in curricula and the needs of current graduates dictate that traditional curricular barriers be removed. Only in this way will students have access to the complete array of professional and technological information required for success in the next century.

Reconsidering the Basic Science Requirements

The committee recognizes that the new curriculum, as outlined on the next page, has more fixed required credits than does the current curriculum. However, we believe that requiring the student to devote 20% of his/her total degree hours to the core discipline should not be considered burdensome for those who truly want a strong professional orientation. Moreover, there are ways to introduce flexibility in planning the student's program. Currently, Agronomy requires 40 credits in the basic sciences, more than most agriculture disciplines and twice as many as some. Whereas we certainly believe in a strong science background for our students, we wonder if all of these courses should be required of all Agronomy majors. Do those with a crops interest really need Geol. 100, for example? Do all students need organic chemistry lab? There are other fixed requirements that could be questioned. We recommend that Agronomy establish several options or "areas of specialization", or some type of distinction among important sub-disciplines, and then evaluate whether certain of the basic science

courses should be required in only one or more of these sub-discipline categories. This would allow for more flexibility, in terms of electives, in the student's program.

Continuous Curriculum Evaluation

The new curriculum must operate as efficiently as possible and continue to evolve as the world around it evolves. Therefore, it is recommended that a committee be formed and a procedure established for study and evaluation of the curriculum, and to make recommendations for improving it on a regular basis. Committee responsibilities should include:

- Evaluation of the curriculum to ensure that it operates efficiently and meets student educational needs.

- A study of the value of teaching methods in knowledge acquisition, mastery and retention

- Monitoring changes in business and society with regard to updating and modifying curriculum needs and goals

- At regular intervals, receiving feedback from employers and students regarding the curriculum and its value.

Agronomy Core Curriculum Outline, Required Courses

Soils Base	***Agron. Prof. Base***	***Crops Base***
Soils 10 (3 Cr.) Fund. Soil Science	Agron. 10 (3 Cr.) Intro. Agronomy. Agron. 12 (Cr. R) Prof. Dev. I. (8 wks) (Prereq: Fr classif).	
Soils 20, 20L (4 Cr.) Crop Soils and Plant Growth. Relation- (Prereq: Soils 10)	Agron. 20 (3 Cr.) Agro-meteorology. Agron. 22 (Cr. R) Prof. Dev. II. (8 wks) (Prereq: So. classif)	Crops 20 (4 Cr.) Structure-Function ships. (Prereq: Agron 10, Biol 202)
	Agron. 30 (3 Cr.) Agron Syst. I: Technical Problems in Crop and Soil Management. (Prereq: Agron 20, Soils 20, Crops 20) Agron 32 (2 Cr.) Prof. Dev. III: Internship. (Prereq: Soils 20, Crops 20, Jr. Classif.)	
	Agron 40 (2 Cr.) Agron Syst. II: Problem-Solving for the Agronomic Professional. (Prereq: Sr. Classif., 8 Cr. in Agronomy) Agron 42 (1 Cr.) Prof. Dev IV: Senior Forum . (Prereq: Sr. Classif.)	

Total credits required in Agronomy -- 25 hours

Agronomy Core Curriculum, Course Descriptions

Agronomy Base

Agron 10 Principles of Agronomy Cr. 3. A beginning course focusing on crop production and soil management principles for the basic agronomic crops. Includes introductory concepts of plant, soil, tillage, pest, and environmental aspects of crop production. Will serve as a terminal course for students wanting some knowledge of agronomy and as a foundation course for students taking advanced agronomy courses. Beginning problem solving skills development should be integrated into course materials.

Agron 20 Agrometeorology. Cr. 3. Concepts in meteorology and their relationships to human activity and agricultural systems. Micrometeorology in agriculture.

Agron 30 Agronomic Systems I. Technical Problems in Crop and Soil Management. Cr. 3. Prereq: Agron. 20 Soils 20, Crops 20. Crop, soil, and climate interactions as they define management strategies. The development of cropping system and management solutions in a "real-world" environment--crop pests, nutrient deficiencies, environmental constraints, etc. Problems and solutions to emphasize productivity and economic return. Students work as individuals with some introduction to team/group dynamics. Problem solving intensive.

Agron 40 Agronomic Systems II. Problem Solving for the Agronomic Professional. Cr. 2. Prereq: Sr. Classif., 8 Cr. in Agronomy. Similar in concept to Agronomic Systems I, except that the issues and problems take on a wider context and will include, perhaps emphasize, the influence of agronomic decisions on the environment, natural resource base, health, safety and other social issues. Includes a cost-benefit analysis of various solutions. Primarily accomplished through a team-work approach. Might be handled on a decision-case basis. Problem solving intensive.

Crops Base

Crops 20 Crop Structure-Function Relationships. Cr. 4. Prereq: Agron 10, Biol. 202. Anatomy, morphology and physiology of crop plants as a basis for identification, adaptation to agroecosystems, and specific uses. Physiological and ecological bases of plant behavior in crop communities. Problem solving component to predict plant community response to various cropping/management decisions. .

Soils Base

Soils 10 Fundamentals of Soil Science. Cr. 3. Introduction to the basic chemical, physical, and biological properties of soils; soil development processes; soil classification systems as a basis for managing cropping and environmental systems. Impact of soil management upon crop production, water quality, soil erosion, mine reclamation, and waste management.

Soils 20 Soil Factors Effecting Plant Growth. Cr. 3. Prereq: Soils 10 and Agron 10. Effects of soil chemical, physical, and biological properties upon plant nutrients and cropping systems. Recommend taking concurrently with Soils 20L.

Soils 20L Soils Lab. Cr. 1. Techniques for measuring chemical, physical, and biological properties of soils. To accompany Soils 20.

Professional Development Courses

Agron 12 Professional Development I. 8 wk, Cr. R. Fr. Classif. Career Development. A course designed to help students explore the opportunities and activities of agronomists in our society. Academic planning and internship procedures to meet professional and career goals are included.

Agron 22 Professional Development II. 8 wk, Cr. R. So. Classif. Professional standards, ethics, networking and accessing. A course designed to help students develop an appropriate context for professionalism. Topics include professional certification, ethics, and methods of maintaining an active network of information sources and professional contacts in support of lifelong learning. Developing a personal library and accessing current information through traditional and electronic means. Career orientation through invited speakers.

Agron 32 Professional Development III: Internship. Cr. 2. Prereq: Jr. Classif., Soils 20, Crops 20. Designed to provide students with an exposure to agronomic/natural resource issues in a real-world situation. This is accomplished by providing credit for a structured work experience. At the very least it should serve two purposes: provide a framework for future learning by reinforcing accountability in decision making and allow for the use of technical information in the work environment. The internship should include a creative component requiring problem-solving and some degree of project management that may go beyond the usual job requirements. (See also p7, third bullet under "The Vision")

Agron 42 Professional Development IV: **Senior Forum.** Cr. 1. Sr. Classif. Student led discussion and debate of current agricultural topics as they impact ethical and socio-political concerns. Students will chose from a range of discussion and debate topics. Semester's activities will be comprised of discussion of prepared topics and guidance of debate teams.

Elective Courses for the New Curriculum.

Crops 24 Crop Culture and Management. Cr. 3. Prereq: Agron 10. The growth, development, adaptation, and management of individual crop species: coarse grains (e.g. corn, the sorghums, millet), seed legumes (e.g. soybean, bean, chickpea), small grains (e.g. rice, wheat, oat, barley), forage grasses and legumes, industrial crops not covered in previous groups (e.g. cotton), and others. Primarily a service course for non-majors. Not accepted as fulfilling the prerequisite for Agron 30.

Crops 26 Weed Science . Cr. 3. Prereq: Biol. 202, Organic Chem. Identification and biology of weed species. Morphological and physiological characteristics of plants that lend them weedy qualities. Mechanisms of weed competition with crop plants. Ecology and management of weeds in sustainable cropping systems. Weed management systems.

Crops 30 Seed Science. Cr. 3**.** Prereq: Crops 20 or 24. Physiologic and anatomic basis of seed and seedling performance. Interaction of these factors with production, conditioning, storage, and marketing high quality seed. Role of seed in agriculture and crop production.

Crops 32 Crop Quality and Utilization. Cr. 2. Prereq: Crops 20 or 24 and organic chemistry. Anatomical, morphological, and chemical characteristics of crop plants and seeds that influence crop utilization. Discussion of factors affecting trends and diversity of crop utilization, and environmental and production factors that influence crop quality attributes. Evaluative methods of assessing crop quality for different uses are reviewed.

Crops 44 Pasture and Forage Management. Cr. 3**.** Prereq: Crops 20 or 24. Forage production and utilization systems. Grazing management. Hay and pasture production. Problem solving will emphasize analysis and solution of sustained production of high quality forage for different farming systems. Oral and written reports.

Crops 46 Crop Breeding. Cr. 3. 1 Prereq: Genetics, Crops 20. Basic principles in the genetic improvement of crop plants. Methods of cultivar development, relationship of reproductive characters and growth characteristics to genetic characteristics of crops. Biotechnology in crop improvement.

Agron. 36 Agricultural Chemicals: Use and Environmental Impacts. Cr. 3**.** Prereq: Organic. Chem.; Crops 20 or 24. Use, safety, environmental considerations, and regulation of agricultural chemicals. Extensive use of databases for information on chemicals. Instruction will focus on chemical characteristics that lend biological activity, persistence, and ecological impacts. Safety and regulatory aspects of chemical use in agriculture. (Important course for students who might become involved in the regulatory aspects of agriculture.)

Agron. 38 World Agronomic Systems. Cr. 3. Prereq: Agron 10, 20, Soils 10. Survey of soils, climates and important crops of the world. Characteristics that lend areas suitability for agriculture. Characteristics that lend crops adaptation to specific ecological areas. Alternative cropping models (e.g. intercropping). World food issues.

Agron. 39 International Agricultural Study. Cr. 1-3. Agric. travel course.

Agron. 41 Special Topics. Cr. var. Educational enrichment activities.

Soils 30 Principles of Soil Conservation and Management Cr. 3:1. Prereq: Soils 10, 20, and 20L; Agronomy 10 recommended. Principles of soil management emphasizing soil fertility, erosion control, tillage, and irrigation and drainage in economically and environmentally sound agronomic systems. In lab the students will work in teams to develop an integrated soil management plan.

Soils 32 Soils and the Environment Cr. 2. Prereq: Soils 10, 20 and 20L. Principles of soil management emphasizing problems and issues in environmental sciences such as mine reclamation, waste management, and industrial spills. Students will work in teams to develop both emergency management plans and long-range management plans.

Soils 40 Soil Genesis and Survey Cr. 4. Prereq: Soils 10. Process of soil development, soil mapping techniques, and soil classification systems; field trips to examine Iowa soils; preparations of soil maps; utilization of soils information in both agricultural and non-agricultural management systems.

Soils 42 The Physical, Biological, and Chemical Environments of Soil Cr. 3:1. Prereq: Soils 10, 20, 20L, one year of college chemistry, one course each in college physics, mathematics, and biology. Lecture and laboratory study of physical, biological, and chemical processes in the soil environment. The course will emphasize the effects of interactions among these processes and how they affect plant growth, soil reclamation, and the movement of soil particles and soluble materials in soils.

V. EDUCATIONAL ENRICHMENT

The Department of Agronomy strongly supports and encourages activities/programs that enrich the academic experience and professional skills of students. Following is a list of enrichment opportunities provided by the department:

Intercollegiate crops, soils, and weed teams.* Develops excellent background and personal skills for the practicing agronomist involved in crop and soil management in the grain, seed, fertilizer, and chemical industries; in land use, environmental, waste, and contamination management; and many other related fields. These programs require strong motivation and ability to compete successfully at the national level.

Undergraduate teaching and research. Available to highly motivated and qualified agronomy majors. Develops teaching and research skills important for students seeking advanced degrees or professional roles where teaching/research experience could be valuable.

Undergraduate agronomy club. A professional club for agronomy majors to develop leadership skills within their discipline. Educational, service, and social activities are included. The ISU Agronomy Club is affiliated with the American Society of Agronomy and its members are active in the student division of this professional society. Club members are eligible for national offices within the student division, and may participate in student contests.

Ag. travel and foreign exchange programs. The department offers winter and summer agriculture tours for undergraduate students within and outside the continental U.S. Students are eligible to participate in exchange programs with cooperating universities in other countries. The program is designed to increase the global, international and cultural awareness of undergraduate majors.

Special topics courses. An unstructured course designed to allow students to pursue and report creative activities in teaching, research, or other learning activities.

*The committee was not able to reach a consensus as to whether these should be offered as specific, named courses, as special topics, or as no-credit activities.

VI. A PROPOSAL FOR AN ENVIRONMENTAL SCIENCE MAJOR.

Natural resource management to decrease or eliminate environmental degradation is a topic of paramount importance. It is imperative that we learn how to manage the interface between people and the environment; i.e., soil, water and air, so that our activities do not result in degradation of our natural resources. This intriguing problem should be approached in two

ways. First, research must be conducted to better understand the effects of our activities upon natural systems. Second, we must begin to create a sensitivity to natural systems in our formal education. These two objectives must be addressed concurrently.

Faculty in the College of Agriculture have specialized in studying soil, water, and air as a integrated, natural system. Because the majority of those trained in studying this natural system are in the Agronomy Department, we recommend that Agronomy assume leadership in development of this curriculum. We recognize that this must be an interdepartmental effort and perhaps even a inter-college effort. However, the time to create this curriculum is now so that we can become a leader in this type of education and research by the year 2000.

VII. RESOURCE NEEDS

Implementation of these curriculum recommendations can not be accomplished without additional resources. The ISU Agronomy Department will need to develop, acquire, equip, and maintain:

- state, regional, national, and international databases of agro-technical information;
- simulations and models concerning agronomic, economic, and meteorological information;
- hardware and software to ensure adequate student computer access and allow for the development of multimedia-based learning modules to support both on-campus and distance/off-campus learning programs;
- video-tapes, slides, and other materials suitable for the development of multimedia based instructional modules.

There will be a need to:

- hire personnel to assist in the development, acquisition, maintenance, and organization of these materials and efforts;
- initiate a standardized professional development program for teaching faculty that utilizes both short- and long-term leaves to allow teaching innovation . Such leaves could be used for short-term work in industry, development of new course modules, development of advanced disciplinary and cross disciplinary course materials, etc. This program should not place undue pressure on the existing faculty but rather should include funding for appropriate personnel to assist with the faculty member's workload while on leave.

The need for further resources (including personnel) may become apparent as this program is refined and implemented.

VIII. TARGET DATES FOR IMPLEMENTATION

The committee believes the new curriculum can and should be fully implemented before 2005. Because implementation will require changes in personnel (faculty and support), the acquisition of new media equipment, and the development of sophisticated software for interactive, self-

learning instruction and problem-solving, a number of years will be required for full implementation. At the same time, we feel there is some degree of urgency in getting the curriculum in place because our clientele currently criticize agriculture curricula. It would not be an exaggeration to say that this curriculum actually is needed now.

Following are recommended initiation dates for various stages in development of the new curriculum. However, the committee hopes that many of these changes will be implemented earlier.

Jan. - Mar. '94 - consideration by Agronomy faculty and revision as needed.

1 April '94	- adoption of the new curriculum by agronomy faculty - begin negotiations with other departments, etc. on development of an Environmental Science Major.
Sept. '94	- have catalog copy for Soils 10 and 20; Agron 10 and 12; and Crops 20
Nov. '94	- establish personnel needs, including faculty - establish equipment needs and begin seeking funds for its purchase
Sept. '95	- complete implementation of the "10's" courses. - teach Soils 32 on an experimental basis. - begin design of the new internship program
April '96	- adopt catalog copy for Environmental Science major - develop a system for evaluation and renewal of curricul um
Sept. '96	- complete implementation of the "20's" courses - adopt catalog copy for "30's and 40's" courses
April '97	- implement the new internship program - institute the first curriculum evaluation/review
Sept '97	- complete implementation of the "30's" courses
Sept '98	- complete implementation of the "40's" courses

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