UNIVERSITY OF HORTICULTURAL SCIENCES, BAGALKOT, KARNATAKA

SELF STUDY REPORT FOR THE M.Sc. HORTICULTURE IN GENETICS ANDPLANT BREEDING, COH, BENGALURU 2014-15 to 2018-19

SUBMITTED TO

Indian Council of Agricultural Research,
Krishi Bhavan, New Delhi.

SUBMITTED BY

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PREFACE

Horticulture - a science of production and management of plants for food, comfort, feed, recreation, and beauty – is potentially vital in raising agricultural production, value addition, farm income and employment in the country. In the context of hazards like climate change, scarcity of water, labour problem etc., Horticulture is contributing incessantly in planning sustainable development goals. After UN General Assembly Summit held on January 1st of 2016, India has adopted 17 SDGs and 169 targets to strengthen health and economy of the nation. Modern era of digitalization has introduced new perspectives like digital horticulture, precision farming, climate smart farming, and nutritional security into the prospectus of horticulture.

Karnataka was the first state in the country to recognize the potential of horticulture sector to bring prosperity to the farmers. To increase the focus on the sector, the state took the lead and created the country's first Horticulture Department and other states followed the example of Karnataka. Presently Karnataka is placed second in horticulture performance in the entire country and the state received 'Best State in Horticulture' award in 2015. Karnataka is the highest exporter of cashew, roses, gherkins, rose onions, spices and condiments. The state has achieved remarkable progress in many fronts from production to storage, packaging and marketing of fruits, vegetables, flowers and plantation crops.

The horticulture sector, which includes a wide variety of crops such as fruits, vegetables, spices, plantation crops, floriculture, medicinal and aromatic plants etc., is recognized as an important sector for potential diversification and value addition for the sustainability of the farmers. It has been recognized that growing horticulture crops is now an ideal option to improve livelihood security; enhance employment generation; attain income and food security; and increase income through value addition.

After its establishment in 2008, University of Horticultural Sciences, Bagalkot established RHREC in a newly transferred land of 125 acres at its campus in Bengaluru in the year 2010 and in the year 2011 Post Graduation Centre was established. Initially the campus was called as Post Graduation Centre but with the commencement of Bachelor's degree programme and two year diploma course in the year 2014, it was re-christened as College of Horticulture.

The college is striving hard to impart quality education in terms of theory, research and extension. The college is gathering laurels through the performance of teachers as well as the students. The college has an excellent track record in both academicals and co-curricular activities.

ICAR, through an accreditation procedure of its own is assessing facilities available and to improve the quality of education rendered by the college. After accreditation, by the financial support of ICAR and State Government, the growth and developmental activities of the college will be

improved further to a greater extent. Since the college is due for accreditation by ICAR the present report provides all the necessary information about the college activities performed during last five years.

The University level task force and steering committee is gratefully acknowledged for the help, guidance and suggestions given in preparing the report. The College level steering committee and task force have done a great job in compiling information and bringing out this report to be submitted to Accreditation Board of ICAR. I gratefully thank all those who have helped in preparing this report.

Dean
(Vishnuvardhana)
College of Horticulture, Bengaluru

CONTENTS

6.4.1. EVOLUTION OF THE P.G. PROGRAMME:

A diverse agro-climatic condition prevailing in Karnataka facilitates growth of a large variety of horticultural crops including fruits, vegetables, flowers, spices, plantation, root and tuber crops, aromatics crops, medicinal crops, oil palm etc. Besides the essentiality of these crops, now-a-days the utility vistas of horticultural commodities are getting diversified with the new scientific and technological advancements in related disciplines.

The liberal economic policy regime of the country and advancements in related scientific disciplines have carved niche of new opportunities, which has resulted in a need to improve the productivity of horticulture crops and impart new consumer traits to make them further attractive both to the industry and food sectors. Advancements in molecular biology and platform technologies including next generation breeding approaches and genetic engineering have opened new opportunities in improvement of the vegetable crops, plantation crops, flower crops, fruit crops, medicinal crops for yield, resistance to biotic and abiotic stresses and industrial requirement. Many horticulture crops are being considered for whole genome sequencing in recent years and large-scale genomic resources are getting accumulated in public databases. Advanced tools in the plant breeding and biotechnology and increasing finding their relevance in improvement of horticulture crops in recent years.

Hence, establishment of a Post-Graduation degree programme in covering Genetics & Plant Breeding, Plant Biotechnology, Seed Science & Technology, Crop Physiology and Biochemistry disciplines, in the name of 'Biotechnology and Crop Improvement' was started at then Post Graduate Centre, UHS campus, GKVK post, Bengaluru of University of Horticultural Sciences, Bagalkot with a primary aim of training the students and meeting the trained man power requirement in the sector for horticulture biotechnology and crop improvement and applications of cutting edge molecular biology and biotechnology tools in horticulture. With this objective, and available faculty and infrastructure in the department of Biotechnology and Crop Improvement the master degree programme was started during the academic year 2013-14 with admission of four students at College of Horticulture Bengaluru. Immediate next year, in 2014-15 with well-established molecular biology laboratories and other essential facilities as part of Centre for Biotechnology Research (CBR), funded by Department of Information Technology, Biotechnology and Science and Technology (IT, BT and S&T) of Government of Karnataka both at COH, Bengaluru and UHS Bagalkot campuses, the doctoral programme in the discipline of

'Biotechnology and Crop Improvement;' was started during the year 2014-15, at College of Horticulture, Bengaluru with an initial intake of three students.

Further, during 2017-18 the Academic Council of University of Horticulture Sciences, Bagalkot changed the nomenclature of degree programme as 'Plant Biotechnology' and 'Genetics and Plant Breeding' – two separate degree programmes both at Master's and Doctoral level to fall in line with the ICAR Dean's Committee recommendation and ICAR nomenclature Committee. At present, the following PG degree programs have been offered at Department of Biotechnology and crop improvement:

1. M.Sc. (Hort.) Plant Biotechnology
2. M.Sc. (Hort.) Genetics and Plant Breeding

Both curricula and guidelines are completely as per the ICAR guidelines recommended by Vth deans committee.

Vision

"Our responsibility is to continually improve overall learning and professionalism of the students through imparting quality education and training in the disciplines of Biotechnology and Crop Improvement for a challenging tomorrow so as to serve the agri- horticulture sector in particular and society at large and be valuable assets to the nation. Our vision is to evolve creativity in research and education base with a focus to do a larger good to the society and nation"

Mandates

- To impart quality postgraduate education in the disciplines of plant biotechnology, genetics & plant breeding, biochemistry and crop Physiology.
- To develop skilled manpower required to various stakeholders including plant breeding, plant biotechnology and intensive industries besides others.
- Conservation and characterisation of plant genetic resources of horticulture crops
- To undertake need based strategic and applied research by the faculty in genetics and plant Breeding.
- To develop high yield varieties, hybrids, transgenics in horticulture for immediate needs of the farmers and industry.
- To facilitate transfer of technology to the industry and other stakeholders through continuous trainings.

Objectives

1. Teach, train and graduate qualified skilled scientists in the disciplines of genetics and plant breeding.
2. Develop, implement and evaluate the curriculum of Genetic and Plant Breeding with a strong commitment to be aligned and comply with the national and international standards
3. Conduct applied research in basic and translational plant breeding and fosters interactions and collaboration between faculty, researchers and industry.
4. Promote a supportive learning environment for life through implementing continuous learning programmes.
5. Apply the general principles and standards of technology transfer and ensure adequate training of our personnel in modern plant breeding and biotechnology.

Accomplishments:

1. P.G. student's research outcomes which are helpful for the farming community and further research:

Sl. No.	Year	Student name	Research Outcome
Masters' students			
1	2013-14	Nayana R. S.	Identified potential vegetable type soybean accessions from initial set of core collection and understood the genetic plasticity for venerability traits
2.	2013-14	Adiveppa Siddannawar	Elucidated genetic and population architecture of landrace population of brinjal covering entire Karnataka state
3	2013-14	Sumuka L.	Green synthesis of nanoparticles and their effect on the expression of selected microRNAs and cognate genes in tomato and *Arabidopsis thaliana*
4	2013-14	Mamatha S.	Genetic diversity in muskmelon accessions was done pinning down superior genotype for quality traits
5	2014-15	Chitra	Developed protocols for regeneration of wild orchid species from *Western Ghat*
6	2014-15	Karthik	Elucidated and characterized RGAs in tomato with special reference to ToLCV New Delhi virus
7	2014-15	Ajay	Developed M_2 mutants for vegetability traits in cluster bean
8	2014-15	Basavraj A.	Identified advanced breeding lines resistant to water stress and nutritionally superior genotypes
9	2015-16	Shreedhar R. S.	Developed superior hybrids with better yield performance for ToLCV resistance using breeding and biotechnology approach
10	2015-16	Rashmi	Identified cluster bean genotypes resistant to drought traits

11	2015-16	Kavya	Identified downy and powdery mildew resistant early segregants in muskmelon
12	2016-17	Apoorva K. A.	Identified superior ecotypes of *Garcinia indica* and *Garcini cambogea* for –(-) HCA content.
13	2016-17	Meghana N. M.	Identified superior advanced mutants of cluster bean for yield and quality
14	2016-17	Ashwini L.	Superior genotype identification of cluster bean based on physiological characterization
15	2016-17	Sachin J.	Identified superior muskmelon genotypes by phenotyping and genotyping for powdery and downy mildew resistance
16	2016-17	Manisha Kapure	Identified okra genotypes with superior yield and related traits.
17	2017-18	Mahesh Katagi	Comparative evaluation of ToLCV resistant advanced breeding lines derived through MAS for yield and quality traits in tomato
18	2017-18	Pramod R	Selection of drought tolerance traits in mango
19	2017-18	Rahul	Genetic diversity studies in Mysuru mallige Sambac-a GI crop
20	2017-18	Chaitra S.	Studies on genetic diversity and crossing ability among inter-botanical groups of melon

2. P.G. student's research topics linked with staff research projects:

- Characterisation of genetic diversity and variation for specific traits in germplasm of tomato, soybean, muskmelon, okra, cluster bean, brinjal, pigeonpea and onion
- Genomics assisted breeding of tomato for resistant to diseases and yield
- Development of functional mutants and high yield French been lines
- Genetic diversity and improvement of cluster bean for yield and related traits
- Breeding for vegetable type pigeon pea, soybean and cluster bean.
- Genetic diversity and improvement for samber onion
- Comparative *in silico* analysis of microRNA and RGAs in tomato/*Arabidopsis*
- Structural and functional analysis of genomic regions conferring leaf curl virus (ToLCV) in tomato
- Genetic and molecular characterization of ecotypes/landraces groups of brinjal prevailing in Karnataka
- Genetic diversity and improvement of muskmelon for yield, disease resistance and quality traits
- Genetic improvement of okra for yield and diseases
- Physiological studies in mango for drought tolerance
- Physiological investigations in cluster bean for drought tolerance traits

- Understanding the biochemical basis of fruit quality traits in tomato and legume vegetables crops
- Metabolomic analysis of selected horticulture crops
- Development of protocols for induction of haploids in selected horticulture crops

3. External funded projects in the Department of Biotechnology and Crop Improvement

- Centre for horticulture biotechnology, funded by RKVY, GoK
- Molecular breeding for leaf curl disease resistance caused by tomato leaf curl virus (ToLCV) in tomato(Part of IT,BT and S&T, funded CBR project)
- Establishment of a field gene bank for *Garcinia indica and Garcinia cambogea* ecotypes of *Western Ghats* and their characterization for (-) –Hydroxy citric acid [(-)-HCA] and genetic diversity (Part of IT,BT and S&T, funded CBR project)
- Development of certification protocols for planting materials of Horticultural origin (RKVY, GoK funded)
- VGST funded project funded by GoK
- Development of certification protocols for planting material of horticulture origin (Funded by RKVY, GOK)

4. P.G research publications:

Particulars	Research papers published in > 4 NAAS ratings	Research papers published in < 4 NAAS ratings
PG students paper publications	17	15

6.4.2. FACULTY STRENGTH

Sl. No	Cadre	Sanctioned strength	Faculty in place	Vacant position	Faculty recommended by ICAR	Deviations from ICAR recommendations
1.	Professor	1	1		1	-
2.	Associate Professor	1	0	1	1	1
3.	Assistant Professor	6	4	1	4	1
Faculty from the College of Horticulture, Mysuru and the College of Horticulture, Kolar						
4.	Dean, COH, Kolar		1			
5.	Associate Professor		2			

6.	Assistant Professor		2			

Along with sanctioned strength teachers based on deputation from neighboring campus and contractual bases will be consider for teaching and guiding the students.

6.4.3. TECHNICAL AND SUPPORTING STAFF

Sl. No.	Designation	Sanctioned strength	Faculty in place	Vacant position	Faculty recommended by ICAR	Deviations from ICAR recommendations
1.	Laboratory Assistant	01	01	0	-	
2.	Field assistant	01	01	0	-	
3	Project assistant	01	01 (contractual basis)	0	-	

6.4.4. CLASSROOMS AND LABORATORIES

Laboratories and facilities

Sl. No.	Name of the laboratory		Area	Seating capacity
1	Centre for Biotechnology Research with state-of-the-art facilites		18.5m x 12.5 m	30
	1	DNA isolation area	3.5m x 10 m	
	2	PCR workstation	2m x 1.5	
	3	PCR (Thermocycler) area	15m x 10m	
	4	Gel electrophoresis area	4 x 6m	
	5	Bioinformatics facility	2.5m x 2.2m	
2	Common laboratory for conducting UG and PG practical		20 x 15 m	60
3	Tissue culture laboratory		25 x 20 m	40
4	Field laboratory		15 x 10 m	20
5	Breeding cages – 3 nos		15 x 10 m	
6	Transgenic containment facility		15 x 12 m	20

Major equipment

Sl No	Instrument list	Quantity	Cost (RsIn Lakhs)	Working condition
1	Deep freezer (-80^{o}C),	2	12.00	Good
2	Freezer (-20^{o}C)	2	2.50	Good
3	Thermal cyclers	3	18.00	Good
4	Centrifuge (with cooling)	5	6. 75	Good
5	Spectrophotometer	1	2.00	Good

6	Thermal cycler (gradient)	1	6.00	Good
7	High speed computing systems	1	6.5.00	Good
8	Gel documentation system with software	1	5.00	Good
9	Nucleic acid hybridization oven	1	4.00	Good
10	Vertical electrophoresis systems	1	6.00	Good
11	Laminar air flow	4	7.00	Good
12	Tissue maceration system	1	5.00	Good
13	Quantitative RT-PCR with HRM function	1	6.00	Good
14	Autoclave	2	1.00	Good
15	Precision dry bath	6	4.00	Good
16	Incubation shaker precision	1	6.00	Good
17	Eye wash system	1	0.47	Good
18	Hot air oven	1	0.80	Good
19	Refrigerator	4	1.80	Good
20	Precision oven for oven ISH	1	0.60	Good
21	Western blotting unit	1	0.90	Good
22	Electroporator	1	1.10	Good
23	Open top aqua shaker for silver staining	1	0.10	Good
24	Deep well plate rotor	1	0.80	Good
25	Northern blotting unit	1	0.90	Good
26	Heat sealer	1	0.40	Good
27	pH meters	2	1.00	Good
28	Vertical gel electrophoresis system	1	6.50	Good
29	QIAexcel advanced	1	14.92	Good
30	Nanodrop	1	4.50	Good
31	Growth chamber	1	0.80	Good
32	Humidity system	1	0.80	Good
33	Arabidopsis growth chamber, chemical store and computing place	Unit	4.50	Good
34	Microscopes	5	1.50	Good
35	Hula mixer	1	0.80	Good

36	Speed Vac	1	4.50	Good
37	Micro centrifuges	1	1.80	Good
38	Transgenic containment facility	1	14.00	Good
39	Breeding cages	3	34.00	Good
40	Viral containment facility	1	1.50	Good

(**Miscellaneous:** Filing cabinet steel, Lab stools, Office table, Office executive chairs, almera steel , Glass door almera, Wooden stools teak wood, computer, HCL, printer 2 h p 1020 LESER, Notice board, classroom bench, Lab table modern fixed with reagent racks , Glass block board(6X4)(8x4,Wooden key board with 12 locks, Air conditioner LG Dell, Lenovo desktops, Fire extinguisher, First aid box, Acid storage unit, Barcode generator, essential equipment for field operation, Steel trolley).

Laboratory facilities for molecular and genomics assisted breeding and teaching

Farm facilities

Sl. No.	Name of the Department		Farm Area	Irrigated / Non-irrigated	Crops grown
1	Civil facility	Transgenic containment and bio safety facility (1)	4 Gunta	Irrigated	Seedlings of Garcinia
2		Breeding cage (3)	6 Gunta	Irrigated	Tomato, brinjal
3		Polyhouse and net house	3.5Gunta	Irrigated	*Garcinia* grafts, vegetable soybean
		Viral containment	2Gunta		Whitefly culture
4	Open land		1.5 acre	Irrigated	Tomato, pigeon pea, *Garcinia*, shallots, vegetable soybean, cluster bean, french bean

BCI field facility block


Transgenic containment, nethouse


Viral containment, polyhouse facilities


Breeding cages (3)


Transgenic containment


Field Laboratory

P.G. research facility availabe: Research facilities including experimental field blocks with irrigation facility have been developed for the field experiments. The breeding cages and transgenic containment facilities are being used for contained evaluations and crossing work by the students. The facilities such field gene bank of *Garcinia* species, instructional orchards of major fruits crops and flower crops present in the campus are being used by the students. Further, inputs like seeds, fertilizers, irrigation, pesticides etc. and workforce required for conducting PG research are facilitated from the Department.

Workshops, if any

Sl.No	Title	Place	Date	Sponsored by	Organizer/ Associate
1	One day awareness workshop on 'Guidelines for access to biological resources under the biological diversity Act 2002'	COH, Bengaluru	24th March, 2017	IT,BT and S&T, Govt. Karnataka	State Level

6.4.5. CONDUCT OF PRACTICAL AND HANDS ON TRAINING FOR THE STUDENTS

In order to import domain expertise and hands-on experience in genetics and plant breeding discipline, students are practically trained in following areas:

1) Plant breeding and genetics
2) Plant biotechnology
3) Tissue culture and transgenics
4) Biochemical techniques and procedures
5) Bioinformatics and *in silico* tools

Further, students are also trained in the following disciplines through structured course work related practicals:

Sl. No.		Method of hands-on-training
1	Principles of Genetics (GPB501)-2+1	Laboratory exercises on Mendelian problems, gene interaction, linkages, probability and Chi- square; Demonstration of genetic principles using; Chromosome mapping using three point test cross; Tetrad analysis; Induction and detection of mutations through genetic tests
	Principles of Cytogenetics (GPB502)	• Various chemicals to be used for fixation, dehydration, embedding, staining, cleaning etc. - Microscopy: various types of microscopes, - Preparing specimen for observation – Fixative preparation and fixing specimen for light microscopy studies. • Studies on the course of mitosis in onion and other crops – • Studies on the course of mitosis in important crops - Studies on the course of meiosis in oilseeds and forage crops - Using micrometers and studying the pollen grain size in various crops -Various methods of staining and preparation of temporary and permanent slides - Pollen germination *in vivo* and *in vitro;* • Solution preparation and application at seed, seedling level – • Identification of polyploids in different crops - Induction and identification of haploids; Anther culture and Ovule culture – Morphological observations on synthesized autopolyploids • Observations on C-mitosis, learning on the dynamics of spindle fibre assembly – Morphological observations on alloployploids - Morphological observations on aneuploids – • Cytogenetic analysis of interspecific and intergeneric

		crosses - Maintenance of Cytogenetic stocks and their importance in crop breeding – • Various ploidy levels due to somaclonal variation ; Polyploidy in ornamental crops. -Fluorescent *in situ* hybridization (FISH)- Genome *in situ* hybridization GISH.
	Principles of Plant Breeding (GPB503)-2+1	• Floral biology in self and cross pollinated species, • Selfing and crossing techniques in different crop plants. • Evaluation of breeding material; • Analysis of variance (ANOVA); Estimation of heritability and genetic advance. • Maintenance of experimental records. Selection methods in segregating populations; • Field Visits and practical exposure for study of segregating generations in Horticulture crops.
	Principles of Quantitative Genetics (GPB – 504)-2+1	• Problems on multiple factors inheritance - Partitioning of variance - Estimation of heritability and genetic advance – • Covariance analysis - Metroglyph analysis - D^2 analysis – • Grouping of clusters and interpretation - Cluster analysis, interpretation - Correlation analysis - Path analysis - Parent-progeny regression analysis - Diallel analysis: Griffing's methods I and II – Diallel analysis: Hayman's graphical approach - Diallel analysis: interpretation of results - NCD and their interpretations - Line x tester analysis and interpretation of results. • Working out efficiency of selection methods in different populations and interpretation, Biparental mating, • Triallel analysis, Quadriallel analysis and Triple Test Cross (TTC) –analysis and result interpretation, Advanced biometrical models for combining ability analysis, • Models in stability analysis Additive Main Effect and Multiplicative Interaction (AMMI) model – Principal Component Analysis model - Additive and multiplicative model – Shifted multiplicative model - Analysis and selection of genotypes
	Mutagenesis and Mutation Breeding (GPB – 505)-1+1	• Learning on Radioactivity – Production of source and isotopes at BRIT, Trombay - Learning about gamma chamber; • Radiation hazards - Monitoring – safety regulations and safe transportation of radioisotopes - Visit to radio isotope laboratory; learning on safe disposal of radioisotopes - Hazards due to chemical. • Mutagens - Treating the plant propagules at different doses of physical and chemical mutagens - Learning combined mutagenic treatments;

		• Raising the crop for observation – • Mutagenic effectiveness and efficiency; Calculating the same from earlierliterature-StudyofM1generation–Parameterstobeobserved;Study of M2 generation • Parameters to be observed; • Mutation breeding in cereals and pulses – Achievements made and an analysis - Mutation breeding in oilseeds and cotton – • Achievements and opportunities- Mutation breeding in forage crops and vegetative propagated crops; • Procedure for detection of mutations for polygenic traits in M_2 and M_3generations.
2	Heterosis Breeding (GPB – 506)-1+1	• Male sterile line characterization using morphological descriptors; • Restorer line identification. and diversification of male sterile sources – • Male sterile line creation in oilseeds, pulses, cotton and cereals; problems in creation of CGMS system; Ways of overcoming them ,use of gametocides in inducing male-sterility.- • Apomixis: practical applications and difficulties in breeding; • Estimation from the various models for heterosis parameters – • Hybrid seed production in field crops – an account on the released hybrids. • Hybrid breeding at National and International level; Opportunities ahead.
3	Molecular Breeding (GPB511)	• Methods of development of mapping populations and their utility in gene / QTL mapping; different types of markers- • Hybridization and PCR based markers and their genotyping following different approaches; Construction linkage maps and QTL mapping-different approaches and relevant algorithms; Marker assisted backcross - Foreground and background selection, zygosity assays, • MAS in segregating populations; • High precision phenotyping and genotyping methods and their integration in genome mapping and QTL mapping; • Next gene sequencing and its utility in markers discovery including SNPs and genotyping. • Standardization of protocols especially for the important fruit crops such as Banana, Pomegranate, drumstick etc. development of Tissue culture plants in banana, drumstick, pomegranate etc.

Note: Clearly mention about how the hands-on-training is being imparted to the students as per course curricula for different courses.

Conduct of practical and hands on training for staff under ICAR

Sl. No	Date	Course Coordinator/Associate course Coordinator	Title/Topic	Place
1	1-21st July 2016	Prof. B. Fakrudin (Director) G.K. Halesh (Asst. Prof) Mohan Kumar (Asst. Prof)	Exploring Genomic Resources for the Improvement of Horticultural Crops	COH, Bengaluru
2	5-25th July 2017	Prof. B. Fakrudin(Director) G.K. Halesh (Asst. Prof) Mohan Kumar (Asst. Prof)	Experimental Approaches in Utilization of Genomic Resources for the Improvement of Horticultural Crops	COH, Bengaluru
3	4-24th January 2018	Prof. B. Fakrudin (Director) G.K. Halesh (Asst. Prof) R.K. Ramchandra (Asst.Prof)	Recent Development in Conservation and Characterization of Horticulture Plant Genetic Resources	COH, Bengaluru
4	1-21st August 2018	Prof. B. Fakrudin (Director) G.K.Halesh (Asst. Prof) Mohan Kumar (Asst. Prof) Raghvendra G. (Asst. Prof)	Comparative Genomics of Horticulture Plant Genetic Resources: Methods and Applications	COH, Bengaluru

6.4.6. SUPERVISION OF STUDENTS IN PG/PH.D. PROGRAMMES

Every student shall have Advisory Committee with a Major Advisor and at least four members among whom two members shall be from outside the major field of specialization. Advisory Committee for Ph.D. student shall consist of at least five members of whom three are from outside the major field of specialization. Programme of Research proposed by the Advisory Committee and approved by the Dean (Post Graduate Studies) will be carried out by the student under the supervision of Advisory Committee. Totally 16 M.Sc. students are passed out from the Department of Biotechnology and Crop Improvement, College of Horticulture, Bengaluru from 2013 to 2018. Research work was carried out by students on the major crops which are grown in this area *viz.*, tomato, cluster bean, brinjal, vegetable soybean, muskmelon, okra etc and research related to ToLCV resistance, fruit quality parameters, variability for morphological traits, mutation etc. are being carried out. Further expressional and functional analysis of transcription factor genes, microRNAs and their cognate genes were studied in various contexts.

With respect to the allotment of the students to the PG teacher the major advisor shall not take more than 6 PG students and also the PG teacher shall not be a member of the advisory committee for more than 15 PG students.

Supervision of students in PG / M.Sc. programmes

Sl. No.	Year	No. of PG recognised teachers	Intake of students	Student to teacher ratio
1.	2014-15	03	05	<1:1
2.	2015-16	05	05	1:1
3.	2016-17	07	05	>1:1
4.	2017-18	09	02	>1:1
5.	2018-19	10	00	-

Actually, Department of Biotechnology and Crop Improvement is running with the shortage of faculty. This is taken care by the deputing teachers from neighbouring campuses and nominating the teachers on contractual basis for taking up of classes of PG and UG as well. Teachers from neighbouring campuses-College of Horticulture Mysuru and College of Horticulture Kolar, are involved in guiding and teaching the students of M.Sc. and Ph.D. degree programmes.

6.4.7. FEEDBACK OF STAKE HOLDERS (STUDENTS, PARENTS, INDUSTRIES, EMPLOYERS, FARMERS)

Feedback by the graduated students

Sl. No.	Name	Year of completion	Important remarks/feed back
M.Sc. Passed out students			
1.	Nayana R. S.	2015	Teaching facility is good. Centre for biotechnology is equivalent to state of art laboratory which is best platform for research work
2.	Adiveppa Siddannawar	2015	Well-equipped lab facilities for molecular biology. A department with supportive staff
3.	Sumuka L.	2015	Better exposure and understanding of course through hands on and their utility in farmers point of view. Need to provide additional reading material in library related to course
6	Karthik	2016	Course curriculum is designed very well which gives deep insights related to application of biotechnology in crop improvement. Diverse teaching facility is available.
7	Ajay	2016	Molecular biology platform is very good, need to develop tissue culture facility
8	Kavya	2017	Great exposure in field of biotechnology and its relation with crop improvement from

			this course. Need to establish competitive exam forum
9	Apoorva K. A.	2018	Teaching facility is good, Research areas with which department is working would be beneficial for farming community
11	Shreedhara R. S.	2018	Better exposure to biotechnology theory and field work with positive guidance from staff

Feedback that demanded immediate action and action taken by the Department

Students		
1	Need of advanced software packages and bioinformatics training routines	• Software and manuals related to in silico analysis of the genomics data have been installed in the server and being used by the students • Advanced statistical programs like Windowstat, Design, Spar1, SPSS have been installed for the benefit of the PG students in the centralised facility at college library
2	PG Research along with financial assistance	• University is providing Rs 2000 financial assistance to all admitted PG students along with 20000 research grant. • Most of the students are getting vidyasiri scholarship from state government. • Some of the staff research projects are given as PG research along with assistance.
3	JRF/SRF to the PhD students	• As much as possible the opportunities in the ad hoc projects are given to the PhD students
4	Exposure visit to PG students to industry and advanced institutions	• Exposure visits PG students are being made to well know institutions and industry in and around Bengaluru.
5	Domain personality development and better expression – soft skills	• Invited talks by the industry professionals and visits to the biotechnology / plant breeding industries are being done routinely. • Further, through peer to peer interactions involving experts, soft kills are being improved amongst the out going students.

6.4.8.STUDENT INTAKE AND ATTRITION

Year	Sanctioned seats	Actual intake	Attrition	% Attrition
Master's Programme				
Degree programme- Biotechnology and Crop Improvement				
2014-15	5	5	0	0
2015-16	5	5	1	20
2016-17	6	5	2	44
Degree Programme -Plant Biotechnology				
2017-18	2	2	0	0
2018-19	3	0	-	-

Reasons for the Attrition:

Students who got job in government sector left the studies

8.10.8.1. Details of Fellowships/ Scholarships to PG students (2013-14 to 2017-18)

Type of Scholarship	M. Sc				
	2013-14	2014-15	2015-16	2016-17	2017-18
Merit Scholarship	**2**	**1**	**1**	**1**	**1**
Vidyasiri	**1**	**3**	**2**	**2**	**2**
ICAR fellowship	**-**	**1**	**-**	**1**	

6.4.9. ICT application and curricula

In the college, the students are paying the fee and registering through Academic Management System (AMS). All PG correspondences like Plan of Work, Programme of Research and Submission of all PG forms by the students were through AMS. All approvals by the Head of the Department, Chairman and members of the Advisory Committee, Dean (PGS) and Registrar approval through on line by using AMS in order to make paperless transactions. Teaching will be done by using PPT and smart boards.

CeRA and other online e-resources:

CeRA is the ICAR Consortium of e-resources in Agriculture. This covers more than 3000 scholarly journals pertaining to the Agriculture and allied sciences which are available in full text.

E-books:

Library is having access to Springer e-books for the copy right years 2014-16, which covers nearly 1900 books in virtual format with full text availability and at a time 25 users can open an e-book. In addition library has access to 200 Indian e-books.

Krishikosh:

Krishikosh is database of theses submitted to the Agriculture universities and ICAR institutions, The UHS is member for Krishikosh and all the theses submitted to the UHS are being uploaded regularly.

Internet

The computer laboratory is provided with separate internet link with better speed. Laboratory is equipped with 25 computers with internet access. Web OPAC of the main campus library is made available through EZ-proxy remote access server to access e-resources, CeRA, and Agristat in distant places.

6.4.12.

CERTIFICATE

I the Dean, College of Horticulture, Bengaluru hereby certify that the information contained in the Section 6.4.1 to 6.4.9 are furnished as per the records available in the college and degree awarding university.

Date: March, 2019