DEBRE BERHAN UNIVERSITY

COLLEGE OF AGRICULTURE AND NATURAL RESOURCE

DEPARTMENT OF PLANT SCIENCE

CURRICULUM FOR MASTER OF SCIENCE (MSc) DEGREE IN AGRONOMY

Revised SEPTEMBER 2018

Debre Berhan

1. BACKGROUND

Ethiopia has great agricultural potential due to its vast areas of fertile land, diverse climate, generally adequate rainfall and large labor pool. Despite this potential, however, Ethiopian agriculture has remained underdeveloped. Key constraints for development include recurrent droughts which have repeatedly affected the country since the early 1970s; a poor economic base (low productivity, weak infrastructure, and low level of technology); and over population. Furthermore, the agricultural sector provides employment to 85% of the population (of which women constitute 49.5% according to the 2007 census data), contributes 44% to the country's GDP and 85% of the country's export earnings. Nevertheless, the Ethiopian agriculture sector has an important opportunity to further improve the crop production sector. Thus, improving the techniques of crop production will pave the way for a stronger agricultural sector.

Rationale of the program

Ethiopian agriculture is characterized by the use of inadequate production technologies that in a variable climate produces important fluctuations in crop yields, uncertainties, and food insecurities. The major challenges to sustainable food grain production include availability of quality seed, decline in soil health, fragile cropping systems, looming water crisis, environmental degradation owing to indiscriminate use of farm chemicals, post – harvest losses, minimal value addition and product differentiation, inadequate food storage and preservation and poor marketing system. The imperative need, therefore, is to address these issues more forcefully in order to tap the considerable productivity potential of the agricultural sector through improving the techniques of crop production.

Agronomy was traditionally defined in the context of a speciality area of arable agriculture emphasizing field crops. While breeders attempt to match varieties to the environment, agronomists attempt to adapt them to the environment and management. Agronomy, therefore, is the cornerstone of all crop productivity which must be driven by the necessary education, training, research and capacity building in light of the following imperatives: use of improved seed and other inputs, soil fertility management, knowledge in plant and cell physiology, management of rhizosphere dynamics, decision-making related to biological and environmental constraints.

Productivity in agricultural sector is rapidly changing with emerging use of innovative technologies. For instance, possible changes of climate and their effects on plants, soil, pests and diseases; effects on agricultural potential, on production and land use; implications for food security are a few of the emerging concerns for contemporary crop production. This shift necessitates the education and development of specialists ready to transform agricultural practices using techniques that are more efficient, productive, and profitable and to provide quality food for the world's growing population. The MSc training in crop production integrates agronomic aspects with plant sciences. The course will play a key role in increasing agricultural productivity and improving food security. The program presents an integrated view of the subject, which emphasizes on scientific principles and techniques, and in addition includes an overview of agricultural biometrics. The graduate will get the opportunity to broaden their scientific knowledge in crop management and will promote professional development in agriculture by providing the student with well-founded knowledge and hands-on practical skills. This will greatly contribute to current endeavours of

the government of the Federal Democratic Republic of Ethiopia to boost agriculture outputs to ensure food security. Therefore, the MSc in agronomy program is proposed to help achieve these goals.

Program Objectives

The program aims at providing an in-depth theoretical and practical understanding of the subject matter and also imparts research skills in agronomy. It also generates agronomy professionals that are armed with the necessary knowledge and skill to bring the agricultural transformation in to effect.

The objectives of the program are as follows:

1. To produce competent professionals in the field of agronomy through learning-teaching of advanced and updated teaching, problem solving and original dissertation research
2. To increase agronomy professionals in crop production research in national and regional agricultural institutes
3. Enhance the competence of the staff and capacity of the department in undertaking relevant research activities in agronomy.
4. To generate, demonstrate and promote technologies that contribute to national food security and also increase the export competitiveness of the country.
5. To produce graduates with ability to identify research problems, design and execute research projects aimed at solving the problems within a changing agricultural environment
6. To produce graduates who can discover opportunities concerning efficiency and sustainability of crop production systems by developing safe and environmentally – sound practices.
7. At the same time, the training is to update the agronomists with the latest developments in the field of crop production and/or environmental agronomy.
8. Develop trained human resource base who conduct basic and applied research in various aspects of crop production and soil management under varying agro-ecological and socio-economic conditions of the farming community.
9. To train highly skilled agronomists who will help optimise the country

10. To generate, integrate, and apply knowledge about crop plants that are grown for food, fiber, and the general benefit of people

11. To develop trained human resource base who conduct basic and applied research in various aspects of crop production and soil management under varying agro-ecological and socio-economic conditions of the farming community.

12. To create synergetic effect among candidates and professionals with different background and link with academic and research initiatives cutting across other fields of agricultural science to provide the technical know-how that will address problems related to agriculture and crop production so as to alleviate food insecurity and improve livelihoods

Graduate profile

MSc graduates in Agronomy can engage in one of the following:

➢ Engage in teaching and communication in universities or agricultural schools or to the broader public.

➢ Conduct research on crop production, soil management, and weed management in national and international agricultural research institutes

➢ Identify, analyze and develop holistic solutions to the problems of crop production and protection

➢ National and international advising and consultancy in crop improvement, crop production and protection, nature and environment related to land use and in the horticultural and agricultural sector.

➢ Engage in policy development, implementation and administration related to crop production, nature, environment and related technologies in the public sector (ministries and municipalities) and in private stakeholder organizations, including international NGOs.

➢ Manage small and large-scale agricultural farms effectively and efficiently.

➢ Create their own agricultural business

➢ Assist farming community and extension workers to identify and understand major constraints of crop production in the field and assist in managing the problem all over the country.

Description of competence profiles

Students graduated from the program will acquire the knowledge, skills and competencies, and work as educators, researchers, consultants, producers in various governmental and non-governmental institutions serving in the agronomy sectors at national, regional and international levels. Generally students following the program are expected to acquire knowledge, skills and competencies listed below:

Knowledge about:

- The theoretical basis and current research within fundamental and applied aspects of crop production.
- The physiological and molecular functions of plants from the cellular level to whole organism.
- Crop diversity and how genetic resources and modifications can be used in crop improvements.
- Why and how input of resources (such as fertilizer, water, pesticide and energy) influence productivity, product quality, and the environment.
- The significance for and impact of crop production improvement on society and environment.
- The role of agricultural and horticultural production in society and environment, internationally and nationally.
- Elements in production systems and their interactions in different contexts.

Skills in/to:

- ✓ Apply biological and ecological knowledge to develop management principles (pests, disease, weeds and nutrient) in crop production systems.
- ✓ Understand and apply state-of-the-art methodologies used in plant science.
- ✓ Analyse how internal and external factors affect plant physiology, growth and development and product quality.
- ✓ Ability to make effective agronomic recommendations

Competences in/to:

- ➤ Capacity to understand and overcome barrier to change
- ➤ Capacity for independent thought, creativity and rigor in the application of knowledge and skills in work situations or research

- ➢ Participate in public discussions of the impact crops and crop production on society and environment, both from an international and a national perspective
- ➢ Manage complex and unpredictable work and development scenarios within the professional scope of the program
- ➢ Transfer research results on molecular and physiological plant processes into approaches towards improving quality, utilization and processing of plants and plant products

Human resource and facilities

The agronomy section of the school of plant sciences currently have -------- agronomists of which ------- are assistant professors and -------- lecturer. ------ Agronomists are on study leave towards their PhD and MSc.

The section has one functioning laboratory used for both teaching and research. The laboratory is in better condition in terms of basic equipment, and is expected to be improved. The laboratory is run by experienced laboratory technicians. The section can also use facilities of other laboratories with in the school and the university. Field based experiments can be conducted in any of the university experimental field stations at Debre Berhan university main campus and Shewarobit. Field experiments can also conducted at national and regional agricultural research centers, and other higher learning institutions in partnership and collaborations.

Admission Requirements

The common rules and regulations for the Master's degrees programmes specified in the Debre Berhan university statutes shall apply.

1. Admission shall be offered to holders of Bachelor of Science in plant science, crop science, horticulture, soil science and other related disciplines from nationally and internationally known university.
2. Candidates seeking admission from fields other than the above mentioned may be required to take additional courses to compensate for the deficiencies as per the recommendation of school of graduate studies.
3. Applicants must pass written entrance examination

Duration of the degree program

Candidates may qualify for the award of the MSc degree by fulfilling the following requirements: the program shall consist of course work, examinations and thesis.

- Candidates are required to successfully complete at least ------ credit hours of their course work and in addition successfully complete ------- credit hours of a thesis to qualify for the award of the Masters degree in agronomy. It is normally a two-year program. However, students may be allowed to delay for more than two years due to compelling reasons.

Course delivery

Course delivery methods are pointed for each course under course description. Generally the courses will be offered through lecturing, laboratory work and field visit, group work and discussion on topics from contents of the course, published research articles reviewing, presentation and discussion.

Student course performance assessment

Course assessment methods for each course are indicated under course description. All practical components of the coursework will be assessed by presentations and by individually assessing each student.

Generally course assessment will include written and oral examination, report writing, term paper writings and reviewing articles and presentations.

Quality assurance mechanisms

The quality assurance mechanisms are in-built beginning from admission, course delivery and performance assessment, thesis write up, supervision, and defence examination. In addition the curriculum will be revised after serving _____ academic year and assessing its merit and shortcomings.

Examination regulations

- Candidates registered for the master of science in agronomy program shall be required to do coursework examinations following assessment procedures approved by Debre Berhan university

- In case a candidate is taking remedial courses form undergraduate level, the evaluation will be as per undergraduate coursework evaluation process of the university. These remedial courses, however, will not be counted in postgraduate credits.

- Examinations shall be given separately for each course at the end of the semester in which the course is offered.

- The grading system and the process of computing GPA shall be as per the regulations of Debre Berhan University

- A candidate who fails in course examinations shall be given supplementary examination in the failed courses. The maximum grade for supplementary examination shall be B for major courses and C for elective course.

- A candidate who fails in the first supplementary examination shall be required to re-take and pass the failed courses within the second academic year

- A candidate who fails to meet the pass mark in the second supplementary examination of the retaken course shall be discontinued from studies

Research Project

- The research project report shall be examined in accordance with the requirements for such examinations in the College of Agriculture.

- Each candidate will submit, with the approval of the supervisors, a duly completed project paper for examination by the main supervisor and two independent examiners.

- A candidate who fails the research project may on the recommendation of the Faculty Board of Examiners be allowed to resubmit the project paper up to a maximum of two times.

- A candidate who fails in the second resubmission of the project paper or fails to complete the project within the prescribed period shall, on the recommendation of the Faculty Board and approval of the senate, be discontinued.

Grading system

The grading of examination for this programme shall be conducted in accordance with Debre Birhan University.

The following letter grading system will be employed. The grading systems for all courses are given in the table below.

Table1. Grading system

Marks	Grade	Grade points
[90, 100)	A^+	4.0
[85, 90)	A	4.0
[80, 85)	A^-	3.75
[75, 80)	B^+	3.5
[70, 75)	B	3.0
[65, 70)	B^-	2.75
[60, 65)	C^+	2.5
[50, 60)	C	2.0
< 50	F	0

<u>For thesis</u>

Excellent – (86% and above),

Very good – (76-85%),

Good – (61-75%),

Satisfactory – (50-60%) and

Failure – (less than 50%) based on the merit of the thesis and oral defense.

If the final decision by the examiners board is poor, he/she will not get graduated unless additional work is done.

Graduation requirement

To be eligible for graduation, all candidates need to fulfil the following requirements:

1. A minimum of _____ credit hours of course work (------compulsory courses and --------- elective course).

2. There should be no "D" grade in any course taken as well as not more than one "C" grade.

3. _____credits research work on which a thesis must be prepared, written, defended and got a pass.

4. <mark>Successful defense of thesis examination.</mark>

5. The research thesis shall be evaluated and graded as Excellent (_____%), Very Good (_____%), Good (____%) and Pass (_____%).

6. A minimum cumulative grade point average (CGPA) of 3.0 out of the maximum 4.0.

7. The program will be run in English.

Name of the Degree

- The final degree award shall be named as Master of Science in Agronomy and will be written both in English and Amharic.

Course Structure

Distribution of courses by year and semester

Year I; Semester I

Course code	Course title	Credit hours

E = elective course

Year I; Semester II

Course code	Course title	Credit hours

E= elective course

Year II; semester I and semester II

Course code	Course title	Credit hours

	MSc thesis	

Total course work credit =

Overall total credit =

Course description

Advanced plant physiology (---------- cr hr.)

Objectives:-to enable the students understand the basic physiological processes in plant growth and development

Learning outcomes: up on completion of the course students will be able to:

1   Recognize and explain the subject and scope of physiology of plants
2   Understand the concept and principles of
    ♦ Plant water relation ships
    ♦ Mineral requirement of plants
    ♦ Photosynthesis and Respiration
    ♦ Growth and development of plants
    ♦ Physiological principles of crop production
3   Apply these concepts and principles in the field of crop improvement (breeding) and management aspects
4   Interpret environmental effects on the physiology of crop plants and there by on crop yield.

Description:

plant-water relations, soil-plant-atmosphere continuum; Plant growth and development, growth curves; root-shoot relationship; concept of crop ideotypes: crop physiology and new ideotypes; concept and types of plant growth hormones and their role in filed crop production; plant nutrition-dynamics of nutrient uptake and assimilation, nitrogen metabolism; sulphur metabolism; important metabolic pathways; photosynthesis (C3, C4 and CAM), translocation of photoassimilates, photorespiration, respiration, etc.

Delivery:

Introductory lectures, group discussions, laboratory and field practical's, assignment presentation and individual reading.

Stress physiology (……)

- **Objective: To know the concept of biological stress and how plants generally respond to stressful conditions**

Learning outcomes:

After successful completion of the course, students will be able to:
- List and explain concepts of plant stress physiology
- Differentiate the difference the different types of abiotic and biotic stress
- Explain responses of plants to abiotic and biotic stresses

Description

Definition and concepts of stress; basic problems of rain fed crop production and effect of climatic factors on yield; adaptation and acclimation of plants to water deficit, salinity, chilling and freezing, heat, oxygen deficiency in the root biosphere, and air pollution.

Delivery:

Introductory lectures, group discussions, laboratory and field practical's, assignment presentation and individual reading.

Course title: Advanced Crop Ecology and Cropping Systems

Credit hours: 3

Objective: this course tries to equip with the knowledge of understanding the agro-ecosystems and their optimization in crop production

Learning outcome: upon completion of this course, students will be able to
- Conceptualize various properties of agro ecology and cropping systems
- Grasp different types of competition between crop plants
- Identify the different types of cropping systems

Description

The nature of crop ecology; principles of plant distribution and adaptation, ecosystem characteristics, types and function, ecosystem structure and productivity; global climate change on crop production; Ecological basis of environmental management and environment manipulation through agronomic practices; competition in crop plants; interaction in mixture species; Concept of coexistence and niche in agro ecology; ecological farming; ecology of cropping system; Crop plan population models and regulations.

Delivery:

Course title: Biometery

Course code:

Credit hour: 3 (2+1)

Course objective:

Course description:

Principles of experimental design as introductory, methods for analysis of variance with one and two levels of randomization, regression and model fitting. Other topics include ANOVA with blocking, factorial designs, latin square, split plot, changeover, repeated measures and unbalanced designs. Practical issues such as missing data and analysis will be covered. Introduction to statistical packages and commuter sciences will be given mostly SAS package. Students will be expected to write code for particular designs and interpret output. They will be required to start with design and layout through to analysis and interpretation. Other statistical software packages may be used on occasions for demonstration purposes such as SPSS.

Leaning outcomes

Upon successful completion of this subject, students should:

- Be able to judge and justify whether the statistical methodology and conclusions drawn in the media and scientific papers are appropriate;
- Be able to use a statistical package to : summarize data graphically and numerically, analyze data appropriately, and interpret and present the output in a clear logical manner;
- Be able to explain the concepts of statistical inference, regression and correlation, and apply these to confidence intervals and tests of hypothesis;
- Be able to evaluate if the assumptions underlying statistical techniques are valid in a given scenario;
- Be able to compare standard experimental designs, determine appropriate sample sizes and justify randomization and blocking;
- Be able to appraise a scientific problem and develop a statistical solution to that problem

Course title Irrigation Agronomy

Objectives:

- To help students analyze the source and storage of water for irrigation
- To familiarize students with the mechanisms of soil water measurement and flow of water in to and through the soil
- To help students grasp when and how much to irrigate, irrigation efficiency and water requirements of crop
- To identify irrigation and drainage systems

Learning Outcomes: after completion of this course, students will be able to:

- ➢ Analyze the source and storage of water irrigation
- ➢ Determine the time, quantity and frequency of irrigation
- ➢ Tell the principles of irrigation and measure soil water contents

Course description:

Sources and storage of irrigation water; water lifting devices; measurement, conveyance and control of irrigation water; flow of water into and through the soils; soil irrigablity classification; basic irrigation scheduling, measurement of soil irrigation water; quality of irrigation water; soil water depletion; soil water depletion; consumptive use and water use efficiency; water requirement of crops; irrigation requirement, system and timing; irrigation efficiencies; micro-irrigation systems; drainage of irrigated lands.

Course: Seminar

Objective: to improve student's communication and presentation skills. Selection of topic, preparation of material for presentation and presentation by the student in the class on a particular topic.

Course Description:

The MSc candidate is expected to review and analyze the literature and present his observations in the seminar on the selected topic related to his field of specialization other than his thesis research topic.

Course title: Principles of weed science

Objective:

- ➢ To acquaint students with comprehensive knowledge of weed management in filed crops

Learning outcomes: after completion of this course, students will be able to:

- ➤ Study the economic importance of weeds and their classification
- ➤ Realize and appreciate the amount of agricultural produce lost due to weeds in the field as well as in the storage
- ➤ Comprehend the interaction between weeds and crop plants which result in the reduction of crop yield in quality and quantity
- ➤ See the alternative use (value) of weeds
- ➤ Evaluate various control methods of weeds in relation to cost, resource, and environmental friendship
- ➤ Acquire the knowledge how to prepare plant (weed) specimen and why?
- ➤ Measure weed density in crops
- ➤ Familiarize themselves with the pros and cons of various herbicide formulations and equipment used for their application
- ➤ Compute the dosage of herbicide, and water needed per unit area

Description:

Weeds in agricultural perspective; systems concept for weed management; nature of weed-crop competition; critical period of weed interference. Economic threshold level. Characteristics, diversity and distribution of weeds; ecology of weeds. Elements of weed control. Merits and limitations of different weed control methods; advantages of integrated weed management; weed management systems for field crops. Management of problematic, parasitic, invasive weeds and non-crop land weeds. Tillage implements for weed control. Current developments and research trends in weed management.

Practical

Weed collection and identification. Demonstration of various hand tools and implements for weed control. Computation of herbicide doses. Demonstration of the use of sprayers for herbicide application.

Course: Research and scientific writing

Objective: to provide guidelines for research methodology, develop and improve skills in scientific writing

Description:

Concept of research, scientific method and experiment. Planning and execution of trials. Experimental designs and layout. Research trial observations. Collection, processing and analysis of data. Measures of experimental variability. Interpretation and summarization of results. Types of scientific writing and developing a research proposal.

Practical:

Writing of research proposal. Layout of field experiment, collection, tabulation and analysis of data. Presentation of data in tables, curves, histograms etc. writing of scientific paper/report.

Course: SEED Science

- **Objective:** describe the importance and definition of seed technology in agricultural production and explain its relation with other fields of science

Learning outcome:

At the end of the course, students will be able to:
- Describe the principles of seed production, including the supply methods to produce seeds of annual crops.
- Explain the various seed supply systems.
- comment on the formal and informal seed supply system
- Appreciate the importance and function of integrated seed supply system
- Consider farmers' relevant traits and its role in seed regulatory system

Content:

The importance of seed in agricultural production; the seed; seed as a necessary input; quality aspects; seeds in rural development: adapted strategies and seed supply as a multidisciplinary study; local seed selection and production; seed sources for the farmer; farmers' value; On farm seed sources; Off farm seed sources: methods of farmers' selection; botanical factors; plant genetic factors; variation; selection; seed storage; dissemination of seed; the formal seed sector: seed processing, storage and marketing; seed processing; seed drying; seed cleaning and upgrading; seed treatment; seed packing and handling; seed storage; seed marketing; seed testing: seed testing; seed sampling; determination of seed purity; seed germination; seed viability; seed vigor tests; seed health testing; seed moisture; seed certification and seed legislation: seed certification; field and seed inspection; seed legislation and seed law enforcement

Course: soil fertility

Objective: to provide know-how about mineral nutrition

Learning outcome:

At the end of the

Description:

Mineral nutrients, classification, functions and deficiency symptoms. Criteria of essentiality of mineral nutrients,; factors affecting nutrient availability; mechanism of nutrient uptake and translocation within the plants. Composition of fertilizers. Biological nitrogen fixation; factors affecting nodulation; nitrogen fixation by non-legumes; role of mychorhizae in nutrient absorption. Concept and brief history of organic farming; preparation of organic mater, humus, sewage sludge, organic compost. Quality of food and crop productivity under natural ecological systems.

Course: crop modeling

Objective: to understand the concept and application of crop modeling.

Learning outcome:

Description:

History and introduction of crop growth modeling, importance and uses, introduction to decision support system for agro-technology transfer, components of a model, input data set for different models, modeling and crop improvement, modeling: a tool for future predictions, demonstration and practice of crop growth models, measurement of different environmental variables from observatories.

MSc Thesis Research

Description

A candidate of MSc in Agronomy is required to identify and undertake a research work on a topic of national priority related to the different areas of agronomy under the supervision of a major adviser from the major field. Formulation of the thesis research proposal should be according to the standard research methodology and framed in consulation with the advisory board. The topic planning of the study is to be determined jointly by the student and his advisor(s). After the approval the candidate is expected to execute the proposal and come up with the findings in the form of a dissertation. The MSc thesis research, as a partial requirement for the fulfillment of degree program, includes its presentation and successful open defence.