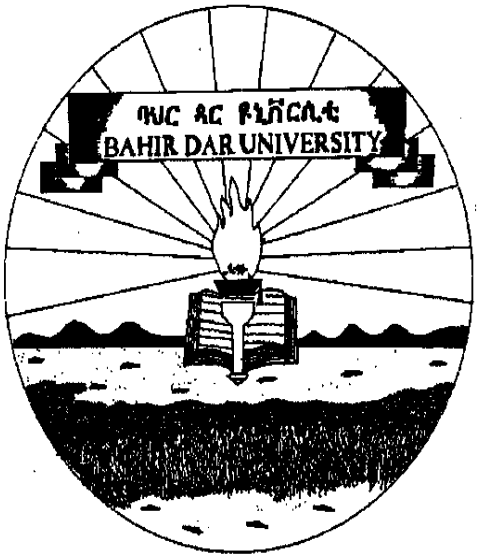
Master of Science (M.Sc.) in Agriculture (Plant Breeding)



Bahir Dar University

Faculty of Agricultural and Environmental Sciences

Department of Crop Sciences

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1. Background

Ethiopia is an agrarian country and agriculture dominates the economy of the country heavily by employing over 85 % of the labour force and contributing about 60 % to the National Gross Domestic Product. Nonetheless, Ethiopian agriculture is unable to feed an increasing population because of the poor management of its resource base and low productivity. The very low agricultural productivity in the country is due to, among others, lack of improved production technology, deteriorating natural resource base, inadequate institutions and linkages.

Ethiopia has a wide range of agricultural environment. This is depicted by the great geographical diversity with high and rugged mountains, flat-topped plateaus and deep gorges, incised river valleys and rolling plains. The effects of altitude on temperature and evapo-transpiration and therefore on soil texture are always compounded with those of relief. This is particularly true in the highlands of the country where sharp changes in climate and soils occur. The highlands are very heterogeneous with variety of landforms, diversified due to differences in elevation, geology, edaphic conditions, steepness and orientation in slope, wind and precipitation. These factors contribute to variations within short distance.

The country's diverse physical and social environments have resulted in a great diversity of tropical, subtropical and temperate climates, soil and vegetation. The variability in environmental factors has an important implication on the diversity of plant life in the country. The elevations provide for temperature differences for growing several kinds of crops. A wide variety of crops are found growing in various parts of the country. In the highlands, where cool temperature prevails, common temperate crops are grown. Many tropical and sub-tropical crops are also grown in low to mid altitudes of the country. The country as a whole is a center of origin and/or diversity for many plant species including several cultivated crops such as coffee, sorghum, tef, durum wheat, finger millet, barely, "gomenzer", "noug", safflower, sesame, castor bean, faba bean, etc.

Especially in the highlands of the country where more than 75 per cent of its population dwells, crop production is the predominant agricultural activity supplemented with livestock production. The crop production system is smallholder dominated farming practiced under rain fed condition, which is characterized by very subsistence farming with crop and livestock husbandry typically put under the same management unit. Despite its high potential of crop production the country is faced with chronic problems of shortages of food and cash crops and hence has not been able to achieve self

sufficiency to feed the ever increasing population, to obtain sufficient foreign exchange to purchase agricultural and industrial inputs to enhance production and to produce enough raw material for the local industry to absorb the young and the unemployed. Crop yields have remained extremely low, although some research results indicate that there is tremendous potential to increase productivity.

Current crop production and productivity of the country in general and of the Amhara Region in particular can be reversed and increased through the use of improved production technologies, reduction of pre- and post-harvest crop losses, and conservation of resource bases. This can be attained if only if huge number of well trained and qualified human resource is involved in all processes of technology generation, dissemination and adoption. Bahir Dar University which is situated in the midst of agrarian region having about 18 million human population and contributing to about 30 per cent of the national crop production, therefore, should start to produce enough number of well trained and qualified personnel in crop sciences both in regular, extension and summer programs.

2. Rationale for the Program

Ethiopia, like other countries of Africa produce different types of crops but the yield of each crop is typically low due to various biotic and abiotic factors. Common crops grown in Ethiopia are cereals (wheat, tef, barley, sorghum, maize, finger millet), highland pulse crops (faba bean, field pea, lentil , chickpea, lathyrus), lowland pulses (Haricot bean, Soybean, cow pea, pigeon pea, mung bean), high land oil crops (noug, gomenzer, linseed), lowland oil crops (sesame, groundnut, sunflower, safflower), which have are being threatened by different yield limiting factors like low soil fertility, crop pests (insect pests, crop diseases, weeds, vertebrate pests), moisture stress, socioeconomic problems, lack of improved varieties, etc. This programme is developed in response to the ongoing need to increase various crop production and productivity in the country and thereby to improve the livelihood of its people. The programme seeks to produce competent professionals who are equipped with both academic and practical knowledge and skills in managing all the phases of the crop production and management conducting various research and extension activities which can contribute for the region as well as country food security program.

3. Objectives of the Program

The Department will be fully involved in training and research, as well as, partly involved in extension activities of crop breeding and production. The ultimate goal of the Department, therefore, is to train high quality personnel, develop technologies that increase crop production and productivity in the region in particular and in the country in general, and thereby to improve the livelihood of its people.

The specific objectives of the Department of Plant Breeding are:

- To produce sufficient specialized humanpower that will be involved in generation, of improved crop varieties;
- To produce future farmers that can directly run their own farms, and thus will play a pivotal role in the transformation of the existing subsistence mode of agriculture to a commercial one.
- To integrate training-research-extension so as to increase the efficiency of crop variety generation and thereby to timely attains the intended development.

4. Staff profile

NO	Name	Rank	Qualification	Research Interest
1	Tsige Genet	Assistant Professor	BSc,1986 (Alemaya) MSc,1994 (Alemaya) PhD, 2003 (South Africa)	Plant Breeding
2	Adane Tesfaye	Lecturer	BSc (Alemaya) MSc (India)	Pest Management
3	Dereje Ayalew	Lecturer	BSc (Aemaya) MSc (Alemaya)	Agronomy
4	Berhanu Aberha	Associate Professor	BSc (AAU) MSc (AAU) PhD (Norway)	Stress Physiology
5	Jonson, M	Assistant Professor	BSc (India) MSc (India) PhD (India)	Biotechnology

5. Graduate Profile

The programme consists of a blend of academic and skill-based disciplines to ensure the development of plant breeding expertise to prepare graduates for employment in a variety of development, research and academic organizations. These include government and non-government agencies especially those involved in development, research and academic areas. Students will also have an opportunity to study at PhD level upon successful completion of the programme.

6. Academic Requirements

6.1. Course requirement

The program of the study leading to the M.Sc. degree in Plant Breeding requires 26 credit hours course and a 6-credit hour Master's Thesis.

6.2. Admission Requirement

Applicants must be graduates in Plant Sciences, Biology and other related fields with CGPA of 2.00 and above, and meet other admission requirements of the School of Graduate Studies (SGS) of Bahir Dar University.

6.3. Duration of the study

The MSc program is a two year program, with one year (2 semesters) taught courses and one year for a research project in a specific area of specializations.

6.4. Assignment of course code

Each course is coded with four letters and three numbers. The four-letter abbreviation shows the department, the first number shows the year of the study, the second letter shows the course type and the third number shows the semester. The assignment of numbers to represent course types as follows:

0 = Advanced Genetics, Quantitative Genetics, and Plant Breeding

1 = Advanced Plant Biochemistry, Biotechnology and Marker Assisted Selection

2 = Advanced Biometrics and Software tools for data analysis in Plant Breeding

3 = Current Topics, Graduate Seminar and Thesis Research

The even number at the end of the course code shows second semester course and odd number denotes courses that will be conducted in the first semester.

6.5. Assessment and evaluation

Graduate student progress is assessed regularly and informally by the respective Faculty member. Informal assessment focus on both completion of coursework and the development of professional skills in research, writing, leadership and service. The formal ways of assessment includes the following:

For course work

Assignments

Mid semester examination

Final semester examination

Seminars and presentations

For practical courses

Laboratory reports/Field reports

Practical examinations

Written examinations

For thesis/Seminars/Report presentation

Paper organization

Quality of paper presented

Way of presentation

Defending material presented

6.6. Graduation Requirement

The student must score a minimum of 3:00 and successfully defend thesis.

6.7. Degree Nomenclature

Upon successful completion of the program "**THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURE (PLANT BREEDING)"** will be awarded. **በአማርኛ "□ማስተርስ □□ይ በግብርና ሳይንስ/በዕጽዋት ማሻሻያ /".**

7. List of Courses Required	Course NO	Course Title	Credit Hours
1	**Crsc** 601	Advanced Genetics	3
2	**Crsc** 613	Advanced Plant Biochemistry	3
3	**Crsc** 615	Application of Biotechnology in Plant Breeding	3
4	**Crsc** 627	Advanced Biometrics and Statistical Tools	4
5	**Crsc** 638	Current Topics in Plant Breeding and Genetics	1
6	**Crsc** 600	Quantitative Genetics in Plant Breeding	3
7	**Crsc** 602	Advanced Plant Breeding	3
8	**Crsc** 614	Molecular Markers and Marker Assisted Selection	3
9	**Crsc** 606	Cytogenetics in Plant Breeding	2
10	**Crsc** 731	Graduate Seminar in Plant Breeding and Genetics	1
11	**Crsc** 733	M.Sc. Thesis	6
		Total Credit hours	**32**

8. Course Breakdown

S.N	Course NO	**Year 1, Semester-1** List of Courses	Credit Hours
1	**Crsc** 601	Advanced Genetics	3
2	**Crsc** 613	Advanced Plant Biochemistry	3
3	**Crsc** 615	Application of Biotechnology in Plant Breeding	3
4	**Crsc** 627	Advanced Biometrics and Statistical Tools	4
		Total Credit hours	**13**

		Year 1, Semester-2	

S.N	Course NO	List of Courses	Credit Hours
1	**Crsc** 600	Quantitative Genetics in Plant Breeding	3
2	**Crsc** 602	Advanced Plant Breeding	3
3	**Crsc** 606	Cytogenetics in Plant Breeding	2
4	**Crsc** 614	Molecular Markers and Marker Assisted Selection	3
5	**Crsc** 638	Current Topics in Plant Breeding and Genetics	1
		Total Credit hours	**12**

		Year 2, Semester-1	
S.N	**Course NO**	**List of Courses**	**Credit Hours**
1	**Crsc** 731	Graduate Seminar in Plant Breeding and Genetics	1
2	**Crsc** 733	M.Sc. Thesis	6
		Total Credit hours	**7**

		Year 2, Semester-2	
S.N	**Course NO**	**List of Courses**	**Credit Hours**
1	**Crsc** 733	M.Sc. Thesis	6
		Total Credit hours	**6**

9. Course Descriptions

Course title: Advanced Genetics
Course code: Crsc 601
Credit hours: 3
Course description:

Mendelian genetics and its implication; gene concept, classical and modern; measurement of linkages and construction of chromosome maps; environmental modification of phenotypes; mutation and mutagenic agents; mutable loci; genetic control and metabolic patterns; genetic unit its structure and function; present concept of gene organization; nature of genetic code, regulation

of gene activity and development; extra-nuclear genetics; genetic counseling and eugenesis; genetic engineering; introduction to ecological, behavioral and development genetics, introduction to population genetics.

Course title: Cytogenetics in Plant Breeding
Course code: Crsc 606
Credit hours: 3 (2 lectures and 3 hours laboratory)
Course description:

Chromosome theory of inheritance, chromosome structure, cytogenetical basis of linkage and crossing-over, genetic implications of cell division, concepts in chromosome models, change in chromosome number and change in structure of chromosomes, balanced lethal systems, karyotype analysis, evolution and phylogenetic relationships, role of cytogenetics in plant breeding, polyploidy breeding - types of polyploidy and their applications in crop improvement; genome analysis; barrier in inter- and intra-generic and inter- and intra-specific hybridization.

Course title: Advanced Biometrics and Statistical Tools
Course code: Crsc 627
Credit hours: 4 (3 lectures and 3 hours laboratory)
Course description:

Descriptive analysis of data, types of variables and measurements, Probability distributions; Analysis of variance models; assumptions and their tests, alternatives in case of failures of assumptions; principles of designs of experiments; detail discussion on the applicability, layout and randomization, analysis of variance, mean separation, interpretation of results and missing plot techniques with respect to completely randomized design, randomized completely block design, latin squares design, youden square design, factorial experiments with confounding and fractional factorial design concepts; split plot design and strip plot design with two or more factors; compact family block design; incomplete block designs-simple and balanced lattice design, augmented randomized block designs; combined analysis of variance and its interpretation; analysis of covariance with randomized block design for adjustment; simple and multiple correlation and regression analysis; application of chi-square and non-parametric statistics.

Practical software tools Agrobase Generation II software (Data base management, File management, Design and Randomization, Experiment Management, Analysis of Variance (Augmented designs, Balanced RCBD, Factorials, Alepha Lattice, Moving Mean Analysis,

Nearest Neibour Analysis); Statistics (AMMI, G X E, Nonparametric statistics); Plant breeding (Griffing Diallel analysis, Line x Tester analysis), Pedigree management.

Course title: Current Topics in Plant Breeding and Genetics
Course code: Crsc 638
Credit hours: 1
Course description:

Supervised study on advanced topics in plant breeding. A reading and conference course designed to acquaint the graduate student with topics not covered in other courses in plant breeding and genetics and related fields.

Course title: Advanced Plant Breeding
Course code: Crsc 602
Credit hours: 3
Course description:

Plant breeding, its objectives and achievements; genetic basis of breeding of self and cross pollinated crops; nature of variability and component of variance; heritability, genetic advance and response to selection; genotype-environment interaction, concept of adaptability; gene and genotypic frequency; genetical and physiological basis of heterosis and inbreeding depression; implication of genetic components for adopting appropriate breeding methods; concept of plant ideotypes; mechanism, induction and utility of male sterility and apomixis; mechanisms and utility of self incompatibility and methods to overcome it; developments in breeding methodology in self pollinated, cross pollinated and asexually propagated crops.

Course title: Advanced Plant Biochemistry
Course code: Crsc 613
Credit hours: 3
Course description:

Plant cell, ultra structure of the cell, cell membrane, structure and function of biomolecules (proteins; lipids-membranes; carbohydrate-peptidoglycans; etc.). Metabolism, (carbohydrate, protein, lipid); including photosynthesis and organ specialization. Integration of carbohydrate, protein and lipid metabolism and regulation. Vitamins, enzymes, coenzymes and mineral metabolism. Biosynthesis of macromolecules, structure and function of RNA and DNA.

Course title: Application of Biotechnology in Plant Breeding
Course code: Crsc 615
Credit hours: 3
Course description:

Biotechnology, history and development; types of biotechnology protoplast, cell tissue and organ culture; embryo and ovule culture for wide hybridization; *in vitro* pollination and *in vitro* fertilization for overcoming incompatibility; anther and pollen culture for production of haploids; meristem culture and production of pathogen-free plants; vegetative propagation and cloning; mutagenesis in cell and tissue culture; somatic hybridization and exploitation of somatic hybrids; transformation, molecular markers technology, and biosafty.

Course title: Molecular Markers and Marker Assisted Selection
Course code: Crsc 614
Credit hours: 3 (2 lecture and 3 hour laboratory)
Course description:

This course covers Protein and DNA markers. The course covers topics on protein markers isolation, Electrophoresis, SDS-PAGE; DNA isolation methods, historical development of molecular markers, PCR, Types of DNA markers (RFLP, RAPD, ISSR, SSCP, CAPS, SCAR, AFLP, SSR, SNP, etc.,), description, advantages and disadvantages, of each molecular technique; applications of molecular markers in genetic resource conservation, seed production, variety development, risk assessment of genetically modified organisms. Mapping genes controlling quantitative traits, QTL mapping in double haploid line, map based gene cloning, basic strategies for gene cloning. Marker assisted selection in breeding for diseases, insect pest and herbicide resistance, marker assisted selection efficiency and biological effects, importance of MAS for perennial crops.

Course title: Quantitative Genetics in Plant Breeding
Course code: Crsc 600
Credit hours: 3
Course description:

Nature and origin of continuous variation; relationship between genotype and phenotype; separation of components of variability correlation and path analysis at the genotypic and phenotypic levels; discriminate functions; Multivariate methods, parent-offspring regression analysis; estimation of genetic effects and testing the adequacy of additive-dominance model by simple scaling and joint scaling, line x tester and diallel analysis for combining ability; Mixed model approaches, North Carolina mating designs; genotype-environment interaction and models

of adaptability; metroglyph analysis; concepts of triple test cross, and incomplete partial diallel, partial diallel mating design.

Course title: Graduate Seminar in Plant Breeding
Course code: Crsc 731
Credit hours: 1
Course description:

Literature review and discussion of current research in the field of Plant breeding and genetics.

Course title: M.Sc Thesis Research
Course code: Crsc 733
Credit hours: 3
Course description:

Organized Research in Plant Breeding including thesis organization, presentation and defense as part of the requirement for the Master of Science Degree in Agriculture (Plant Breeding).

PLANT BREEDING SUMMER

S.N	Course NO	Year 1, Summer-1 List of Courses	Credit Hours
1	**Crsc** 601	Advanced Genetics	3
2	**Crsc** 613	Advanced Plant Biochemistry	3
3	**Crsc** 615	Application of Biotechnology in Plant Breeding	3
4	**Crsc** 627	Advanced Biometrics and Statistical Tools	4
		Total Credit hours	**13**

S.N	Course NO	Year 1, Summer-2 List of Courses	Credit Hours
1	**Crsc** 600	Quantitative Genetics in Plant Breeding	3
2	**Crsc** 602	Advanced Plant Breeding	3
3	**Crsc** 606	Cytogenetics in Plant Breeding	2
4	**Crsc** 614	Molecular Markers and Marker Assisted Selection	3
5	**Crsc** 638	Current Topics in Plant Breeding and Genetics	1
		Total Credit hours	**12**

S.N	Course NO	Year 2, Semester-1 List of Courses	Credit Hours
1	**Crsc** 731	Graduate Seminar in Plant Breeding and Genetics	1
2	**Crsc** 733	M.Sc. Thesis	6
		Total Credit hours	**7**

S.N	Course NO	Year 2, Semester-2 List of Courses	Credit Hours
1	**Crsc** 733	M.Sc. Thesis	0
		Total Credit hours	**0**