

## Plant and Soil Science

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### COLLEGE OF AGRICULTURAL SCIENCES

**Benton, Ralph A.**, Professor, *Emeritus*, Ph.D., University of Illinois, 1955; 1956.

**Bond, Jason P.**, Assistant Professor, Ph.D., Louisiana State University, 1999; 2000. Nematology and plant pathology.

**Chong, She-Kong**, Professor, Ph.D., University of Hawaii, 1979; 1979. Soil physics.

**Diesburg, Kenneth L.**, Assistant Professor, Ph.D., Iowa State University, 1987; 1989. Turfgrass science.

**Doerr, William A.**, Associate Professor, *Emeritus*, Ph.D., Southern Illinois University Carbondale, 1973; 1965.

**Elkins, Donald M.**, Professor, *Emeritus*, Ph.D., Auburn University, 1967; 1967.

**Fakhoury, Ahmad M.**, Assistant Professor, Ph.D., Purdue University, 2001; 2003. Plant-microbial toxicology.

**Harrison, Tony V.**, Assistant Professor, Ph.D., University of Florida, 1995; 2000. Agricultural systems.

**Henry, Paul H.**, Associate Professor, Ph.D., North Carolina State University, 1991; 1992. Ornamental horticulture.

**Hillyer, Irvin G.**, Professor, *Emeritus*, Ph.D., Michigan State University, 1956; 1956.

**Jones, Joe H.**, Professor, Ph.D., *Emeritus*, Ohio State University, 1960; 1964.

**Kapusta, George**, Professor, *Emeritus*, Ph.D., Southern Illinois University Carbondale, 1975; 1964.

**Klubek, Brian P.**, Professor and *Interim Chair*, Ph.D., Utah State University, 1977; 1978. Soil microbiology.

**Legacy, James**, Professor, *Emeritus*, Ph.D., Cornell University, 1976; 1977.

**Lightfoot, David A.**, Professor, Ph.D., University of Leeds, 1984; 1991. Agricultural molecular biology and biotechnology.

**McGuire, James M.**, Professor, *Emeritus*, Ph.D., North Carolina State University, 1961; 1993.

**Meksem, Khalid**, Assistant Professor, Ph.D., University of Cologne, Germany, 1995; 2000. Genomics, plant genetics, plant molecular biology and biotechnology.

**Midden, Karen L.**, Professor, M.L.A., University of Georgia, 1983; 1988. Landscape design.

**Myers, Oval, Jr.**, Professor, *Emeritus*, Ph.D., Cornell University, 1963; 1968.

**Olsen, Farrel J.**, Professor, *Emeritus*, Ph.D., Rutgers University, 1961; 1971.

**Pense, Seburn L.**, Assistant Professor, Ph.D., Oklahoma State University, 2002; 2003. Agricultural education.

**Preece, John E.**, Professor, Ph.D., University of Minnesota, 1980; 1980. Horticultural physiologist.

**Russin, John**, Professor, Ph.D., University of Kentucky, 1983, 1998. Plant pathology.

**Schmidt, Michael**, Associate Professor, Ph.D., Southern Illinois University Carbondale, 1994; 1979. Plant breeding.

**Shoup, W. David**, Professor, Ph.D., Purdue University, 1980; 1999. Precision farming, global positioning systems.

**Steffen, Richard W.**, Associate Professor, Ph.D., Iowa State University, 1993; 1994. Agricultural mechanization.

**Stitt, Thomas R.**, Professor, *Emeritus*, Ph.D., Ohio State University, 1967; 1967.

**Stucky, Donald J.**, Professor, *Emeritus*, Ph.D., Purdue University, 1963; 1970.

**Taylor, Bradley H.**, Associate Professor, Ph.D., Ohio State University, 1982; 1982. Fruit production.

**Tweedy, James A.**, Professor, *Emeritus*, Ph.D., Michigan State University, 1966; 1966. Herbicides and weed control.

**Varsa, Edward C.**, Professor, Ph.D., Michigan State University, 1970; 1970. Soil chemistry, fertility, and management.

**Wakefield, Dexter B.**, Assistant Professor, Ph.D., Purdue University, 2001; 2001. Agricultural education.

**Walters, S. Alan**, Associate Professor, Ph.D., North Carolina State University, 1997, 1998. Vegetable production.

**Watson, Dennis**, Associate Professor, Ph.D., Michigan State University, 1987; 2002. Agricultural systems and information.

**Wolff, Robert L.**, Professor, *Emeritus*, Ph.D., Louisiana State University, 1971; 1972.

**Wood, Eugene S.**, Professor, *Emeritus*, Ed.D., University of Missouri, 1958; 1949.

**Young, Bryan G.**, Assistant Professor, Ph.D., University of Illinois, 1998; 1998. Weed science

The Department of Plant, Soil and Agricultural Systems offers programs of study leading to the Master of Science degree with a major in plant and soil science with concentrations in the areas of crop, soil, and horticultural sciences; an emphasis in environmental studies in agriculture is also available in each of these concentrations. We offer graduate work in agricultural education and information and agricultural technologies.

Supporting courses in education, communication, engineering, plant biology, microbiology, chemistry, statistics, and other areas essential to research in the student's chosen field may be selected. Supporting courses are selected on an individual basis by the student and the advisory committee. Once the general field has been selected, the research and thesis may be completed in any one of the many divisions of that field. In field crops, the research may be directed toward crop production, management and precision farming, weeds and pest control, or plant breeding, genetics and biotechnology; in horticulture, the research and thesis may be in landscape design, vegetables, tree-fruits, small-fruits, floricultural and ornamental plants, plant tissue culture, or turf management; in soils, the research may relate to soil fertility, soil physics, soil microbiology, soil chemistry, or soil and water conservation; in environmental studies, the research may be directed toward water pollution, reclamation of strip-mined soil, or

agricultural chemical pollution problems. Often two of these more restricted areas can be combined in one thesis problem.

Agricultural education coursework is designed for instructors in secondary schools, for students preparing for employment at junior colleges, and for those desiring to continue their education by obtaining a Ph.D. degree. Agricultural information coursework is designed to provide graduate training for extension agents, agricultural communication professionals, product-education specialists, and others who are interested in agricultural information processing and transfer to a variety of non-student clientele. Agricultural technologies coursework is designed to offer students interested in technology based systems the opportunity to study one or more of the following areas: (a) power and machinery, (b) product handling, processing, and storage, (c) farm equipment evaluation, and (d) precision farming. Each of these areas offers application in agricultural environmental studies.

Students interested in plant and soil science at the doctoral level can be admitted to a program of study leading to the Ph.D. degree in plant biology. The program, which is administered by the Graduate School through the Department of Plant Biology, is adequately flexible to allow students to explore such interests as plant physiology, plant nutrition, chemical control of plant growth, plant genetics, etc.

### Admission

Application for admission to graduate study should be directed to the department. The applicant must have the registrar of each college previously attended send an official transcript directly to the department. In addition applicants should send a letter directly to the chair of the Department of Plant, Soil and Agricultural Systems expressing their professional and personal career objectives. Applicants should also request that four persons who can evaluate the student's academic ability write letters directly to the Chair in their behalf. Final admission to the program and a particular concentration administered by the Department of Plant, Soil and Agricultural Systems is made by the department. Minimal admission requirements to the program are: a) completion of the plant and soil science or agricultural systems undergraduate requirements and b) a minimal grade point average of 2.7 ( $A = 4.0$ ). The students who do not meet the requirement of completing the required courses in the undergraduate program in plant and soil science or agricultural systems may apply to enroll as nondeclared students to make up these deficiencies. Undergraduate course work taken to correct these deficiencies will not apply to the minimum requirements for the master's degree. Students entering the Plant, Soil and Agricultural Systems graduate program with a GPA below 2.70 are accepted on a conditional basis and must enroll in 12 hours of structured courses at the 400–500 level and make a GPA of 3.0 or be suspended from the program.

A non-refundable application fee of \$35.00 must be submitted with the application. Attach your check or money order, payable to Southern Illinois University, to the top of the application form. Do not send cash. Only checks or money orders payable to United States banks will be accepted.

### Program Requirements

If the student submits a thesis, minimum coursework requirements for the master's degree may be fulfilled by satisfactory completion of 30 semester hours of graduate credit. At least 20 hours of that credit must be from structured courses. At the 500 level 15 hours of course credit are required, of which no more than 10 hours may be from unstructured courses. Graduate seminar is required but is not a structured course. Overall, at least 15 semester hours must be from departmental courses.

If the student submits a research paper (non-thesis option) minimum coursework requirements for the master's degree may be fulfilled by satisfactory completion of 40 semester hours of graduate credit. At least 30 hours of that credit must be from structured courses. At the 500 level 18 hours of course credit are required, of which no more than 10 hours may be from unstructured courses. Graduate seminar is required but is not a structured course. Overall, at least 25 semester hours must be from departmental courses.

Students who wish to teach in agriculture education must complete a minimum of 15 hours in agriculture (including agricultural education), six hours of research methods or statistics, and six hours in education or community development. M.S. students usually take 4-6 hours of research or thesis, and complete the additional hours by taking courses in education or agriculture.

Each student, whether in the thesis or non-thesis option, will be assigned a mutually agreed upon major professor to direct the program. The major professor will serve as chair of the student's advisory committee which will consist of at least 2 members from within the department and 1 member from another department. Each master's degree candidate must pass a comprehensive oral examination covering graduate work including the thesis or research paper.

### Courses (PSAS)

Field trips are required for certain courses.

**400-2 Trends in Agronomy.** (Same as Plant and Soil Science 400.) A discussion session format will be employed as a means of acquainting students with recent literature and allowing them to remain current with latest developments in their area of specialty. Prerequisite: senior standing.

**401-2 Agricultural Plant Pathology.** A study of macro and micro-organisms and environmental factors that cause disease in plants of agricultural importance; of the mechanisms by which these factors induce disease in plants; and of the methods for managing diseases and reduce the damage they cause. Prerequisite: Plant Biology 200 or equivalent; Plant Biology 320 or and Plant Soil Science/Plant, Soil General Agriculture 409 recommended.

**402-1 to 12 (1 to 6 per topic) Problems in Agricultural Education and Technology.** (Same as Agricultural Systems 402.) (a) Agriculture education, (b) agriculture technologies. Designed to improve the techniques of agricultural education and mechanization workers through discussion, assignment and special workshops on problems related to their field. Emphasis will be placed on new innovative and currently developed techniques for the field. A limit of six hours will be counted toward graduation in Master's degree program. Prerequisite: consent of chair.

**403A-2 Field Crop Diseases.** A survey of major diseases of important field crops in the United States. Disease identification, cycles, and management strategies will be addressed. Prerequisite: concurrent enrollment in, or prior completion of 401 or equivalent.

**403B-2 Horticultural Crop Diseases.** A survey of major diseases of important horticultural crops in the United States. Disease identification, cycles, and management strategies will be addressed. Prerequisite: concurrent enrollment in, or prior completion of 401 or equivalent.

**403C-1 Turfgrass Diseases.** A survey of major diseases of important turfgrasses in the United States. Disease identification, cycles, and management strategies will be addressed. Prerequisite: concurrent enrollment in, or prior completion of 401 or equivalent.

**403D-1 Tree Diseases.** A survey of major diseases of important tree species in the United States. Disease identification, cycles, and management strategies will be addressed. Prerequisite: concurrent enrollment in, or prior completion of 401 or equivalent.

**405-3 Plant Breeding.** (Same as Plant and Soil Science 405.) Principles of plant breeding emphasized together with their application to the practical breeding of agronomic, horticultural and forest plants. Field trip costs approximately \$10. Prerequisite: 305 or equivalent.

**408-3 World Crop Production Problems.** (Same as Plant and Soil Science 408.) Ecological and physiological factors influencing production in various areas of the world. Natural limitations on world crop production. Non-agricultural factors influence world crop output. Prerequisite: 200.

**409-3 Crop Physiology.** (Same as Plant and Soil Science 409.) Principles of basic plant physiology. Topics include cell structure, photosynthesis, respiration, water and mineral relations, vascular transport, and plant growth regulators. Course fee: \$50. Prerequisite: Plant Biology 200 and a course in organic chemistry.

**411-3 Human Resource Development Programs in Agriculture.** (Same as Agricultural Systems 411.) Principles and procedures of human resource development (HRD) programs in agriculture with emphasis on program determination and methods. Prerequisite: junior standing.

**412-3 Methods of Agriculture Mechanization.** (Same as Agricultural Systems 412.) Theory and use of educational materials and devices adaptable to the needs and interests of educators involved in agricultural mechanization laboratories. There is a \$15 laboratory fee for this course.

**414-3 Adult Education Procedures, Methods and Techniques.** (Same as Agricultural Systems 414.) Determining adult education needs and interests of the community. Securing and organizing the information needed for adult education programs and planning teaching activities.

**415-3 Beginning Teacher Seminar.** (Same as Agricultural Systems 415.) The application in the professional field setting, of principles and philosophies of the education system. Includes application of principles of curricula construction, programming student and community needs. Prerequisite: consent of instructor.

**418-3 Applications of Integrated Software/Agriculture.** (Same as Workforce Education and Development 409.) (Same as Agricultural Systems 418.) Design of agricultural or educational applications of integrated software. Spreadsheet, database, wordprocessing, graphic and communications software will be applied to the solution of agricultural problems. Individual student projects will be the focus of the applied nature of the class. Prerequisite: junior standing or consent of instructor.

**419-3 Forage Crop Management.** (Same as Plant and Soil Science 419.) Forage crop production and utilization; forage crop characteristics, breeding, and ecology; grasslands as related to animal production, soil conservation, crop rotation and land use. Field trip costs approximately \$5. Prerequisite: Plant Biology 200 or one course in biology or equivalent.

**420-4 Crop Pest Control.** (Same as Plant and Soil Science 420.) Study of field pests of forest; orchard, field and garden crops; pest control principles and methods; control strategy; and consequences of pest control operations. Prerequisite: introductory biology or crop science course and/or consent of department.

**421-3 Turf Management Issues and Strategies.** (Same as Plant and Soil Science 421) Issues in environmental, technical, management, social, political, business, and sports arenas that interact with turf management. Students will utilize periodicals and other references for preparing papers addressing these issues. Laboratory fee: \$25. Prerequisite: Plant and Soil Science 322 or equivalent, or permission of instructor.

**422-3 Turf Science and Professional Management.** (Same as Plant and Soil Science 422.) Basic concepts of physiology, growth, and nutrition of turfgrasses and their culture. Application of turfgrass science to management of special turf areas such as golf course, athletic fields, and sod farms; and to the turfgrass industry. A fee of \$50 is assessed to pay for guest speaker expenses, laboratory materials, and field trips.

**423-3 Greenhouse Management.** (Same as Plant and Soil Science 423.) Principles of greenhouse management controlling environmental factors influencing plant growth; greenhouses and related structures; and greenhouse heating and cooling systems. Laboratory fee: \$40. Prerequisite: 220 or consent of instructor.

**424-4 Floriculture.** (Same as Plant and Soil Science 424.) Production, timing and marketing of the major floricultural crops grown in the commercial greenhouse. Each student will have an assigned project. Laboratory fee: \$40. Prerequisite: 423 or consent of instructor.

**425B-5 Advanced Plant Physiology.** (Same as Plant and Soil Science 425) Physics of plants, membrane phenomena; water relations; mineral nutrition. Prerequisite: 320 and consent of instructor.

**426-4 Genomic and Bioinformatics.** (Same as Plant and Soil Science 426.) The course is designed to introduce students from a variety of backgrounds and departments to the scope and methodology of genomic and bioinformatic sciences. Real problems and solutions from genome data analysis are studied in this course to see how high throughput genomics is driving bioinformatics, and changing the biological sciences in revolutionary ways. Prerequisite: One course in the principles of genetics and consent of instructor.

**427-5 Plant Biochemistry.** (Same as Plant Biology 427 and Plant and Soil Science 427.) Primary and intermediary metabolism. Exploration of fundamental biochemistry pathways in plants with an emphasis upon carbon and nitrogen metabolism. Prerequisite: Plant Biology 320 or consent of instructor.

**428-3 Advanced Landscape Design I.** (Same as Plant and Soil Science 428.) Development of the design process, graphics and verbal communication of landscape projects. Emphasis on large-scale projects and residential design. Laboratory fee: \$25. Prerequisite: 328 or consent of instructor.

**429-3 Advanced Landscape Design II.** (Same as Plant and Soil Science 429.) Development of the design process, graphics and verbal communication of landscape projects. Emphasis on construction details, color rendering and portfolio development. Laboratory fee: \$25. Prerequisite: 328 or consent of instructor.

**430-4 Plant Propagation.** (Same as Plant and Soil Science 430.) Fundamental principles of asexual and sexual propagation of horticultural plants. Actual work with seeds, cuttings, grafts and other methods of propagation. Field trip costs approximately: \$5. Lab fee: \$40. Prerequisite: 220.

**431-4 Landscape Construction.** (Same as Plant and Soil Science 431.) An introduction course in the basic elements of landscape construction dealing with wood, concrete, masonry and stone. Emphasis will be placed on safety, construction interpretation of construction drawings, specifications for specific structures, materials selection, cost estimation, site preparation, and construction techniques. Laboratory fee: \$170. Prerequisite: 220.

**432-4 Garden Center and Nursery Management.** (Same as Plant and Soil Science 432.) Principles and practices in both field and container production of ornamental landscape materials and the marketing of landscape plant materials at the nursery and retail garden center. Business management of both nurseries and garden centers will be included. Laboratory fee: \$50. Prerequisite: Plant and Soil Science 220 or consent of instructor.

**433-4 Introduction to Agricultural Biotechnology.** (Same as Animal Science 433.) (Same as Plant and Soil Science 433.) This course will cover the basic principles of plant and animal biotechnology using current examples; gene mapping in breeding, transgenic approaches to improve crop plants and transgenic approaches to improve animals will be considered. Technology transfer from laboratory to marketplace will be considered. An understanding of gene mapping, cloning, transfer and expression will be derived. Prerequisite: Senior standing or consent of instructor.

**434-3 Woody Plant Maintenance.** (Same as Plant and Soil Science 434.) Care and management of ornamental shrubs and trees commonly used in the landscape. Topics to include trimming, pruning, fertilization, transplanting and diagnosis of woody plant problems. Prerequisite: 327 or Forestry 202 or consent of instructor.

**435-1 to 4 Agricultural Molecular Biotechnology Seminar.** (Same as Plant and Soil Science 435.) Molecular Biology is rapidly making important contributions to agricultural science through biotechnology. An appreciation of the techniques of molecular biology and their application to plant improvement is important to all in agriculture and biology. The relationships between plant molecular biology and the biotechnology industry will be discussed. Presentations on particular research problems will be made. Graded S/U only.

**436-4 Successful Fruit Growing.** (Same as Plant and Soil Science 436.) Learn how to grow and use temperate fruit trees for your pleasure and/or economic benefit. Learn to use the basic principles of plant-environment interaction to understand and solve common problems found in the culture of tree fruit crops in the landscape, garden or orchard. Master the secrets of fruit growing through emphasis on hands-on experiential laboratories. Focus on Midwest culture of tree fruit and nut crops. One-day field trip. Required textbooks mandatory. Laboratory fee: \$135. Prerequisite: Plant and Soil Science 220 or consent of instructor.

**437-4 Vegetable Production.** (Same as Plant and Soil Science 437.) Culture, harvesting, and marketing of vegetables; with morphological and physiological factors as they influence the crops. Laboratory fee: \$25. Prerequisite: Plant and Soil Science 220 or consent of department.

**438-3 Techniques in Plant Molecular Biology.** Student will gain hands-on experience with current molecular techniques being applied to questions in the plant sciences. These include isozyme electrophoresis, DNA and RNA extraction, restriction endonuclease digestions, Northern blotting, Southern blotting, PCR (polymerase chain reaction), gene cloning and DNA sequencing. Student will also gain some exposure to the use of computers in manipulating and analyzing molecular data. Prerequisite: either Biology 200b or Plant Biology 200 and junior standing.

**441-3 Soil Morphology and Classification.** (Same as Plant and Soil Science 441.) Development, characteristics, and identification of soils, study of profiles; and interpretation and utilization of soil survey information in land use planning. Field trip costing approximately \$5. Prerequisite: 240 or consent of instructor.

**442-3 Soil Physics.** (Same as Plant and Soil Science 442.) A study of the physical properties of soils with special emphasis on soil and water relationships, soil productivity and methods of physical analysis. Prerequisite: 240.

**443-3 Soil Management.** (Same as Plant and Soil Science 443.) The soil as a substrate for plant growth. Properties of the soil important in supplying the necessary mineral nutrients, water and oxygen and for providing an environment conducive to plant root system elaboration. Soil management techniques that are important in optimizing plant growth. Prerequisite: 240.

**445-3 Irrigation Principles and Practices.** (Same as Plant and Soil Science 445.) This course will cover basic principles of irrigation sciences; water requirements of crops; soil water relationship; water application methods including flooding, sprinkler and drip (or trickle) systems; water conveyance, distribution and measurement; evaluation of irrigation efficiency; and irrigation scheduling. Considerations will also include crop production effects and economic aspects of irrigation. Prerequisite: 240 or consent of instructor.

**446-3 Soil and Water Conservation.** (Same as Plant and Soil Science 446.) Covers the principles of hydrologic processes and soil erosion. Consideration will be given to the occurrence of soil erosion as it affects humans, food production and the environment. The methods and technologies for protecting against and controlling of erosion will also be discussed. Prerequisite: 240 and Mathematics 110 or 113 or consent of instructor.

**447-3 Fertilizers and Soil Fertility.** (Same as Plant and Soil Science 447.) Recent trends in fertilizer use and the implications of soil fertility build up to sufficiency and/or toxicity levels; the behavior of fertilizer material in soils and factors important in ultimate plant uptake of the nutrients; the plant-essential elements in soils and ways of assessing their needs and additions; tailoring fertilizer for different uses and management systems; implication of excessive fertilization in our environment. Prerequisite: 240; concurrent enrollment in 448 suggested.

**448-2 Soil Fertility Evaluation.** (Same as Plant and Soil Science 448.) A laboratory course designed to acquaint one with practical soil testing and plant analysis methods useful in evaluating soil fertility and plant needs. One hour lecture, two hours laboratory. Laboratory fee: \$15. Prerequisite: 240; 447 or concurrent enrollment; or consent of instructor.

**454-4 Soil Microbiology.** (Same as Microbiology 454.) (Same as Plant and Soil Science 454.) A study of microbial numbers, characteristics and biochemical activities of soil microorganisms with emphasis on the transformation of organic compounds, nitrogen phosphorus, sulfur, iron and other plant essential nutrients. Lab fee \$15. Prerequisite: 240 or Microbiology 301.

**461-3 Programming for Agricultural Systems.** (Same as Agricultural Systems 461) Computer programming concepts and strategies are applied to agricultural problems and systems. Students will analyze problems, design solutions, develop software and test solutions. Student will be expected to develop a software project related to their academic interests. Lab fee: \$10. Prerequisite: Agricultural Systems 361 or instructor consent.

**466-4 Vine and Small Fruit Culture.** (Same as Plant and Soil Science 466.) Study of the developmental patterns and environmental responses of important vine and small fruit crops; strawberries, brambles, blueberries, grapes and exotic crops. Learn to adapt these crops to profitable culture for the amateur or professional with a Midwest focus. Practical hands-on experience in the classroom and the field. Two one-day field trips required. Required textbooks mandatory. Lab fee: \$150. Prerequisite: Plant and Soil Science 220 or 436 or consent of instructor.

**468-3 Weeds - Their Control.** (Same as Plant and Soil Science 468.) Losses due to weeds, weed identification and distribution, methods of weed dissemination and reproduction, mechanical, biological and chemical control of weeds. State and Federal legislation pertaining to weed control herbicides, herbicide commercialization. Field Trips costing approximately \$5. Prerequisite: an introductory biology course.

**470-2 Post Harvest Handling of Horticultural Commodities.** (Same as Plant and Soil Science 470.) Fundamental principles of post harvest physiology, handling, and evaluation of horticultural commodities will be covered. Specific details will be given on vegetable, fruit, ornamental and floricultural commodities. Field trip costing approximately \$30. Prerequisite: 220 and Plant Biology 320.

**472-3 Precision Agriculture.** (Same as Agricultural Systems 472.) A study of the basic principles of the Global Positioning System and how that system, along with currently available and emerging technologies is applied to the intensive management of production agriculture resources. Prerequisite: junior standing.

**473-3 Agricultural Automation.** (Agricultural Systems 363) This course introduces students to topics such as power distribution, programmable controllers, sensors and components, ladder control circuits and diagrams, and motor controls. The lab will address automation issues for different industrial processes such as pasteurization. Lab fee: \$20. Prerequisite: 363 or consent of instructor.

**475-4 Golf Course Green Installation and Maintenance.** This course will mainly focus on the requirements, installation, care and maintenance of the rooting media of golf course putting green and turfgrass on disturbed soils. Prerequisite: Plant and Soil Science 240

**476-3 Agricultural Safety and Health.** (Same as Agricultural Systems 476.) Analysis of safety and health issues important to managers and supervisors in agricultural operations. Topics include agricultural accident data, causes and effects of accidents, hazard identification, strategies for accident prevention, response to accidents and health risks and safeguards. Development and documentation of accident and illness prevention activities in the workplace. Prerequisite: junior standing.

**483-3 Agricultural Processing Systems.** This course provides students with an understanding of the design principles, equipment, procedures and processes utilized in handling processing and storing agricultural products.

**497-2 Agricultural Operations Management.** Practical management skills and strategies are applied to the agriculture industry. This course is intended for students who desire to advance into management positions in the agricultural industry. Skills and strategies include: interpretation of financial reports, preparing and monitoring budgets, time and process management, critical thinking, advanced problem solving, professional development, strategy planning and communication, leadership, personnel interaction and team-building. Prerequisite: graduate standing or instructor consent.

**499-3 Agriculture Information for Elementary Teachers.** (Same as Agricultural Systems 499.) A general inquiry into the agriculture literacy appropriate for elementary students. A framework for evaluating content appropriate for elementary students in the pursuit of agriculture literacy will be developed.

**500-3 Agricultural Systems Research Methodology.** Research methodology for agricultural education and agricultural systems technology including defining research problems, preparing project proposals and sources of data. Prerequisite: consent of instructor.

**501-43 Recent Research in Agricultural Education.** A study of recent research and development in agricultural education. The course includes an analysis of regional and national scholarly publications, procedures and products. Prerequisite: graduate status and consent of instructor.

**518-3 Principles of Herbicide Action.** Chemistry and mode of action of herbicides. Nature of herbicidal action. Illustrates the various types of chemical weed control procedures in current use. The physiology of herbicidal action examined using the different mechanisms established for various chemical groups of herbicides. Prerequisite: 468, Plant Biology 320.

**520-3 Growth and Development of Plants.** Physiological control of developmental processes. Emphasis on exogenous growth-regulating compounds and their behavior in plants. Prerequisite: Plant Biology 320 or consent of instructor.

**524-2 Advanced Plant Genetics.** (Same as Plant Biology 524.) Prerequisite: Biology 305 or equivalent.

**525-3 Program Development in Agricultural Education.** Analysis and appraisal of current trends in agricultural education program development. Attention is given to implications for educators at the high school, post secondary and in extension education positions. Offered each year, alternating spring and summer semesters.

**526-4 Cytogenetics.** (Same as Plant Biology 526.) Prerequisite: Biology 306 or equivalent.

**527-3 Professional Development in Agricultural Education.** Recent developments and trends in agricultural education are presented for review and discussion. The role of the agricultural instructor in determining educational priorities is emphasized. Offered each year, alternating fall and summer semesters.

**530-3 Plant Ecophysiology.** A study of the physiological processes that influence the growth reproduction, adaptation, and geographic distribution of plants. The ecophysiology of plant stress and interactions. Prerequisite: Plant Biology 320 or equivalent and Biology 307 or equivalent.

**547-2 Soil-Plant Nutrient Relationships.** A study of advanced topics relating to fertilizer and nutrient use efficiency by plants, including research methods for fertilizer use evaluation and plant response. Mechanisms in the soil for nutrient storage, release, fixation and loss will be dealt with as they relate to efficient use by plants. Prerequisite: 447 or equivalent.

**551-4 Plant Nematology.** This course will provide an understanding of plant parasitic nematode anatomy and morphology, identification, life cycles, and management strategies. Emphasis will be placed on practical or applied aspects of information presented. Prerequisite: 401 or Plant and Soil Science 401 or consent of instructor.

**560-5 (3,2) Field Plot Technique.** (a) Design of field plot and greenhouse experiments including appropriate statistical analyses for each of the designs. Data interpretation. Prerequisite: consent of instructor. (b) Each of the designs discussed in (a) will be illustrated with a type problem and solved by computer processes using primarily MINITAB and SAS software programs. Prerequisite: 560a or concurrent enrollment or consent of instructor.

**571-4 Genomics of Eukaryotes.** (Same as Plant Biology 571.) Genomics, Proteomics and Bioinformatics are rapidly making important contributions to the life sciences through biotechnology. An appreciation of the genomic tools is important to all in agriculture and biology. The relationships between plant molecular biology and the biotechnology industry will be explored. Short independent practical projects in genomics, proteomics or bioinformatics will be pursued. Prerequisite: graduate standing or consent of instructor, 400-level course in genetics, biotechnology

**572-3 Current Research in Agricultural Systems.** A study and analysis of current problems, research findings and innovations in agricultural systems. Technical reports and journal articles will be discussed and analyzed. Students will select articles related to their own research interests and begin writing a thesis or research proposal. Prerequisite: consent of instructor.

**575-3 Introduction to Agricultural Systems.** Agricultural systems are studied from a manager's perspective as a specified group of components, operational functions and processes that are integrated to accomplish a designated, well-defined purpose. Topics include planning, evaluating, and adjusting systems using strategies to maximize productivity with consideration for: reliability, manpower, scheduling, economy, packaging, human and animal factors and decision systems. Agricultural systems are studied in the context of a field production, manufacturing and processing, technical sales and marketing and technical communications. Laboratory fee \$10.

**581-1 to 4 (1,1,1,1) Seminar.** Individual presentations on subjects and problems relating to soils, field and horticultural crops, education, information, and technologies and other phases of plant, soil and general agriculture. Graded S/U only.

**582-6 (2,2,2) Colloquium in Plant and Soil Science.** Recent developments and trends in specialized areas of plant and soil science will be discussed in (a) Genetics and plant breeding, (b) Research methods, (c) Physiology and ecology.

**588-1 to 8 International Graduate Studies.** Residential graduate study programs abroad. Approval of department required both for the nature of program and number of hours of credit. Prerequisite: consent of department chair. Graded S/U only.

**590-1 to 4 Readings.** Contemporary books and periodicals on selected subjects within the fields of plant, soil and agricultural systems. Prerequisite: consent of department.

**592-1 to 3 Special Problems.** Directed study of specialized areas of crop production, horticulture, soils or agricultural systems depending on the program of the student. Discussion, seminars, readings and instruction in research techniques. Prerequisite: consent of department.

**593-1 to 6 Individual Research.** Directed research on approved projects investigating selected fields of plant, soil and agricultural systems. Prerequisite: consent of department.

**595-1 to 4 Agricultural Occupation Internship.** Prepares coordinators to fulfill their responsibilities in selected areas in agricultural related occupations through an internship in the area of specialization and through orientation to related technical information. Prerequisite: consent of department.

**599-1 to 6 Thesis.** At least three hours of thesis credit is required for the Master's degree under the thesis option. Prerequisite: consent of department.

**601-1 per semester Continuing Enrollment.** For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis or research paper. The student must have completed a minimum of 24 hours of dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded *S/U* or *DEF* only.