



**MAHIDOL
UNIVERSITY**
Wisdom of the Land

AUN-QA
SELF-ASSESSMENT REPORT

DOCTOR OF PHILOSOPHY PROGRAM
IN BOTANY
(INTERNATIONAL PROGRAM)

DEPARTMENT OF PLANT SCIENCE
FACULTY OF SCIENCE
MAHIDOL UNIVERSITY

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LIST OF ABBREVIATIONS

CDC	Curriculum Development Committee
CIF	Central Instrument Facility at the Faculty of Science, Mahidol University
CLOs	Course Learning Outcomes
ELOs	Expected Learning Outcomes
FTE	Full-Time Equivalent
GPA	Grade Point Average
HR	Human Resource
ISI	ISI Web of Science by Thompson Reuters
IT	Information Technology
LAN	Local Area Network
MUIT	Division of Information Technology, Mahidol University
OBE	Outcome-Based Education
OHEC	Office of Higher Education Commission, Ministry of Education, Thailand
Ph.D.	Doctor of Philosophy degree
QA	Quality Assurance
SAR	Self-Assessment Report
TLA	Teaching and Learning Approaches
TOEIC	Test of English for International Communication
TQF	Thailand Qualification Framework
Wi-Fi	Local area wireless computer networking technology

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I. INTRODUCTION

EXECUTIVE SUMMARY

Doctor of Philosophy Program in Botany, offered by the Department of Plant Science, Faculty of Science, Mahidol University since 2016, is the only international Ph.D. in Botany program in Thailand. The program was designed to facilitate student's lifelong learning skill. During the one-year coursework, students would develop their professional knowledge and skills in botany by exploring current topics and forefront issues through paper-based revision, class-discussions, and presentations. Students also have the opportunity to practice in botanical knowledge transfer under the supervision of faculty staff. These would help students to identify thesis research topic of their interest.

Our curriculum has been revised every 5 years to keep the structure concise and up-to-date, as well as to ensure that it is comparable to similar academic programs offered by universities abroad while also meeting the demand for botanist and plant science graduates in various fields, including cell and molecular biology, anatomy, taxonomy, physiology, genetics, systematics, and forensics. The current program specification was launched in the 2022 academic year in response to technological trends and impending disruption.

The compliance of our curricula and activities with the AUN-QA criteria version 4.0 is described in detail in this report's main body. Key evidence is provided in the appendices.

ORGANIZATION OF THE SELF-ASSESSMENT REPORT

This SAR report is consisted of four main parts – I. Introduction, II. AUN-QA Criteria Requirements, III. Strength and Weakness Analysis, and IV. Appendices. The introduction part involves an executive summary and overview of the university, faculty, and department. The AUN-QA criteria requirements part is the main section demonstrating how our academic program complied with the mandatory criteria. The Strengths and Weaknesses Analysis part summarizes our findings of program strengths and weaknesses for subsequent program improvement plans. In the last part, Appendices provide key examples of documents and evidences for supporting the criteria justification.

OVERVIEW OF THE UNIVERSITY, FACULTY, DEPARTMENT

Mahidol University

Mahidol University has its origins in the establishment of Siriraj Hospital in 1888 by His Majesty King Chulalongkorn (RAMA V) and the hospital's medical school is the oldest institution of higher learning in Thailand, granting its first medical degree in 1893. The medical school later became the University of Medical Sciences in 1943. In 1969, the University of Medical Sciences was renamed, with great honor by H.M. King Bhumibol Adulyadej, to Mahidol University after his Royal Father H.R.H Prince Mahidol of Songkla, who has been recognized as the 'Father of Modern Medicine and Public Health in Thailand'. Mahidol University has since developed into one of the most prestigious universities in Thailand and internationally recognized for its high caliber research and teaching. Other than medical science, this diversified institution now offers top quality academic programs in numerous areas including arts, engineering, linguistic, music, social science, etc. This diversified institution now offered top quality in numerous social and cultural disciplines

including the most doctoral programs of any institution in Thailand, yet have maintained its traditional excellence in medicine and the sciences. Mahidol University has set its own vision and mission as following:

Vision: To be 1 in 100 World Class University

Mission: To excel in health, sciences, arts, and innovation with integrity for the betterment of Thai society and the benefit of mankind.

[Data retrieved from <https://mahidol.ac.th/core-value/> March 29th, 2023]

Faculty of Science

The Faculty of Science was initially founded as a Premedical School in 1958 by Professor Stang Mongkolsuk with supports from the Rockefeller Foundation and the Royal Thai Government. The Premedical School later took the name “Faculty of Science” in 1969. Currently, the Faculty of Science, Mahidol University has set its vision and mission as following:

Vision: To be a leader in integrated science education, research and innovation for well-being of mankind

Mission: To develop human resources with knowledge and morality and produce research output of international quality that benefits society

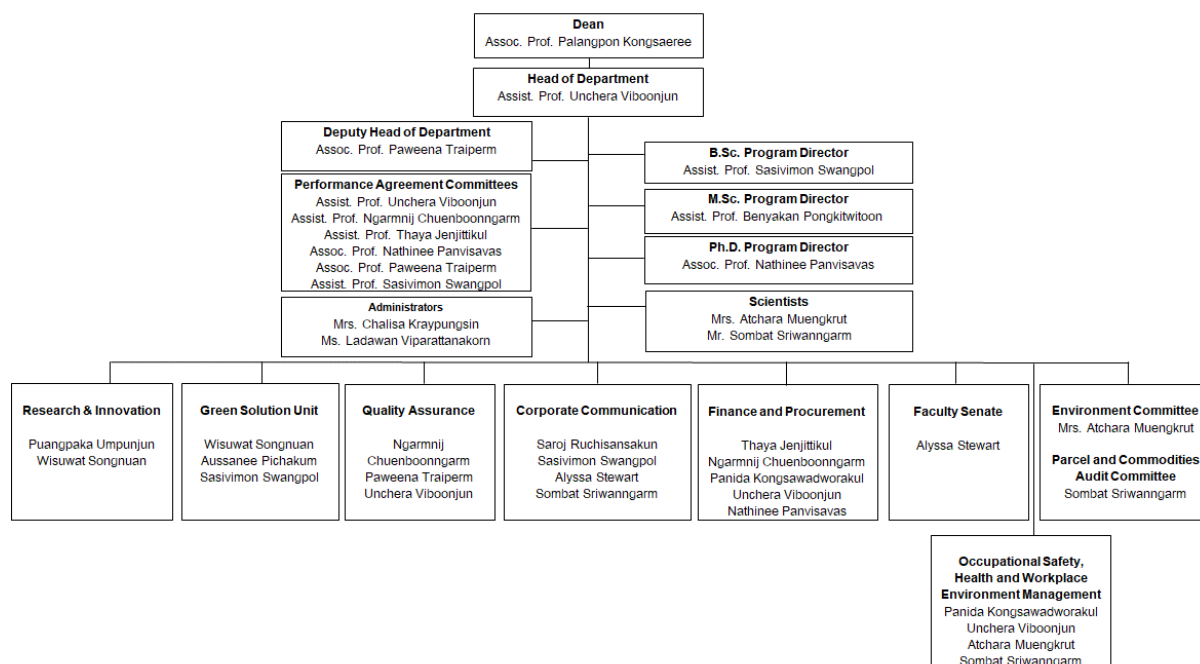
[Data retrieved from <https://science.mahidol.ac.th/aboutsc.php> March 29th, 2023]

Department of Plant Science

The Department of Plant Science at Mahidol University was established in 1992, as announced in the 109th Royal Gazette dated September 18, 1992 providing one program of B.Sc. (Plant Science). Most of our graduates decide to seek degrees in higher education, both within and outside the country. Many students have been awarded prestigious scholarships, such as the Royal Thai scholarship, scholarships from Office of the Higher Education Commission, and from other institutes and universities. A significant portion of our graduates choose to pursue careers in agriculture and horticulture as researchers at the National Science and Technology Development Agency (NSTDA), the Royal Project Foundation, universities, schools, and private companies, or as producers and exporters of fruits, vegetables, flowers, and other ornamental plants. In 2004, our department, in collaboration with the Department of Pharmaceutical Botany at Mahidol University, launched an international program for Master's degree in Plant Science. In 2016, our Ph.D. program in Botany were first opened for students. Since its establishment, the Ph.D. program in Botany offered by the Department of Plant Science has 20 Ph.D. candidates.

Accordingly, the Department of Plant Science offers totally three programs—B.Sc., M.Sc., and Ph.D.; twelve academic staff and four supporting staff have well-carried functional responsibility in the department under the administration of the department head

(as shown in the organization chart), so that the department can facilitate the three programs and activities smoothly.



**Organization Chart of Department of Plant Science, Faculty of Science,
Mahidol University (2022-2023)**

DEVELOPMENT OF THIS SAR

This SAR report was written by the program director and program administrative committees. The staff at Department of Plant Science, Faculty of Science, Mahidol University helped provided all key information for completing the required criteria. The first draft of SAR report was then presented to all staff of the Department for further suggestion and improvement. The final version of SAR report will be submitted for internal assessment by the committees from Faculty of Science, Mahidol University within the year 2023.

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II. AUN-QA CRITERIA REQUIREMENTS

1. EXPECTED LEARNING OUTCOMES

1.1 The program to show that the expected learning outcomes are appropriately formulated in accordance with an established learning taxonomy, are aligned to the vision and mission of the university and are known to all stakeholders.

Program's expected learning outcomes (ELOs) are requirements that students must achieve by graduation. They can be achieved by incremental attainment over the courses of the program along with the verification via numerous assessment methods. The ELOs as well as curriculum structure of our Doctor of Philosophy Program in Botany (International Program), was formulated according to the protocol briefly described as following. Program's ELOs as well as program structure and specification was drafted by taking into consideration of Thai Qualifications Framework for Higher Education (TQF:HEd) and the feedbacks received from stakeholders. The drafted curriculum is presented to and approved by the departmental staff meeting before submission to the Faculty of Graduate Studies. The Faculty of Graduate Studies rechecked the documents to certify that the curriculum conformed to the TQF requirement before further passing to a Peer Review Committee appointed by Mahidol University Council. According to the Peer Review Committee's comments, the curriculum was revised and sent for final approval by Mahidol University Council.

According to the last curriculum revision process in 2022, the ELOs of our doctoral program in botany have been formulated as shown in Table 1. Our ELOs were formulated using Bloom's Taxonomy levels ranging from understanding to creating. Both Mahidol University and the Faculty of Science share the same vision and mission of "directing to be a world-class institute by providing high-quality education and producing international-standard research outputs." Therefore, in terms of alignment with the vision and mission of the university, our program's ELOs aligned very well with the direction of the university. The vision and mission of Mahidol University and the Faculty of Science have been well communicated to all students and staff by several ways, i.e., web site, meetings, program orientation, etc. The Doctor of Philosophy Program in Botany at the Department of Plant Science, Faculty of Science, Mahidol University aims to produce doctorates with international-level of knowledge, skills in botany and plant science research, and graduated with at least one good quality of international publication in international journal. Accordingly, our program's ELOs are clearly aligned with the vision and mission of the university.

Table 1. ELOs of Doctor of Philosophy Program in Botany, Department of Plant Science, Faculty of Science, Mahidol University.

Expected Learning Outcomes	Bloom's Taxonomy Level
1. Conduct research and scientific works professionally with moral, ethics, academic integrity, discipline, and punctuality	Cognitive/Applying
2. Critically evaluate scientific merit of up-to-date botanical knowledge and their integration with other related disciplines	Cognitive/Understanding/Evaluating
3. Create new knowledge in Botany or problem-solve new scenarios by analyze scientific questions and synthesize scientific information/ findings using interdisciplinary approach	Cognitive/Employ/Creating
4. Demonstrate leadership, accountability, and decision-making skills in culturally diverse and multi-disciplinary team with personal and collective responsibility	Conceptual/Recognize/Dramatize
5. Transfer frontier knowledge in botany to audiences using adequate tools, appropriate technology, and statistics to critically evaluate the significance of scientific information and communication in an organized manner	Cognitive/Describe/Illustrate

1.2 The program to show that the expected learning outcomes for all courses are appropriately formulated and are aligned to the expected learning outcomes of the program.

The expected learning outcomes of each course (CLOs) were clearly defined and specific. They indicate what students are expected to know, understand, and be able to do after completing the course. The CLOs are measurable, so progress towards achieving them can be tracked and assessed.

The CLOs could be aligned with the PLOs, contributing to the overall goals and objectives of the program. The students who successfully complete all the courses have then achieved the PLOs.

1.3 The program to show that the expected learning outcomes consist of both generic outcomes (related to written and oral communication, problem-solving, information technology, teambuilding skills, etc) and subject specific outcomes (related to knowledge and skills of the study discipline).

Our program's ELOs can be categorized into subject-specific and generic skills. Subject-specific outcomes refer to knowledge and skills exclusive to the field of Botany. Alternatively, generic learning outcomes are generic competencies, which include skills such as communication, problem-solving, ethics, IT, leadership, conflict resolution, teamwork, etc. Accordingly, Table 2 demonstrates the classification of our program's ELOs into either generic or specific skills.

Table 2. Classification of program's ELOs as generic or subject-specific learning outcomes.

Program ELOs	Generic ELOs	Subject-Specific ELOs
1. Conduct research and scientific works professionally with moral, ethics, academic integrity, discipline, and punctuality	√	
2. Critically evaluate scientific merit of up-to-date botanical knowledge and their integration with other related disciplines		√
3. Create new knowledge in Botany or problem-solve new scenarios by analyze scientific questions and synthesize scientific information/ findings using interdisciplinary approach		√
4. Demonstrate leadership, accountability, and decision-making skills in culturally diverse and multi-disciplinary team with personal and collective responsibility	√	
5. Transfer frontier knowledge in botany to audiences using adequate tools, appropriate technology, and statistics to critically evaluate the significance of scientific information and communication in an organized manner		√

1.4 The program to show that the requirements of the stakeholders, especially the external stakeholders, are gathered, and that these are reflected in the expected learning outcomes.

During the development of our doctoral curriculum, opinions and comments from all the stakeholders were taken into consideration. Program stakeholders were defined as follows: 1) academic staff of the Department of Plant Science or program, 2) current students in the department at that time, 3) alumni of the department from the B.Sc. and M.Sc. program in Plant Science, and 4) Mahidol University. Opinions and comments from academic staff and current students were obtained through brainstorming, a questionnaire, and an interview. Feedbacks from alumni were gathered from both questionnaires, interview, and meeting. Requirements of Mahidol University on our graduate program were received in the form of comments, feedbacks, and suggestions from the Peer-Review Committee during the curriculum development process. The program's ELOs as well as program specification were drafted by taking into consideration all feedback from stakeholders (Exhibit 1.1). Table 3 demonstrates the mapping of stakeholders' requirements and our program's ELOs.

Table 3. Mapping of stakeholders' requirements and our graduate programs' ELOs. The symbol * indicates that the ELO reflects the need of individual stakeholders. The symbol ** means that the ELO was derived from emphasis suggested by the stakeholders.

Program ELOs	Academic Staff	Students	Alumni	Mahidol University
1	**	*	*	*
2	**	**	*	*
3	**	**	*	*
4	**	*	*	*
5	**	**	*	*

1.5 The program to show that the expected learning outcomes are achieved by the students by the time they graduate.

The Ph.D. program in Botany aims to produce graduates excel in the Botany by acquiring life-long learning skills and exposure to problem-solving scenarios using interdisciplinary approach. The program is designed to support graduate students with the acquisition of ethics and morality necessary to conduct scientific research, data analysis, and research evaluation.

Students are expected to apply their knowledge and skills to complete the dissertation research and the international publication. Students will obtain feedback based on their ability and responsibility to complete the dissertation research. The ability to work as a team, and write the report will be evaluated by the dissertation committees. In addition, responsibility will be evaluated by the course coordinator through their performance on assigned tasks, while oral communication skills will be evaluated through the presentation at the end of the course by the audience in the class.

2. PROGRAM SPECIFICATION

Since 2009, the Office of Higher Education Commission (OHEC), Ministry of Education, has enforced the Outcome-Based Education (OBE) in Thailand in the form of the Thailand Qualifications Framework for Higher Education (TQF:HEd), which is the regulation that all academic programs must follow. Accordingly, our Doctor of Philosophy Program in Botany was recently revised in 2022 to comply with the TQF requirement. Program structure and specification were represented in the official TQF2 document (Exhibit 2.1).

2.1 The specifications of the program and all its courses are shown to be comprehensive, up-to-date, and made available and communicated to all stakeholders

The program specification of our Doctor of Philosophy Program in Botany is presented as the form of TQF2 (Exhibit 2.1), which provides the necessary information for stakeholders especially for prospective students, and current students. The key information regarding the study plan, program objectives, program learning outcomes, possible job after graduation, curriculum, course description, as well as list of lecturers and their qualifications are listed. The current program specification was inaugurated in the academic year of 2022 to respond to the changes in market trends of botany, plant science, and upcoming technological disruption.

In addition, the short English version of program specification (referred as “Ph.D. (Botany) Student Guide”) is summarized by Program Administrative Committees for student distribution (Exhibit 2.2). This “Ph.D. (Botany) Student Guide” is comprehensive and up-to-date. It will be systematic revised if some detailed information needs to be updated. Program Administrative Committees monitor all teaching and learning activities throughout the academic year and annually organize a meeting between academic staff and students in order to summarize and make appropriate plans for improvement. The students can express their satisfaction or dissatisfaction toward the teaching and learning processes and program organization. Certain feedbacks can be implemented immediately while some others that require adjustment of the program structure need to wait for the next program revision period.

The course specifications are presented as the form of TQF3(Exhibit 2.3), which includes the details of topics, course syllabus, teaching and learning activities, expected learning outcomes of the course, assessment method, and assessment criteria. At the end of the semester, course director and teaching staff must evaluate the teaching and learning processes as well as assessment methods employed in course by taking into accounts student feedbacks. Strength and weakness information of each course will be used for improvement in the next semester. The report of each course is recorded in TQF5 (Exhibit 2.4). From these processes, it can be concluded that the information of our course specification (course syllabi) is comprehensive and up-to-date.

Both program and course specifications are disseminated to our current students, prospective students, as well as stakeholders, on the web site of the Department of Plant Science, Faculty of Science, Mahidol University at <https://graduate.mahidol.ac.th/thai/?p=curriculum&id=2130D01G>. For internal stakeholders, like lecturers, all aspect of the issues of the program and course specifications are discussed or informed in the department meeting. For students, the update “Ph.D. (Botany) Student Guide” and course schedules are distributed. The overall program orientation meeting is held at the beginning of the first semester.

2.2 The design of the curriculum is shown to be constructive aligned with achieving the expected learning outcomes.

A brief overview of the program structures and contents are explained. Figure 1 illustrates a diagram showing the overall structures of doctoral program and the paths that students can go through from new entry to exiting the programs. Entry into the Ph.D. program requires M.Sc. degree or a relevant B.Sc. degree with the first-class Honors from a recognized institution. During the first academic year, our doctoral programs from B.Sc. and M.Sc. share the same required courses (with minor difference in the number of credits for elective courses). The students are then assessed for their achievement of ELO #3 via a qualifying examination. Before the students can continue with their graduate research, they must present thesis proposal for approval by the committees. Once the proposal is approved, the Dissertation Advisory Committees will be appointed to provide guidance and to monitor the student's research progress. Upon completion of the research project with output achievement required by the programs, graduate students must write and orally defend their thesis/dissertation, all in English language. By passing all the requirements, students are awarded with the doctoral degree.

Not only the specific skills of Botany, but students can also improve their soft skills including communication skills through reports, assignments, and oral presentations; and social skills when working as a team in laboratory, class activity, teaching assistance or even extra-curriculum activities i.e., Wai Kru, Science Camp for new undergraduate students, MU Open House, Annual National Science and Technology Fair (Exhibition), Welcoming New Plant Science students, Plant Science Graduation Party, Plant Science Annual Homecoming, Plant Science's CSR activities. The program also encourages students to participate in organizing team of academic symposiums, workshops, and conferences (including student/undergraduate symposium, national/international conferences) at least once throughout the study.

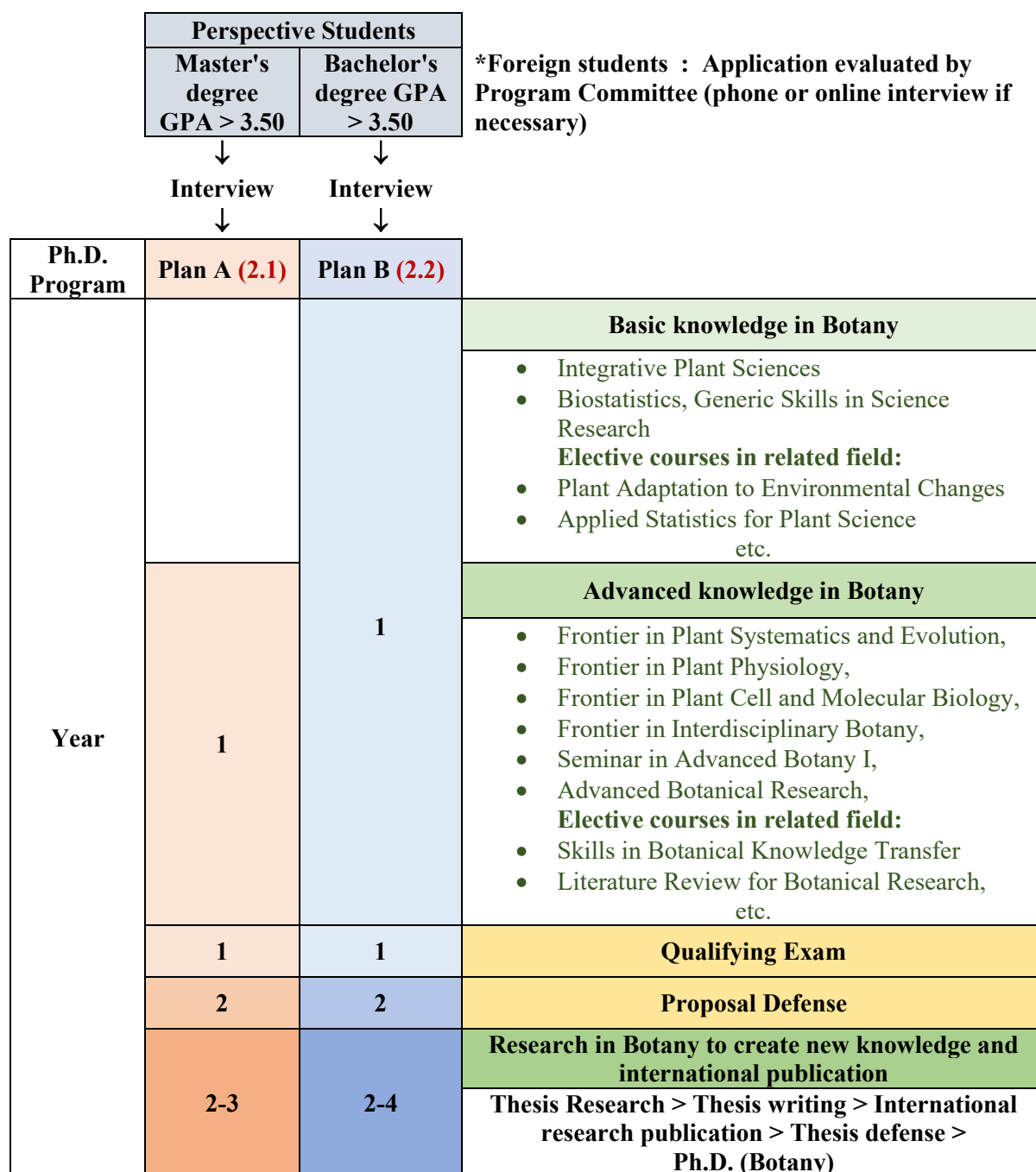


Figure 1. Diagram showing the structure of our doctoral programs with the paths that students can go through, from application process toward completion or termination of the degree.

2.3 The design of the curriculum is shown to include feedback from stakeholders, especially external stakeholders.

As mentioned earlier, the program and curriculum are required to be revised every 5 years. Our program regularly collects feedback from stakeholders, including current students, graduates, alumni, instructors, and employers (Table 4). Information regarding stakeholders' comments was subjected to course improvement, program management, and curricular development.

Table 4. Methods to obtain the stakeholders' feedback.

Stakeholder	Approaches	Example of issues	Frequency
Students	<ul style="list-style-type: none"> • Online survey • On-site meeting 	<ul style="list-style-type: none"> • Teaching-learning process • Quality of instructors • Extra-curriculum activities 	<ul style="list-style-type: none"> • At least twice a year (end of semester)
Graduate	<ul style="list-style-type: none"> • Online survey, Curriculum review 	<ul style="list-style-type: none"> • Program satisfaction • Alignment of the courses • Skills obtained 	<ul style="list-style-type: none"> • After thesis defense
Alumni	<ul style="list-style-type: none"> • Informal interview (Alumni meeting, SCPL event) 	<ul style="list-style-type: none"> • Program satisfaction • Alignment of the courses • Skills obtained 	<ul style="list-style-type: none"> • Occasionally
Academic staff	<ul style="list-style-type: none"> • Department meeting, • Informal meeting 	<ul style="list-style-type: none"> • Problems on student skills • Duration of graduation 	<ul style="list-style-type: none"> • Occasionally
Employers	<ul style="list-style-type: none"> • Informal meeting, Interview 	<ul style="list-style-type: none"> • Graduate satisfaction • Skills missing 	<ul style="list-style-type: none"> • Annually
External committee (Experts Persons)	<ul style="list-style-type: none"> • Formal meeting for curriculum development 	<ul style="list-style-type: none"> • Knowledge and skills required 	<ul style="list-style-type: none"> • Every 5 years (revising program)
Advisory committee	<ul style="list-style-type: none"> • Formal meeting for curriculum development 	<ul style="list-style-type: none"> • Knowledge and skills required 	<ul style="list-style-type: none"> • Every 5 years (revising program)

2.4 The contribution made by each course in achieving the expected learning outcomes is shown to be clear.

All the coursework as well as non-coursework activities within our curriculum have been designed to contribute, at least in part, to students' achievement of program ELOs. By integrating all teaching and learning processes along with non-coursework activities, all ELOs can be achieved. Table 5-6 exemplifies the alignment of program ELOs and the contribution of individual courses.

Table 5. Relationship between Courses of the Program and Program Learning Outcomes
(Plan A: M.Sc. to Ph.D.).

Code	Course Name	Credit	PLOs				
			1	2	3	4	5
Require course							
SCPL 604	Frontier in Interdisciplinary Botany	2(2-0-4)	R	R	R	R	R
SCPL 605	Frontier in Plant Systematics and Evolution	2(2-0-4)	R	R	R	R	R
SCPL 607	Advanced Research in Botanical	1(1-0-2)	R	R	R	R	R
SCPL 612	Frontier in Plant Physiology	2(2-0-4)	R	R	R	R	R
SCPL 622	Frontier in Plant Cell and Molecular Biology	2(2-0-4)	R	R	R	R	R
SCPL 673	Seminar in Advance Botany I	1(1-0-2)	R	R	R	R	R
SCPL 699	Dissertation	36(0-108-0)	M	M	M	M	M
Elective course							
SCPL 572	Applied Statistics for Plant Science	1(1-0-2)	R	I	R	-	R
SCPL 606**	Skills in Botanical Knowledge Transfer	1(0-2-1)	R	R	P	P	P
SCPL 674**	Seminar in Advanced Botany II	1(1-0-2)	R	R	R	R	R
SCPL 675	Literature Review for Botanical Research	1(1-0-2)	I	R	R	-	-
SCPL 676	Advanced project in Botany	1(0-2-1)	R	R	R/P	R	R
Extra-Curricular Activities							
Qualifying Examination			A	A	A	-	A
Proposal Presentation			A	A	A	-	A
Dissertation Writing			FA	FA	FA	FA	-
Doctoral Dissertation Defense			FA	FA	FA	FA	FA
International Research Publication			FA	FA	FA	-	-

I = ELO is introduced & assessed

P = ELO is practiced & assessed

A = Assessment

** Recommended elective course for all students

R = ELO is reinforced & assessed

M = Level of Mastery is assessed

FA = final assessment

Table 6 Relationship between Courses of the Program and Program Learning Outcomes
(Plan B: B.Sc. to Ph.D.).

Code	Course Name	Credit	PLOs				
			1	2	3	4	5
Require course							
SCID 516*	Biostatistics	3(3-0-6)	R	R	-	R	P
SCID 518*	Generic Skills in Science Research	1(1-0-2)	R	R	-	R	P
SCPL 562*	Integrative Plant Science	2(1-2-3)	R	R	-	R	R
SCPL 604	Frontier in Interdisciplinary Botany	2(2-0-4)	R	R	R	R	R
SCPL 605	Frontier in Plant Systematics and Evolution	2(2-0-4)	R	R	R	R	R
SCPL 607	Advanced Research in Botanical	1(1-0-2)	R	R	R	R	R
SCPL 612	Frontier in Plant Physiology	2(2-0-4)	R	R	R	R	R
SCPL 622	Frontier in Plant Cell and Molecular Biology	2(2-0-4)	R	R	R	R	R
SCPL 673	Seminar in Advance Botany I	1(1-0-2)	R	R	R	R	R
SCPL 799*	Dissertation	48(0-144-0)	M	M	M	M	M
Elective course							
SCPL 572	Applied Statistics for Plant Science	1(1-0-2)	R	I	R	-	R
SCPL 606**	Skills in Botanical Knowledge Transfer	1(0-2-1)	R	R	P	P	P
SCPL 611	Plant Adaptation to Environmental Changes	2(2-0-4)	-	R	R	-	R
SCPL 621	Applied Plant Genetics	2(2-0-4)	-	R	R	-	-
SCPL 671	Special Problems in Plant Sciences	2 (1-3-3)	R	R	R/P	R	R
SCPL 674**	Seminar in Advanced Botany II	1(1-0-2)	R	R	R	R	R
SCPL 675	Literature Review for Botanical Research	1(1-0-2)	I	R	R	-	-
SCPL 676	Advanced project in Botany	1(0-2-1)	R	R	R/P	R	R
Extra-Curricular Activities							
Qualifying Examination			A	A	A	-	A
Proposal Presentation			A	A	A	-	A
Dissertation Writing			FA	FA	FA	FA	-
Doctoral Dissertation Defense			FA	FA	FA	FA	FA
International Research Publication			FA	FA	FA	-	-

I = ELO is introduced & assessed

R = ELO is reinforced & assessed

P = ELO is practiced & assessed

M = Level of Mastery is assessed

A = Assessment

FA = Final assessment

* Require course for students with Bachelor's degree background

** Recommended elective course for all students

2.5 The curriculum made by each course are logically structured, properly sequenced (progression from basic to intermediate to specialized courses) and are integrated.

Figure 1 shows the structure of our doctoral programs with the paths that students can go through, from application process toward completion or termination of the degree. Table 7 demonstrates the expectation of learning outcomes at the end of the academic year. According to our doctoral program, the main learning process to achieve the program's ELOs is thesis/dissertation research. Thesis/dissertation research provides students with hands-on, directed research experience and prepares students for the type of research/scholarship that will be expected of them after they receive the Ph.D. degree.

Table 7. The expectation of learning outcomes at the end of the academic year.

Plant A: M.Sc. to Ph.D.	
Year of study	Knowledge, skills, and any other expected learning outcomes
1st	After completion of courses in the first year, students would acquire frontier knowledge in botany and relating fields of interest. Students would be able to ethically conduct research and scientific work, critically evaluate scientific information and integrate with other related disciplines, analyze scientific questions and research finding using theoretical framework, statistics, and principles in botany to come up with rational explanation or discussion, and transfer knowledge in botany to others.
2nd	Before the end of the final year, novel botanical research proposal with scientific experimental design would be developed. Student independently conducted his/her research, so that he/she demonstrate leadership, accountability, and decision-making skills. There may be opportunity to work in culturally diverse and multi-disciplinary team. Knowledge/findings from the research can be transferred to others in different ways.
3rd	By the end of the final year of study, student publish the research work in the form of international research publication

Plan B: B.Sc. to Ph.D.	
Year of study	Knowledge, skills, and any other expected learning outcomes
1st	After completion of courses in the first year, students will acquire basic and advance knowledge in botany and relating fields of interest. Students would be able to ethically conduct research and scientific work, critically evaluate scientific information and integrate with other related disciplines, analyze scientific questions and research finding using theoretical framework, statistics, and principles in botany to come up with rational explanation or discussion, and transfer knowledge in botany to others.
2nd	Before the end of the final year, novel botanical research proposal with scientific experimental design would be developed. Student independently conducted his/her research, so that he/she demonstrate leadership, accountability, and decision-making skills. There may be opportunity to work in culturally diverse and multi-disciplinary team. Knowledge/findings from the research can be transferred to others in different ways.
3rd	

Plan B: B.Sc. to Ph.D.	
Year of study	Knowledge, skills, and any other expected learning outcomes
4 th	By the end of the final year of study, student publish the research work in the form of international research publication.
5 th	

Our Doctor of Philosophy Program in Botany is a Credit-based system. To graduate, a student needs to complete all blocks of knowledge and skills in which there are coherence number of credits or adequate courses. After completing all requirements, students are expected to have acquired strong foundation in Botany-related knowledge, both in breadth and depth. The curriculum encompasses 48 credits (Master's degree background) and 72 credits (Bachelor's degree background) in total for Ph.D. program.

From Master's degree background (Plan A)

Total credits required of at least 48 credits

- Core courses 10 credits
- Elective courses *of at least* 2 credits
- Thesis 36 credits

From Bachelor's degree background (Plan B)

Total credits required of at least 72 credits

- Core courses 16 credits
- Elective courses *of at least* 8 credits
- Thesis 48 credits

The Advanced Research in Botanical (SCPL 607) offered in the second semester of the first year are responsible for strengthening the core competencies of the doctoral graduates by allowing the students to practice on ethical awareness, critical thinking, survey and critically review literature, formulation of research questions/hypotheses, and experimental design. as well as communicating knowledge as a frontier seminar, which are skills specified in ELO 1-5. Advanced Seminar in Botany I and II (SCPL 673 and 674) further emphasize these skills through a series of seminar presentations, discussion, questions and answers. After one year with extensive coursework activities, qualifying examination (QE) will be taken within the first semester of the 2nd year. QE is an assessment method to ensure that the doctoral students have achieved or gained ability to analyze scientific/research questions and apply their in-depth knowledge in Botany to address such problems. Thesis/dissertation writing and defense as well as writing an international research publication are the ultimate activity to assess the students' learning outcomes.

During study, a Ph.D. student with Bachelor's degree background can be transferred to a lower level of related M.Sc. program under the conditions of the announcements of the Faculty of Graduate Studies. To change the study level, a student must submit a written request to the Administrative Program Committee. Final decision to approve will be made by the President of the Mahidol University via the Dean of the Faculty of Graduate Studies. Criteria used in considering a request are 1) reasons for requesting to change the study level,

2) academic and research capability potentials of the student, 3) remaining time until the completion of the program should the permission.

2.6 The curriculum to have option(s) for students to pursue major and/or minor specializations.

The curriculum includes core courses that provide a foundation for the program. These courses cover the fundamental concepts and theories in the field and will be required for all students. The specializations should be based on the areas of interest of the students. Students can independently determine which areas they are most interested in pursuing. To allow students to customize their Ph.D. program to their interests and goals, the curriculum offers flexibility in the selection of both elective courses as well as electives outside of their specializations and their dissertation topic. The research should be supervised by faculty members with expertise in the student's area of specialization.

2.7 The program to show that the curriculum is reviewed periodically following an established procedure and that it remains up-to-date and relevant to industry.

The curriculum is reviewed every five years. The committees have been formed to review the curriculum, consisting of faculty members and external committees. The committees will have diverse expertise and perspectives and will be representative of the program's stakeholders. Accordingly, the program regularly collected feedback from stakeholders, including current students, graduates, alumni, instructors, and employers from academic institutes and industry.

The committee has evaluated the trends to identify any changes or developments that may affect the program's curriculum. This includes analyzing the future perspective of jobs in the Botany area. The committees have also evaluated the program's goals and PLOs to ensure they remain relevant and aligned with the updated trends. Any changes or updates needed to the goals and learning outcomes were identified and incorporated into the curriculum.

The committee has reviewed the content of each course in the curriculum to ensure it remains up-to-date and relevant to trends, including updating course materials, incorporating new technologies, and adding new topics or areas of study. The committees seek feedback from stakeholders, including current students, alumni, and employers, to identify any areas of the curriculum that may need improvement or revision.

Based on the findings of the review process, updates and changes were made to the curriculum as needed. These changes were communicated to students and other stakeholders and implemented in a timely and effective manner. This helps to ensure that students receive a high-quality education that prepares them for successful careers in their chosen fields.

3 TEACHING AND LEARNING APPROACH

3.1 The educational philosophy is shown to be articulated and communicated to all stakeholders. It is also shown to be reflected in the teaching and learning activities.

The educational philosophy was developed and articulated by university educational philosophy, which aims to produce graduates who excel in the Botany by acquiring life-long learning skills and exposure to problem-solving scenarios using an interdisciplinary approach. The program is designed to support graduate students with the acquisition of ethics and morality necessary to conduct scientific research, data analysis, and research evaluation. We emphasized this educational philosophy to our faculty members to transfer the key concept through teaching activities.

The educational philosophy has been communicated to all stakeholders, including students, staff, alumni, and employers, through various channels, such as program handbooks, orientation sessions, and websites.

The educational philosophy reflected in the program's teaching and learning activities uses active learning methods, emphasizes critical thinking and problem-solving skills, and promotes a collaborative and inclusive learning environment.

The alignment between the educational philosophy and teaching and learning activities was assessed periodically through various assessment methods, such as student feedback surveys and program evaluations. Based on the assessment results, the educational philosophy and teaching and learning activities have been revised and improved as needed. This can help to ensure that the program remains aligned with its educational philosophy and continues to meet the needs of the students and stakeholders.

3.2 Teaching and learning activities are shown to allow students to participate responsibly in the learning process.

Teaching and learning activities were designed in a way that encourages students to participate responsibly in the learning process for example, group discussions, problem-solving activities, and hands-on projects. Accordingly, setting clear expectation and providing feedback on their participation can encourage students to take responsibility for their learning and participate responsibly in the learning process.

During the COVID-19 outbreak, access to the onsite activities was limited to only serious issues or a small class; therefore, all lecture-based classes had to be switched to online mode. Students, with or without difficulties on the internet, must study at their accommodations. The disadvantages of taking an online course, such as a poor or intermittent internet connection, a lack of privacy for study, interruptions from family members, and a loss of concentration have been considered. The committee encouraged the course coordinators to provide video recordings for each class so students could attend all classes without unnecessary burden. This provided the flexibility of learning to students leading to more focus and an understanding of the knowledge and skills provided in the class.

For learning activities that can help students develop research skills, the assigned research projects that require students to use a variety of sources and to critically evaluate the

information they find. Encourage students to use a range of resources, including academic journals, books, and credible websites, and to cite their sources correctly. For group discussion, encourage them to ask questions, challenge assumptions, and share their own perspectives. This can help students develop critical thinking skills and learn from each other. Writing assignments require students to synthesize information from multiple sources and to present their own ideas in a clear and concise manner. Encourage them to use evidence from their research to support their arguments. The students must present their research findings. This can help them develop their presentation skills, as well as their ability to communicate complex ideas to a general audience.

3.3 The teaching and learning activities are shown to involve active learning by the students.

Active learning implies activities that encourage thinking, discussing, investigating, and creating. Here are some teachings and learning activities in our program that are known to involve active learning by students.

Class discussions: All classes encourage students to participate in class discussions by asking open-ended questions that require them to share their opinions and ideas. This can help students develop critical thinking skills and learn from each other.

Interactive lectures: Incorporate interactive elements into lectures, such as small group discussions or activities that require students to apply course content in real time. This can help students keep engaged and focused during lectures.

Problem-based learning: Assign students problems or scenarios that they must solve using the knowledge and skills they have learned in class. This can help them apply what they have learned to real-life situations and develop problem-solving skills.

Peer teaching: Assign students to teach a topic to B.Sc. students. This can help them develop communication and leadership skills, as well as a deeper understanding of the material. This is assigned in the SCPL 606 Skills in Botanical Knowledge Transfer course for students to practice skills in botanical knowledge, organizing learning activities suitable for learners by using media, innovations, techniques, and learning strategies, and learning assessment and evaluation.

Field trips: Take students on field trips (extra-curriculum activity) to apply course content in real settings. This can help students understand how the course content is applied and develop a deeper understanding of the material.

Overall, teaching and learning activities that involve active learning by students can help them develop critical thinking, problem-solving, communication, and leadership skills, as well as a deeper understanding of the course content.

3.4 The teaching and learning activities are shown to promote learning, learning how to learn, and instilling in students a commitment for life-long learning (e.g., commitment to critical inquiry, information-processing skills, and a willingness to experiment with new ideas and practices).

Our programs provide students with both the basic and advanced knowledge required to specialize in different fields of botany, and we also encourage self-study as part of our learning approach in many courses, with additional support from the instructors. For example, in SCPL 604 Frontier in Interdisciplinary Botany, SCPL 673: Seminar in Advance Botany I, SCPL 675: Literature Review for Botanical Research, SCPL 676: Advanced Project in Botany, and SCPL 699/799: Dissertation.

The instructors encourage students to ask questions, challenge assumptions, and explore new ideas. They create an environment that values intellectual curiosity and rewards students for taking risks and pursuing novel research questions. In addition, students were encouraged to explore topics outside of their discipline and consider how their research can be applied to other fields. This can help students see the broader implications of their work and develop a more well-rounded perspective. Moreover, the students have the opportunity to participate in professional development, including attending conferences, workshops, and other events that can help them develop new skills and broaden their knowledge base. This can also help them build professional networks and stay up-to-date on the latest research and industry trends. The supervisors model a commitment to life-long learning by sharing their own experiences of continuing education, discussing new research with their students, and staying up-to-date on developments in our field. All of this can help students develop the skills and mindset necessary for continued success after graduation.

Life-long learning is concerned with promoting skills and competences necessary for developing general capabilities and specific performance in work situations. Skills and competences developed are vital for how well the students can adapt their general and particular knowledge and competences to the new tasks. In this regard, the teaching and learning strategy functions as a tool to enhance their life-long learning.

Students registering thesis/dissertation have to conduct the doctoral research under supervision of advisory committees. Students are expected to develop their own research proposal, conduct research with concern of research ethics, collect and analyze data, interpret the results, report the result in terms of thesis, present and publish the research in international peer-reviewed journals. According to the thesis research, students' progress is continuously monitored by the advisory committee through regular lab/group meeting and progress report. Appropriate guidance and training are assiduously given.

During doing thesis research, students can achieve numerous skills in research competencies plus developing interpersonal communication and team-working skills with other students or researchers in the same laboratory or department. Ethical responsiveness is also enforced and monitored by the major advisor and advisory committees. All the skills achieved by the students are life-long experiences and contribute to the accomplishment of the programs' ELOs.

3.5 The teaching and learning activities are shown to inculcate in students, new ideas, creative thought, innovation, and an entrepreneurial mindset.

In the Ph.D. curriculum, students have to create their own thesis proposal as part of inquiry-based learning that involves asking questions, making observations, and investigating topics in depth. This approach can help students develop a deep understanding of a topic as well as the ability to generate new ideas and think creatively. After that, they have to do their own research as part of the project-based learning. They must solve complex problems and think creatively. These helps students develop critical thinking skills, collaborate with others, and generate innovative solutions. The research experience can help students develop an entrepreneurial mindset, which involves a willingness to take risks, embrace uncertainty, and pursue innovative ideas. Entrepreneurship education can include activities such as business plan development, pitch competitions, and mentorship opportunities. Accordingly, the Ph.D. student can independently challenge themselves in different ways, i.e., by attending several types of conferences and pitching research activities, mentoring the B.Sc. and M.Sc. in the advisor's lab, etc.

The developing of a business plan for science research can be an effective way to cultivate an entrepreneurial mindset in researchers. An entrepreneurial mindset involves a willingness to take risks, identify and pursue opportunities, and innovate in order to achieve goals.

3.6 The teaching and learning processes are shown to be continuously improved to ensure their relevance to the needs of industry and are aligned to the expected learning outcomes.

Continuous improvement of teaching and learning processes is essential to ensuring that they meet the needs of stakeholders and are aligned with ELOs. This was achieved through various means, such as ongoing feedback from stakeholders (i.e., lecturers, students, and alumni), assessment of student learning outcomes, and professional development for teachers.

To ensure that teaching and learning processes are relevant to stakeholders needs, it is important to establish strong partnerships with university and research institute leaders. These partnerships can provide valuable insights into the skills and knowledge required for success in the workplace, as well as opportunities for students to gain practical experience through internships, work placements, and collaborative projects. For example, our students have the opportunity to do internships in national and international institutes both in Thailand and abroad as also described in Criteria 8.3, Table 23.

Alignment with ELOs requires a clear understanding of the knowledge, skills, and competencies that students are expected to acquire. This can be achieved through the development of well-defined learning outcomes and assessment criteria, as well as the use of appropriate teaching and learning strategies to support student achievement. Continuous improvement of teaching and learning processes was regularly ongoing through evaluation and reflection.

In addition, students needed more practice in some areas of expertise, i.e., the research skill, especially for the student from the B.Sc., and the skill for writing a literature review for

both their thesis and publication, since some scholarship requires publications of both research articles and review articles. Therefore, in the revised program, more elective courses (SCPL 676, Advanced Project in Botany; SCPL 675, Literature Review for Botanical Research) were added (Exhibit 2.1).

Ultimately, a focus on continuous improvement of teaching and learning processes is essential to ensure that students are equipped with the knowledge and skills required for success in the workplace, and to meet the evolving needs of all stakeholders.

4. STUDENT ASSESSMENT

4.1 A variety of assessment methods are shown to be used and are shown to be constructively aligned to achieving the expected learning outcomes and the teaching and learning objectives.

The program employs teaching and learning strategies to ensure the achievement of both CLOs and ELOs. Most of core courses employ the small group discussions/presentations on frontier scientific publications with leading questions or a set of scientific problems to promote the application of basic knowledge in order to train students with ability to integrate, translate and apply the knowledge in different fields of Plant Sciences. Seminars are also the learning activities that promote achievement of several programs' ELOs. Students must read papers, critically evaluate, and present via oral presentation. Finally, all students must conduct a doctoral dissertation research, a research based on independent scientific work, which strengthens their knowledge, skills, and life-long experience. The curriculum mapping displaying contribution of individual courses toward achievement of the program ELOs is presented in Table 5-6. A full alignment between CLOs and programs' ELOs along with teaching and learning strategy is also listed in the course syllabi shown in Exhibit 4.1 (Course Specifications).

Overall, by using a variety of assessment methods that are aligned with the expected learning outcomes (ELOs), teaching and learning process, and achievement indicators (Table 8), it can ensure that students are able to achieve the intended learning outcomes and develop the necessary skills and knowledge to succeed in their academic and professional pursuits.

Table 8. Assessment methods and key achievement indicators for assurance of students' attainment of the program ELOs.

Program ELOs	Teaching and Learning Process	Assessment Methods	Achievement Indicators
1. Conduct research and scientific works professionally with moral, ethics, academic integrity, discipline, and punctuality	<ul style="list-style-type: none"> • Orientation • Lecture/training • Learn by example • Emphasis and monitoring by major advisor and instructors 	<ul style="list-style-type: none"> • Rubric check for written assignment and thesis/dissertation • Research monitoring/lab meeting 	<ul style="list-style-type: none"> • Passing the Rubric check • No ethical misconduct • Accepted manuscript for international research publication
2. Critically evaluate scientific merit of up-to-date botanical knowledge and their integration with other related disciplines	<ul style="list-style-type: none"> • Lecture • Seminar • Group discussion • Assignments 	<ul style="list-style-type: none"> • Rubric assessment • Q&A 	<ul style="list-style-type: none"> • Approved dissertation research proposal • Passing the thesis/dissertation defense • Accepted manuscript for international research publication
3. Create new knowledge in Botany or problem-solve new scenarios by analyze scientific questions and synthesize scientific information/ findings using interdisciplinary approach	<ul style="list-style-type: none"> • Written research proposal • Thesis/dissertation writing • Group discussion • Lab progress • Seminar 	<ul style="list-style-type: none"> • Rational discussions of results in thesis/dissertation or publication • Thesis progress • Q&A 	<ul style="list-style-type: none"> • Approved dissertation research proposal • Accepted manuscript for international publication
4. Demonstrate leadership, accountability, and decision-making skills in culturally diverse and	<ul style="list-style-type: none"> • Group Assignment • Seminar/oral presentation • Lab progress • Soft skill practice 	<ul style="list-style-type: none"> • Rubric assessment 	<ul style="list-style-type: none"> • Ability to be Team leader and member • Soft skill certificates

Program ELOs	Teaching and Learning Process	Assessment Methods	Achievement Indicators
multi-disciplinary team with personal and collective responsibility			
5. Transfer frontier knowledge in botany to audiences using adequate tools, appropriate technology, and statistics to critically evaluate the significance of scientific information and communication in an organized manner	<ul style="list-style-type: none"> • Lecture • Assignment/reports • Seminar/oral presentation • Thesis/dissertation writing 	<ul style="list-style-type: none"> • Written examination • Assignments • Rubric assessment for seminar/oral presentation Q&A 	<ul style="list-style-type: none"> • Ability to explain fundamental knowledge • Ability to answer scientific questions • Passing the qualifying examination • Passing the thesis/dissertation defense

4.2 The assessments and assessment-appeal policies are shown to be explicit, communicated to students, and applied consistently.

The student assessments including timelines, methods, regulations, weight distribution, rubrics and grading are clearly defined in the detailed outlines of each course (Exhibit 4.1). Besides, it is the responsibility of each lecturer to inform their students about the course syllabus and assessment methods at the beginning of each course. To ensure that the goals of the class are fulfilled, lecturers must have adequate assessment methods and be responsible for addressing questions or complaints from students if they arise. Process performance is graded during each course. It bases on quiz, homework, seminar, presentation, report, and examination. Timeline as well as guidelines for non-coursework assessments such as qualifying examination, thesis/dissertation proposal presentation and defense are also addressed during new student orientation (Exhibit 4.2). In addition, the description of each course is made available online at <https://graduate.mahidol.ac.th/inter/?p=curriculum&id=2130D01G> for students and other stakeholders.

Students can directly contact the course coordinator or program coordinator to request for the course syllabus and asking question regarding to the course. Most of the courses also use Google Classroom as an additional platform that provided two-way communication between instructors and students. In case of unexpected situation, such as pandemic, the course coordinator can directly contact to all students via google classroom or the Line group of the students to sudden change.

4.3 The assessment standard procedures for student progression and degree completion, are shown to be explicit, communicated to students, and applied consistently.

Standard methods, including assessment rubrics and marking schemes, are used to ensure the validity, reliability, and consistency of student assessment. (Exhibit 6.1). Instructors are trained to understand different assessment methods and are able to design the assessment to match the learning outcomes. For the course which there is more than one instructor, the evaluation method, grading, and rubrics, are created based on the agreement among the instructor team.

For the progress in degree completion, students are encouraged to follow the study plan provided in TQF2, and in degree completion form distributed to students at the

beginning of the student orientation day. All required courses in the curriculum as well as the minimum requirements for the elective courses are listed in the study plan. Prior to the registration in each semester, students are informed to take the required courses, and the confirmation process is made through the approval of advisor. Students are informed that they should pass all required courses in each semester and register for the general courses, elective courses at a minimum credit based on the regulation to complete their study on time.

The thesis or thematic paper examination will be open to general audience and be held at the date specified in the document issued by the Thesis or Thematic Paper Defense Committee appointed by the Faculty of Graduate Studies. When the examination is complete, the Defense Committee will discuss and deliver their judgement of the examination result. The decision from individual committee member must be treated as confidential. The net result of the examination will be graded as follows:

(1) “Passed” means the student has satisfactorily completed the thesis or thematic paper and showed the ability to answer all questions asked by the Defense Committee. There are no further corrections or additions in the thesis. The manuscript of the thesis is complete and ready to be printed and published.

(2) “Passed with Conditions” means the thesis is not satisfactorily completed and/or the student could not show ability to answer all questions asked by the Defense Committee. The Committee will require that the thesis or thematic paper be corrected or have main contents added or have the text revised. The conditions and time period for revising the thesis must be specified in order to allow the student to do so. This period, however, must not exceed 90 days or 30 days for revising the thesis or thematic paper, respectively, starting from the date on which the student is informed of the examination results.

When MU applied the full credit-based system, teaching staff are responsible for all activities related to the course such as teaching, designing tests, organizing exams, marking, and publicizing the results to students; and the teaching staff must follow the approved course specification. The results of students’ assessment are approved by the Dean before publicizing and storing. The assessment standards are explicit and consistent, but they must be adjusted because they depend on change of ELOs, program structure and contents and teaching and learning strategy.

4.4 The assessments methods are shown to include rubrics, marking schemes, timelines, and regulations, and these are shown to ensure validity, reliability, and fairness in assessment.

The instructors have been informed to maintain the standard for marking schemes, especially in classes with more than one instructor to mark or score students’ performance and in classes where preferences may arise, such as seminars and assignments. In that case, the assessment rubric is extremely necessary to calibrate the marking schemes of all instructors. The course coordinator is responsible for creating and communicating assessment rubrics to instructors and sometimes students, and must manage the argument and find the appropriate way to normalize and create fairness in the scoring. Instructors are also responsible for improving the assessment rubric by giving suggestions or comments on the rubric. Then, if other instructors agree with the suggestion, the improved version will be

distributed and used for the student assessment. In addition, after scoring is announced, students can request permission to view their own answer sheet and consult with the instructor for an explanation of the marking.

4.5 The assessment methods are shown to measure the achievement of the expected learning outcomes of the program and its courses.

As shown in Table 8, the assessment methods are designed based on the PLOs, and are revised annually according to the situation change each year. The course coordinators are in charge to design the course learning outcomes that aligned to the program learning outcomes and provide the information to the instructors in their courses. The instructors are informed to design the assessment method that matched their teaching and learning activities and the course learning outcomes.

4.6 Feedback of student assessment is shown to be provided in a timely manner.

Several courses, especially those emphasizing soft skill competencies, provide immediate feedbacks to students for improvement. For examples, in the seminar courses and the course containing assignment plus presentation, feedbacks on the strengths and weaknesses of students' presentations are made in both verbal and written comments at the end of the presentation. Progress report conducted every semester also allows assessment of students' progression on their thesis/dissertation research. Immediate feedback or comments on certain aspects of the research or technical problems are provided to the students by the dissertation advisory committees.

All lecture-based and laboratory-based courses divide the assessment to midterm and final examination. According to that, instructors are responsible for marking the students' performances and inform the course coordinators. For midterm examination, students will receive the exam score within 30 days after exam date via announcement by course coordinator. Therefore, students can see the result and can directly consult with instructors for the evaluation. In addition, the assessment of assignments and quiz also be available for students. For the seminar class, presenters in each week will receive the feedback from audiences within that day and will have a meeting with assigned instructors to discuss about possible improvements for future presentation.

4.7 The student assessment and its processes are shown to be continuously reviewed and improved to ensure their relevance to the needs of industry and alignment to the expected learning outcomes.

Feedback from students was timely collected through informal and formal approaches. Students can inform and discuss directly with the instructors during the class or with the course coordinators. At the end of the semester, all courses are subjected to being evaluated by students through the e-evaluation system. The evaluations were presented in quantitative form as a score (ranging from 1–5) and in descriptive form as suggestions or comments. The course coordinators have to report the students' evaluations in the TQF5.

Response to the problems or issues related to the course has to be done with the proposed solution. The deadline for solving the issue also has to be set.

5. ACADEMIC STAFF QUALITY

5.1 The program to show that academic staff planning (including succession, promotion, re-deployment, termination, and retirement plans) is carried out to ensure that the quality and quantity of the academic staff fulfil the needs for education, research, and service.

To ensure smooth continuity on operation of our academic programs, academic staff planning have perpetually been performed. Regulation on new staff procurement is governed by the Faculty of Science and Mahidol University. The HR Unit of the Administrative and Clerical Division at the Faculty of Science constantly keep tracks and perform analysis on workforce capability and capacity needs. Workforce capacity is determined annually by the availability of positions while competency is defined by expertise needed by current and future research direction. Demand of new staff is/are requested by individual departments/units to the Deputy Dean for Administrative and compiled by the HR Unit. Approval of new staff acquisition is considered based on current and future workload of the departments/academic programs, student to staff ratio, students' and customers' requirements and expectations, present and prospective required core competencies, etc. The Faculty of Science has set the target that the students to staff ratio for any graduate program should not exceed 5:1. Individual departments/units are responsible for arranging the initial staff selection process before submitting the candidate's profile to the Faculty of Science for preapproval by the Academic Staff Recruitment Committee. Final approval of new staff hiring is carried out by Mahidol University.

At the department level, Department of Plant Science generally keeps track of our academic staff in terms of teaching load, research activities, and retirement date (retirement age of 60 years old). The following conditions are considered for arranging a new staff acquisition process:

- There is academic staff retiring within the next 3-5 years
- New areas of research or teaching topics are required according to the advancement of scientific knowledge.
- Department committees screen candidates' curriculum vita for their track record in term of research competency. Candidates are then invited to give a seminar on their research work. Accordingly, the performances in terms of communication skills, ability to deliver knowledge to the audiences as well as question answering ability, etc. are evaluated. Other areas of qualification including personality and ethical awareness are further determined by direct interview. Decision is made in the department staff meeting before submitting the candidate' s profile to the Faculty of Science and Mahidol University for approval.

Both short-term and long-term planning of academic staff establishment or needs (including succession, promotion, re-deployment, termination, and retirement plans) are carried out to ensure that the quality and quantity of academic staff fulfill the needs for education, research and service. By March 2023, the MU-SCPL has 12 faculty members (Table 9); comprising 5 Associated Professors, 7 Assistant Professors. All the faculty members have Ph.D. degrees. For a short-term plan, the Department encourages and supports young lecturers to set up a plan to apply for promotion of the academic ranks at the level of

Assistant Professor in the next 1-3 years. In addition, Assistant and Associate Professor are also encouraged to apply for academic promotion to the level of Associate Professor and Professor, respectively. For long-term planning, the training for young staff and recruitment of new staff is carried out to ensure that a young staff generation is ready to take over tasks/responsibilities of the Department.

Table 9. List of the lecturers in the Department of Plant Science.

No.	Name	Title	Degree	Age	Number of International Publication
1.	Puangpaka Umpunjun	Associate Professor	Ph.D. in Science d'Agroressource	64	16
2.	Nathinee Panvisavas	Associate Professor	Ph.D. in Plant Molecular Biology	53	28
3.	Paweena Traiperm	Associate Professor	Ph.D. in Biological Science	45	52
4.	Aussanee Pichakum	Associate Professor	Ph.D. in Plant Science	61	26
5.	Alyssa B. Stewart	Associate Professor	Ph.D. in Ecology and Evolution	36	23
6.	Thaya Jenjittikul	Assistant Professor	Ph.D. in Horticulture	60	46
7.	Ngarmnij Chuenboonngarm	Assistant Professor	Ph.D. in Bioscience	59	23
8.	Sasivimon Swangpol	Assistant Professor	Ph.D. in Biological Sciences	57	21
9.	Panida Kongsawadworakul	Assistant Professor	Ph.D. in Plant Cell and Molecular Biology	51	33
10.	Unchera Viboonjun	Assistant Professor	Ph.D. in Biotechnology	48	34
11.	Wisuwat Songnuan	Assistant Professor	Ph.D. in Genetics	43	24
12.	Saroj Ruchisansakun	Assistant Professor	Ph.D. in Biology (Understanding Evolution)	36	16

5.2 The program to show that staff workload is measured and monitored to improve the quality of education, research, and service.

Staff to student ratio and workloads are constantly monitored by the Program Administrative Committees to ensure optimum quality of educational training. Qualification, number of academic staff and their workloads are presented in Table 10 while the staff-to-student ratio is shown in Table 11.

The workload of staff is monitored by SCPL committee twice a year through the performance evaluation (PE), which includes academic service hour, teaching load, and research project that matched with SCPL vision. All academic staff in SCPL are employed as full-time staffs with minimum requirement of workload at 1380 hour per year. The total FTEs of academic staffs is then considered from number of total staffs. The FTE of students is also

considered based on the number of full-time students studied in each academic year as shown in Table 11. The staff-to-student ratio of our program is less than 1:7, reflecting small class that support effective teaching and learning activities.

Table 10. Table illustrating qualification, numbers and workload (FTEs) of academic staff within the Doctor of Philosophy Programs in Botany, Department of Plant Science, Faculty of Science, Mahidol University, as of academic year 2022.

Category	M	F	Total		Percentage of Ph.D.
			Headcounts	FTEs*	
Professor	-	-	-	-	-
Associate Professor	-	5	5	1748	100%
Assistant Professor	1	6	7	2448	100%
Lecturer	-	-	-	-	-
Total	1	11	12	4196	100%

*FTE calculation is presented in more detail in Exhibit 5.1 using average number of students/staff of 1.

Table 11. Table illustrating staff to student ratio of the Doctor of Philosophy Programs in Botany, Department of Plant Science, Faculty of Science, Mahidol University during 2016-2022.

Academic Year	Number of Academic Staff	Total FTEs of Academic Staff	Total FTEs of Students*	Staff-to-Student Ratio
2022	12	4196	24528	1 to 5.8
2021	13	4250	25704	1 to 6.0
2020	13	4654	27524	1 to 5.9
2019	13	3654	22400	1 to 6.1
2018	13	3154	18760	1 to 5.9
2017	12	1154	8512	1 to 7.4
2016	12	154	1680	1 to 10.9

*FTE calculation is presented in more detail in Exhibit 5.1

5.3 The program to show that the competences of the academic staff are determined, evaluated, and communicated.

The teaching and research competencies of academic staff are identified during the selection process before joining the program through the Department of Plant Science. In addition to a strong track record in research, the potential contribution of prospective staff toward teaching topics is also determined. Once employed, the teaching competence of

academic staff is evaluated every semester via students' feedback on the overall course and individual instructors. Research competency is basically monitored by the publication outputs of each staff member. A grace period is given to newly-recruited staff as settling a new research laboratory usually takes a few years to generate the first research output. Moreover, Mahidol University and the Faculty of Science also enforce systems called Performance Agreement (PA) and Performance Evaluation (PE). PA is a promise that academic staff make to the department each year regarding their job responsibilities and outputs. The department can then compile the target achievements from the academic staff to come up with a PA with the Faculty of Science; the latter, in turn, can make a promise to Mahidol University. PE is the actual evaluation process used to determine staff members' performance. Before the start of any academic year, the departmental staff meets to come up with a consensus evaluation criterion to be used, taking into account problems faced during staff evaluation in the previous year.

The Department of Plant Science and Faculty of Science continuously keep track of the research activities of academic staff. Research grants and publication outputs are parts of the PE criteria. The status of research output in terms of international publications is reported monthly in the staff meeting. A summary of the number of international publications by academic staff for each academic year is presented in Table 12; a detailed list of publications is also available on the Faculty of Science website at <https://science.mahidol.ac.th/th/research/output.php>.

Our academic staff holding Ph.D. degrees are required to engage in active research and have at least one publication per year, either a paper in the national leading journal or a presentation at a national professional conference. And 50% of the publications must be in international journals or at international conferences. Through their research, the academic staff can both enhance their research competence and provide opportunities for students to take part in research activities. The academic staff can share their research results through national and international seminars, workshops, and conferences. During 2016–2022, the academic staff from the Department of Plant Science achieved 131 scientific international publications. All research projects have been supported by national organizations in various fields. The scientific activities of the Department of Plant Science have increasingly advanced plant science knowledge in both quantity and quality, expanding partnerships with national and international organizations. Our Ph.D. program in Botany is the only international Ph.D. in Botany program in Thailand. In terms of benchmarking, obtaining comparable information is important, but its availability is quite limited.

One of the main components of demonstrating competency in research is to regularly publish research findings in international scientific journals. The scientific activities of SCPL have increasingly advanced plant science knowledge in both quantity and quality, expanding partnerships with national and international organizations.

Table 12. Number of research output as international publications of academic staff within the Ph.D. program in Botany at the Faculty of Science, Mahidol University during 2016-2022.

Academic Year	Number of International Publications by Academic Staff	Number of Active Academic Staff	No. of Publications per Academic Staff
2022	17	12	1.4
2021	17	13	1.3
2020	23	13	1.8
2019	24	13	1.8
2018	16	13	1.2
2017	16	12	1.3
2016	18	12	1.5

https://plantscience.sc.mahidol.ac.th/?page_id=8474

5.4 The program to show that the duties allocated to the academic staff are appropriate to qualifications, experience, and aptitude.

This program regularly assesses the performance of academic staff, taking into account factors such as their teaching effectiveness, research productivity, and service to the institution and community.

The evaluation was structured to ensure that duties are allocated in a way that is consistent with the qualifications, experience, and aptitude of each academic staff member. The staff has opportunities for professional development, such as workshops and seminars, to support staff members in developing their skills and expertise in areas relevant to their duties. This can help to ensure that staff members are better equipped to perform their assigned duties effectively and efficiently.

Additionally, regular communication between academic staff members and their mentors can be established to ensure that duties are appropriately assigned and reviewed over time. This can help identify areas where staff members may require additional support or training to improve their performance, especially for supporting staff. This can help to ensure that staff members are able to perform their roles effectively and contribute positively to the institution's academic mission.

5.5 The program to show that promotion of the academic staff is based on a merit system which accounts for teaching, research, and service.

It is generally expected that promotions are awarded based on merit, taking into account the faculty member's achievements in teaching, research, and service. Here is a program to show that promotion of academic staff is based on a merit system that accounts for these three areas:

Teaching merit has been evaluated based on the faculty member's ability to deliver quality instruction and support the academic development of students. The following criteria may be considered in evaluating teaching merit: course design and development, teaching effectiveness and student engagement, curriculum development and innovation, and supervision of graduate students.

Research merit has been evaluated based on the faculty member's ability to conduct significant research and contribute to their academic field. The following criteria may be considered in evaluating research merit: publications in peer-reviewed journals and international conference proceedings; funding from external agencies; patents and intellectual property rights; research impact; and recognition.

Service merit has been based on the faculty member's ability to contribute to the academic community and society at large. The following criteria may be considered: leadership and involvement in academic and professional organizations, peer-review of scholarly work, contribution to institutional and departmental governance, public outreach, and community engagement.

5.6 The program to show that the rights and privileges, benefits, roles and relationships, and accountability of the academic staff, taking into account professional ethics and their academic freedom, are well defined and understood.

The university develops clear policies and guidelines that define the rights and privileges, benefits, roles and relationships, and accountability of academic staff. These policies and guidelines are accessible to all academic staff and regularly updated to ensure they remain relevant and effective. New academic staff receive orientation and training that familiarizes them with the policies and guidelines of the university, including their rights and responsibilities as academic staff members. This helps ensure that all academic staff have a common understanding of what is expected of them.

Professional ethics have been taken into account in defining the rights and responsibilities of academic staff. The university is concerned that all academic staff understand and adhere to ethical principles, such as academic integrity, respect for intellectual property, and confidentiality.

For academic freedom, the academic staff have the freedom to pursue their research and teaching interests without fear of retribution or censorship. For performance evaluation, the evaluation system is transparent and fair and holds academic staff accountable for their work. The system includes clear criteria for evaluation and a process for feedback and improvement.

5.7 The program to show that the training and developmental needs of the academic staff are systematically identified, and that appropriate training and development activities are implemented to fulfil the identified needs.

It is typical that newly recruited staff do not understand rules, regulations, expected responsibility, promotion tracks, teaching philosophy, etc. Mahidol University each year

organizes workshops to train/educate/provide young staff with such information. Moreover, Mahidol University has focused on training outcome-based education (OBE) to academic staff during the annual workshop. This is to ensure that the educational philosophy of the university is deployed directly to the staff. The Faculty of Science also organizes the equivalent retreat or workshop on providing guidance for research grant hunting or helping setup research collaboration. Our entire academic staff actively conducts research and teaches in the area of plant science. Similar to any academic program in science around the world, learning new knowledge and strengthening the research competencies of academic staff can be achieved by allowing staff to attend scientific conferences, especially the international meetings. The Department of Plant Science offers financial support to allow all academic staff to attend a national-level meeting once a year. For international conferences, the department, together with the Faculty of Science and the Faculty of Graduate Studies, offer a partial travel grant for the academic staff to attend. The number of available travel grants, depending on the available budget, is determined each year at the staff meeting.

5.8 The program to show that performance management including reward and recognition is implemented to assess academic staff teaching and research quality.

The Department of Plant Science, the Faculty of Science, and Mahidol University realize that rewards and recognition play a key role in motivating academic staff. Every year, Mahidol University announces many awards in recognition of academic staff who devote themselves to the best of their duties, primarily teaching and research. Examples of such awards include the Mahidol University Prize for Excellence in Research, the Mahidol University Prize for Excellence in Teaching, the Outstanding Lecturer Award from the Council of Mahidol University Faculty Senates, etc. In conjunction with Mahidol University, the Faculty of Science also announces an Outstanding Staff Award annually in recognition of academic and support staff with distinguished performances. Also available is a publication reward for academic staff who publish research outputs in high-quality international journals indexed by respectable databases, such as Scopus or ISI. The reward is in the form of prize money, the amount of which depends on the quality of the article and the staff's role in the authorship. In addition to the prize money, academic staff with qualified publication records are also eligible for promotion from lecturer to assistant professor, associate professor, and full professor, the process of which follows the rules and regulations of Mahidol University. Details on the criteria and guidelines for academic promotion at Mahidol University can be viewed at <https://muic.mahidol.ac.th/eng/research-2/academic-promotion-request/>. To facilitate the academic promotion processes, the Faculty of Science offers a proofreading service for the required documents and paperwork to ensure a high success rate of the applications.

6. STUDENT QUALITY AND SUPPORT

6.1 The student intake policy, admission criteria, and admission procedures to the program are shown to be clearly defined, communicated, published, and up-to-date.

In this criterion, systems employed by our graduate programs for student quality and support, starting from admission to graduation, are explained as follows: Admission criteria and policy for new graduate students are explicitly defined and communicated in the Program Specification, made available on the Department of Plant Science web site at <https://plantscience.sc.mahidol.ac.th/> and on the admission web site at the Faculty of Graduate Studies (<https://graduate.mahidol.ac.th/inter/?p=curriculum&id=2130D01G>). Prospective students can apply online via the Faculty of Graduate Studies at <https://graduate.mahidol.ac.th/inter/>. The candidates are screened by their overall undergraduate or graduate cumulative GPA and the entrance examination (if taken). The applicants are then subjected to an interview in English, and their overall performance is judged using a rubric scale (Exhibit 6.1). The overall rubric assessment score must be at least 75%. In the event that the score is lower than 75%, the students are not admitted.

Methods and criteria for the selection of students are evaluated and discussed among academic staff within the Department of Plant Science every year after the admission period is over. If specific issues arise during the admission process, solutions are sought, and revisions to the admission process will be made in the subsequent years.

Table 13 summarizes the admission statistics of our graduate programs in terms of the number of applicants and the number of admitted students. Our doctoral program in Botany has set a target of recruiting 5 Ph.D. students per year. Although the ratios of students who applied vs. those who enrolled in the programs suggest that the level of competitiveness is not very high, the program has indeed attracted graduate students from other universities in Thailand. In addition, most of the students admitted to our program also have scholarship support to cover their educational and living expenses. Such scholarships significantly reduce the operation cost of the program because the doctoral program in Botany offers partial funding for students who do not have the financial support. Table 14 further shows the accumulation of our students each year. It should be noted that in 2021, because curriculum adjustment was in progress, the program could not recruit a new student.

Table 13. Number of student applicants vs. number admitted and enrolled in the Ph.D. Program in Botany at the Department of Plant Science, Faculty of Science, Mahidol University during academic year 2016-2022.

Academic Year	Doctoral Degree Program Applicants			
	Number Applied	Number Offered	Number Enrolled	Ratio Applied/Enrolled
2022	1	5	1	1:1
2021*	0	0	0	-
2020	1	5	1	1:1
2019	4	5	4	1:1
2018	2	5	2	1:1

Academic Year	Doctoral Degree Program Applicants			
	Number Applied	Number Offered	Number Enrolled	Ratio Applied/Enrolled
2017	7	5	7	1:1
2016	6	5	6	1:1

*In 2021, curriculum adjustment was in process.

Table 14. Number of students enrolled in the Ph.D. Program in Botany at the Department of Plant Science, Faculty of Science, Mahidol University during academic year 2016-2022.

Academic Year	Number of Doctoral Students						Total
	1 st Year	2 nd Year	3 rd Year	4 th Year	>4 th Year	Drop out	
2022	1	0	1	4	11	0	17
2021	0	1	4	2	10	0	18
2020	1	4	2	7	4	0	18
2019	4	2	7	5	0	0	18
2018	2	7	5	0	0	0	14
2017	7	5	0	0	0	0	12
2016	6	0	0	0	0	1	5

6.2 Both short-term and long-term planning of academic and non-academic support services are shown to be carried out to ensure sufficiency and quality of support services for teaching, research, and community service.

Students are continuously monitored by their major advisor from the first year until they graduate. First-year students who have not chosen their major advisor yet are monitored and advised directly by the program director. From the second year onward, when the students choose their own major advisor, such monitoring is transferred to the major advisor. During the time that students are taking the coursework, they are monitored in terms of the courses they take and the grades they receive for each course. This is because the regulation by Mahidol University imposes that, for doctoral students to graduate, the cumulative GPA must be at least 3.50. Should the students' cumulative GPA be below the requirement, they are advised to take additional courses. After the students finish all their coursework and present their thesis or dissertation proposal, they are required to have a progress report on their research advancement every semester. The progress report is in the form of an oral presentation on the students' cumulative results to the Thesis and Dissertation Advisory Committee. The program director and major advisor can also monitor student registration and progress via the online monitoring tool offered by the Faculty of Graduate Studies (<https://graduate.mahidol.ac.th/thai/staff/>). Every month, key issues relating to students' progress and situations, i.e., grades, qualifying examinations, thesis or dissertation proposals, overdue students, etc., are discussed among academic staff during a departmental staff meeting. Students who fail any coursework or non-coursework activities, especially the required courses or qualifying examination, are to be closely supervised and monitored by the advisors, course coordinator, qualifying exam committee, as well as the program director.

6.3 An adequate system is shown to exist for student progress, academic performance, and workload monitoring. Student progress, academic performance, and workload are shown to be systematically recorded and monitored. Feedback to students and corrective actions are made where necessary.

Academic advice is given to new first-year students during program orientation by the program director. The program director is also responsible for providing appropriate academic advice and helping solve various technical issues (registration, credit transfer, financial problems, etc.) throughout the first year of study. Once the students appoint their own major advisor from the second year onward, the advice is the direct responsibility of the advisor, with monitoring from the program director for the overall progress of the students. Accordingly, the program conducts regular assessments of student progress and academic performance that are conducted in a transparent and objective manner using reliable and valid assessment tools. The dissertation research progress reports (GR.42) of each student were officially sent to the Faculty of Graduate Studies for every semester. The thesis committees provide regular feedback to students on their progress and academic performance. This can help students improve their academic performance and ensure that they are meeting the expectations of the program.

6.4 Co-curricular activities, student competition, and other student support services are shown to be available to improve learning experience and employability.

Besides the advisory and awarding systems, from time to time the Department of Plant Science as well as the Faculty of Science organize special seminars by foreign visiting professors and researchers. Students are encouraged to attend such seminars to expand their scientific vision as well as to strengthen their motivation for research. The students can also learn how to deliver an effective oral presentation in a regular seminar class.

From the second year onward, students can work part-time as research assistants (RA) or teaching assistants (TA) to gain financial support. Students aiming for a job in an academic institution are encouraged to work as a TA at least once to gain basic skills in teaching and handling undergraduate students. Several academic staff members within our doctoral program also hold research grants or external scholarships that allow stipend support for students under their supervision. In addition, extra-curricular activities are arranged on both the national and international levels to enhance skills in effective management and communication, knowledge transfer, etc. For example, the program encourages students to participate in the organization of academic symposiums, workshops, and conferences (including student and undergraduate symposiums and national and international conferences) at least once throughout the study.

6.5 The competences of the support staff rendering student services are shown to be identified for recruitment and deployment. These competences are shown to be evaluated to ensure their continued relevance to stakeholders needs. Roles and relationship are shown to be well-defined to ensure smooth delivery of the services.

Recruitment of new supporting staff begins with defining job description and qualification of the available position by the corresponding unit. Job description and qualification are important piece of information for proper deployment of the missions. Announcement of the vacant position is always made available on the announcement board and on the web site of the Faculty of Science. In the announcement, information on the position, job description, qualification, application process, selection method(s) are clearly presented.

For supporting staff to be recruited to the Department of Plant Science, the departmental chairperson assigns a committee, usually includes the retiring staff in that position, to come up with the job description, exam questions (if applicable) and interview criteria. For supporting staff career progression, the Department of Plant Science and the Faculty of Science both follow the regulations and guidelines of Mahidol University. Detail information about the regulation and guidelines are available at the Human Resource Division web site (<https://muhr.mahidol.ac.th>). Supporting staff can be promoted to more advanced position, for example from Practitioner to Senior Professional to Expert and to Advisory level, depending on the expertise and credentials.

Competencies of supporting staff have been identified since the recruitment process as indicated in the qualification of applicants. Each fiscal year, similar to the academic staff, every supporting staff member must also sign a Performance Agreement (PA) form with the head of the unit (departmental chairperson, assistant or deputy dean). Staff are then allowed to perform their tasks and their performances are evaluated every 6 months using Performance Evaluation (PE) form. In academic year 2023, the evaluation will be performed every year. Strengths, weaknesses and areas for improvement are then provided as feedbacks to individual staff to step up their performances.

Reminiscent of the HR planning for staff recruitment, training and developmental needs of supporting staff can be identified from both top-down and bottom-up directions. As described earlier, heads of each operating units are responsible for routine monitoring of the workload vs. number and competency of workforces for accomplishment of strategic action plans. In case that certain areas of staff competencies need to be further developed or trained, the department/unit can make plans accordingly. For examples, the IT staff can be trained on new tools like “Google Workspace for Education Plus” that the university or Faculty of Science purchased in order to further help train other personnels. In addition, laboratory staff at the Central Instrument Facility are often sent to seminars and trainings organized by the equipment companies for latest updates on technical advancement or new effective procedures that the current machines can perform, etc. For top-down policy, the executive team can also initiate the trainings for supporting staff that suit the prospective outlook or strategic plan of the Faculty of Science. Examples of such top-down initiatives include the training for English proficiency skills of supporting staff (to accommodate AEC), especially those who have TOEIC score less than 400, and a Team-Building Workshop that stimulate a team-working mindset.

Following the same approaches to stimulate and motivate academic staff, supporting staff at Mahidol University are also entitled for rewards and recognitions for their efficient

and productive work processes and outcomes. Both Mahidol University and Faculty of Science announce Outstanding Staff Awards every year for excellent supporting staff who performed well on their respective duties (see <https://science.mahidol.ac.th/th/award.php> for a list of exemplary staff and the awards they received). Other than awards and rewards, Mahidol University and the Faculty of Science also provide various kinds of pension and welfare benefits to every staff. For a full list and information on such benefits, please visit (<https://muhr.mahidol.ac.th>).

6.6 Student support services are shown to be subjected to evaluation, benchmarking, and enhancement.

At the Stang Mongkolsuk Library, support services are analyzed yearly through a customer satisfaction survey. Both the Educational Affairs Division and the Classroom Appeal Form were subjected to the response of the staff involved. The program administrator for SCPL student service has consistently been regarded as a friendly and helpful individual, as shown by the graduate survey from each academic year and the interview. The purpose of evaluation is to identify areas that require improvement and determine the overall effectiveness of the services. For example, during the COVID pandemic, the equipment included computers or laptops, high-speed internet connections, webcams, microphones, and other hardware and software required for online classes, assignments, and exams. Moreover, the COVID-19 pandemic has had a significant impact on students' lives and education. To help students during this challenging time, the university has implemented various measures to provide support and assistance, including: mental health support, financial assistance, technology support, flexible learning options, communication, and resources. Overall, providing support and assistance to students during the COVID-19 pandemic is crucial for ensuring that they can continue their education and achieve their academic goals despite the challenges they may face.

7. FACILITIES AND INFRASTRUCTURE

7.1 The physical resources to deliver the curriculum. Including equipment, material. And information technology, are shown to be sufficient.

At Faculty of Science, Mahidol University, green spaces and various academic and research facilities i.e., lecture halls, classrooms, library, and laboratories are situated. A wide variety of modern instruments and supporting personnel help create a dynamic and scientific atmosphere. To develop an atmosphere that encourages cooperation and research achievements, several centers of excellence for multi-disciplinary research have been established.

Our program employs both in- and off-department facilities and equipment. The Department of Plant Science has available two classrooms, one common room, and several laboratory rooms. The Faculty of Science possesses a number of large lecture halls and small classrooms. All of them are available for the academic programs within the Faculty of Science to use upon request or reservation. All lecture halls and rooms are air-conditioned and equipped with WiFi, computers, an LCD projector, and a visualizer. A white or black board is also available for certain teaching strategies that require classical approaches. Most teaching and learning processes are conducted using classrooms and facilities within the Department of Plant Science. Should there be any malfunction of any teaching and learning facilities within the lecture halls or classrooms, staff and students can report to responsible persons for an immediate fix and solution.

7.2 The laboratories and equipment are shown to be up-to-date, readily available, and effectively deployed.

The Department of Plant Science possesses laboratory spaces allocated to all academic staff to conduct their research. Each laboratory has basic equipment for research in the field of Plant Science i.e. Taxonomy, Anatomy, Physiology, Molecular Biology and Genetics, pathology, Tissue culture. In addition, there are central equipment facility rooms containing more expensive equipment shared by all staff and students i.e. real-time qPCR, deep freezers, spectrophotometers, floor centrifuges, fluorescence microscopes, sliding microtome etc. Custodians are assigned for individual equipment to ensure proper usage and maintenance.

For more advanced and very expensive equipment, the Faculty of Science also makes available the Central Instrument Facility (CIF). Equipment available in the CIF include nano LC-MS/MS, GC-MS, HPLC, FPLC, flow cytometer, real-time PCR, confocal fluorescence microscope, spectrophotometers, ultra and preparative centrifuges, etc. For a complete list of equipment made available at the CIF, please visit <https://science.mahidol.ac.th/scrc/booking/>. A technician is assigned for each instrument at the CIF to help students who need guidance and training. For advance visualization of cell and molecular images, the Faculty of Science also hosts an Olympus Bioimaging Center that, in collaboration with the company, provides the most advanced instruments including confocal and fluorescent microscopes. Other than scientific instruments, the Faculty of Science also has Central Animal Facility (CAF,

<https://science.mahidol.ac.th/caf/>) to provide services regarding animal model for research experiments needed by certain academic staff/researchers.

The Department of Plant Science and the Faculty of Science have also allocated budgets for regular equipment maintenance. In addition, a list of prioritized in-need instruments is also drafted to make an annual budget request to the government for approval. Should the requested proposal be approved, the Department of Plant Science or the Faculty of Science would then proceed with the purchase procedure.

7.3 A digital library is shown to be set-up, in keeping with progress in information and communication technology.

Stang Mongkolsuk Library, located at the Faculty of Science, Mahidol University, can be considered the state-of-the-art science library in Thailand. The library contains more than 10,000 books both in the form of hardcopy and online resources. In addition, together with Mahidol University, the library subscribes to major journals and online databases in science and medicine. With the emphasis on instilling 21st century skills in our students, online resources play very important roles in the teaching and learning processes of our graduate programs. The official web site of the Stang Mongkolsuk Library (<https://stang.sc.mahidol.ac.th/en/index.php>) provides online tools for students and staff to search an online database for literature in the form of eBooks or journal articles related to their own research area from anywhere. The web site also provides links to other main online resources that can be useful to teaching and learning processes. Students can even renew the loaned book from home. Moreover, the Stang Mongkolsuk Library also offers a "Journal on Demand Service" that helps students and staff obtain hard copies of the research articles unavailable via regular subscription at the library or Mahidol University within a few days. There is also a "Book Delivery Service," where students can ask the library to help loan the book from other libraries all over Thailand and have it ready for pick up at the Faculty of Science. The service quality of the library has been continuously evaluated. Our graduate programs also asked our own students for their satisfaction with the library resources; most students are satisfied with the library service offered by the Stang Mongkolsuk Library at the Faculty of Science, Mahidol University, even though the number of online journals is less than previously.

7.4 The information technology systems are shown to be set up to meet the needs of staff and students.

According to current situation where learning device is not limited to only computer, tablet, notebook, and even mobile can also be part of e-learning platform. Students can own themselves personal learning devices at reasonable price, however, additional supports are required. The resource provided by MU and SC for Operating system, software and applications are available to be downloaded, updated, and used with legal license (<http://softwaredownload.mahidol/>), such as Windows, anti-virus, Microsoft office, Endnote, WebEx, Zoom. Additionally, the G-suite and Office 365 are also provided to support learning from any mobile device.

Moreover, Stang Mongkolsuk Library regularly sets up valuable special training programs for staff and students during the year. For example, they introduced how to use EndNote 20 software for collecting bibliography data from several famous research databases and PDF full text and how to use Full Text Access Tools: Unpaywall and EZProxy Redirect for using browser extensions to help access full-text research articles from open access or subscribed databases by the institution easily and quickly (<https://stang.sc.mahidol.ac.th/training/v2>). Staff and students can also suggest the training program they require to support their work and activities.

7.5 The university is shown to provide a highly accessible computer and network infrastructure that enables the campus community to fully exploit information technology for teaching, research, service, and administration.

Internet access and electric sockets are also available around the campus. Free WiFi is available for students and is routinely upgraded. Currently, students and staff can use their university accounts to get WiFi for more than one device on any university campus. In addition, students can access the intranet and database from outside campus via VPN. In addition, a free mobile internet package was provided for all students during the COVID-19 pandemic situation.

7.6 The environmental, health, and safety standards and access for people with special needs are shown to be defined and implemented.

The Faculty of Science at Phayathai Campus is considered the green zone containing a lot of large trees and plants. Wheelchair access is possible through almost every part of the campus. Pray rooms are available for people with Islamic religion. The whole campus is also a smoke-free zone. Safety is ensured by patrolling of security guard during day and night. To create a healthy lifestyle in the campus, several sport facilities, such as a football field, tennis courts, a large multipurpose gymnasium, a fitness center, and a swimming pool, are provided for students and staff. Should any students or staff have health issues, an infirmary room is available with medical doctor standing by during specific time of the day. For off schedule or severe health problems, Ramathibodi Hospital is right next to the campus and medical assistance is readily available. Medical insurance is also incorporated into the students' registration fee.

Since conducting research is a crucial part of our graduate programs, health and safety issues are of primary concern. To minimize such issues, all first-year students are required to attend a safety training (including biosafety, chemical safety, and fire safety) organized by the Faculty of Science. Fire alarm drill is also practiced every year. The Faculty of Science also arrange a warehouse for proper disposal of hazardous waste. All toxic and hazardous wastes must be deposited in the warehouse before further disposal by professional outsourced companies.

The University aims to instill the importance of safety and security in our researchers, lecturers, students, and personnel when using facilities on campus, especially research laboratories. Therefore, to raise and maintain standards, there is collaboration in the

implementation of the Enhancement of Safety Practice of Research Laboratories (ESPREL) to achieve the following goals: to enhance the safety of students, faculty, and staff; to establish strict safety standards for all university laboratories; and to prioritize instilling a safety mindset in all students, faculty, and staff. One laboratory in the Department of Plant Science has passed the ESPReL criteria since 2022.

7.7 The university is shown to provide a physical, social, and psychological environment that is conducive for education, research, and personal well-being.

On the university's main campus, Salaya, there are facilities available to support both a physical and social environment, such as dormitories, sports facilities, a running track along the campus, a central library, a canteen, a coffee shop, a convenience store, a communal space, and many more. The concert and event, arranged by the students in another department, as well as the social club of students, are also provided. Occasionally, students can attend the orchestra concert at Prince Mahidol Hall for free or with a special discount. Free transportation is also available on campus or between campuses. The shuttle bus between Salaya and the nearby BTS station is also provided at a reasonable price.

For the Phayathai campus, MUSC provides a sports center for students and staff to do physical exercise, including fitness, a swimming pool, basketball, and a football field. Little gardens around campus are also available to offer a calm and relaxing environment. The security guards provided by SC offer help and a safe environment around the campus, especially during the night. For SCPL students, we have a common room and seating area for meals and socializing, as well as a meeting room for supporting students' activities.

7.8 The competences of support staff rendering services related to facilities are shown to be identified and evaluated to ensure that their skills remain relevant to stakeholder needs.

Besides academic staff, support staff are equally important to fulfill the educational goals of our graduate program. Department of Plant Science, Faculty of Science, Mahidol University together help monitor and make adequate plans regarding supporting workforces. Number and competency of staff involved in each mission and plans are examined annually by both the HR Unit of the Administrative and Clerical Division, Faculty of Science and by individual units/departments including Department of Plant Science. Table 15-18 below summarize the current numbers and competencies of supporting staff associated with key facilities that play important roles in operation of our graduate programs such as library, laboratory, IT and student services.

Table 15. Number of laboratories supporting staff and their educational background at both departmental level and the Faculty of Science level along with their relevance toward the programs' teaching and learning approaches (TLA).

Affiliation of Laboratory Personnel	Highest Educational Attainment				Total	Relevance to Program TLA
	High School	Bachelor's	Master's	Doctoral		
Department of Plant Science	0	2	0	0	2	Student training, technical guidance, equipment custodian
Faculty of Science: Central Instrument Facility or CIF ¹	0	3	5	0	8	Equipment custodian, technical guidance, laboratory services

Table 16. Number of library supporting staff and their educational background at the Stang Mongkolsuk Library, Faculty of Science along with their relevance toward the programs' teaching and learning approaches (TLA).

Affiliation of Laboratory Personnel	Highest Educational Attainment				Total	Relevance to Program TLA
	High School	Bachelor's	Master's	Doctoral		
Stang Mongkolsuk Library	1	13	4	0	18	Book search and loan, journal and database search

Table 17. Number of IT supporting staff and their educational background at the Faculty of Science along with their relevance toward the programs' teaching and learning approaches (TLA).

Affiliation of Laboratory Personnel	Highest Educational Attainment				Total	Relevance to Program TLA
	High School	Bachelor's	Master's	Doctoral		
Stang Mongkolsuk Library ¹	0	4	1	0	5	Electronic resources and technical advices: eBooks, eJournals, eLibrary, eDatabase, software training, IT training and seminar
System Development and Technology Division ²	0	3	4	0	7	Computer software and hardware technical services, network services, IT consultant, computer laboratory services

Table 18. Number of student affair personnel and their educational background at both the Department of Plant Science and at the Faculty of Science along with their relevance toward the programs' teaching and learning approaches (TLA).

Affiliation of Laboratory Personnel	Highest Educational Attainment				Total	Relevance to Program TLA
	High School	Bachelor's	Master's	Doctoral		
Department of Plant Science	0	2	0	0	2	One stop service (help facilitate processes and documentations with other responsible units i.e., Graduate Education Units, Faculty of Graduate Studies, Research Division, etc.)
Faculty of Science: Graduate Education Unit ¹	NA	NA	NA	NA	16	Thesis/Thematic Examination, Thesis/Thematic Submission

Department of Plant Science, which is the parental unit of our graduate programs, houses 4 supporting staff: 2 scientists and 2 administrative staff. The scientist's main duty is to conduct research in association with the assigned research groups and to help teach in laboratory courses. As the skills and experiences of the scientists is generally more than the new entry students, these staff can also provide technical advises and training for new graduate students regarding equipment usage and research protocols. The administrative staff function as a one-stop service station that facilitates students' needs in terms of formal documentations and processes involving other regulating parties such as Faculty of Science and Faculty of Graduate Studies. With these kinds of services, students do not need to run around contacting other units by themselves to resolve their specific needs. In addition to the needs of service on paperwork and formal processes with the regulating bodies, other types of key services such as library, IT, central instrument facility are provided by staff associated with the Faculty of Science.

For supporting staff to be recruited to the Department of Plant Science, the departmental chairperson assigns a committee, usually includes the retiring staff in that position, to come up with the job description, exam questions (if applicable) and interview criteria. For supporting staff career progression, the Department of Plant Science and the Faculty of Science both follow the regulations and guidelines of Mahidol University. Detail information about the regulation and guidelines are available at the Human Resource Division web site (<https://op.mahidol.ac.th/hr/>). Supporting staff can be promoted to more advanced position, for example from Practitioner to Senior Professional to Expert and to Advisory level, depending on the expertise and credentials.

7.9 The quality of the facilities (library, laboratory, IT, and student services) is shown to be subjected to evaluation and enhancement.

• Teaching and Learning Facilities

Classroom and its facilities are subjected to monitoring and maintenance by assigned support staff from the Faculty of Science. Instructor and students can also file a complaint to the Education Division if problem arises regarding lecture room facilities. Service personnel and backup equipment, LCD projector for example, are available for immediate repair and/or replacement in case one becomes nonfunctional. For departmental facility, a supporting staff is also assigned to do similar job as that of the Faculty of Science's level. In case of equipment replacement, the request goes through the departmental staff meeting for approval. Department of Plant Science conducts a yearly survey on students' satisfaction level toward teaching and learning facilities. Major comments and feedbacks related to the common facilities responsible by the Faculty of Science that need immediate attention are forwarded to the Education Division for further consideration.

• Library Resources

The Stang Monkolsuk library, one of the leading science libraries in Thailand, maintains extensive book, journal, and textbook collections in all respective fields of study and offers a full range of services, including electronic database searching and inter-library loans. The services support learning and research activities and can be easily accessed through remote access.

The Stang Mongkolsuk Library keeps track and listens to all aspects of feedbacks from its customers on a regular basis (<https://stang.sc.mahidol.ac.th/survey/survey.php>). Comments and feedbacks are taken into consideration by library staff, under supervision of Assistant Dean for Digital Transformation, for action plan on quality improvement. Every year, the library sends out the survey asking academic staff in every academic program for suggestion of new books for acquisition and journal subscription required for research as well as teaching and learning process for courses. Subscription to the unused journals may also be terminated so that the budget can be allocated to other in-demand journals.

• Laboratory and Research Equipment

Laboratory spaces available at the Department of Plant Science are fixed and cannot be expanded. Due to the nature of graduate education in life science, including our graduate program, laboratory spaces are not as essential as research equipment. Generally, laboratory space in our program and department is designed and managed to foster collaborative, interdisciplinary research. Student and staff can report malfunctions of each piece of equipment for repair or maintenance. The maintenance plan is conducted by the staff committees in the program. Every year, the Department of Plant Science will conduct a survey on students' satisfaction with the equipment facilities within the department. The survey and feedback had led to appropriate planning of equipment purchases. Machines that are in high demand get priority for new purchases, provided the budget is granted by the government. Accordingly, we have recently obtained new research equipment, i.e., Applied Biosystems Real-Time PCR Instruments, Fluorescence microscope, and Ultra-Low Temperature Freezer. At the Faculty of Science level, the CIF also conducts a similar survey, asking every academic staff member for their needs. Purchase plans for CIF usually cover

more expensive equipment beyond the budget available at the departmental level. As most of the instruments at the CIF are top-of-the-line and very expensive, the Faculty of Science has assigned a set of well-trained technicians dedicated to individual equipment to help guide students and staff in proper operation and to provide routine maintenance. Such dedicated custodians help minimize rates of equipment failure from inappropriate use.

- **IT Facilities and Services**

Similar to that of the teaching and learning facilities, the prompt assistance and maintenance are made available by the Faculty of Science and Mahidol University for IT services. The whole internet infrastructure, especially Wi-Fi services, and email accounts are maintained and regularly monitored by the Division of Information Technology, Mahidol University (MUIT). The Faculty of Science, on the other hand, takes care of the computer terminals for hardware maintenance. Requests for technical help or maintenance service can be filed to the IT staff at either MUIT, the System Development and Technology Division and Stang Mongkolsuk Library. At least once a year, MUIT sends email to every internet user including students and staff asking for feedbacks on service quality and areas for improvement. Appropriate action plans are made and implemented in the subsequent fiscal year. At the Faculty of Science level, both the System Development and Technology Division and Stang Mongkolsuk Library also consistently conduct satisfaction survey on students and staff for quantity and quality of computer and software facilities. The comments are taken into consideration for future strategic plans on quality improvement.

8 OUTPUT

8.1 The pass rates, dropout rates, and average time to graduate are shown to be established, monitored, and benchmarked for improvement

As shown in Table 19, the number of students enrolled in the Ph.D. Program in Botany at the Department of Plant Science, Faculty of Science, Mahidol University in each academic year 2022 is totally 17. During 2016–2022, only one student dropped out of our graduate program to continue her job in a private company. It must be noted that the COVID-19 pandemic has had a significant impact on Ph.D. students' ability to perform their research work in the lab. Many labs were closed or had limited access due to the pandemic, which has slowed down the research progress of many Ph.D. students. The Faculty of Graduate Studies has extended deadlines for Ph.D. students to complete their research work, such as thesis submissions or defenses.

The average study times for students who graduate from Plans A and B are 5.5–6.5 and 5 years, respectively (Table 20). It is important to note that these are just averages, and the actual study time for individual students can vary based on a variety of factors, such as their program of study, research topic, research internship abroad, funding availability, and personal circumstances.

The expected time to complete the Ph.D. program is 3 years at the minimum. Students can expedite the time frame if they have orientation for their graduation thesis early enough (from the 2nd semester of their first year). In order to improve the average time to graduate, all students have to present their progress reports to the thesis advisory committee and report to the program committee at the end of every semester. The students who take longer than 6 years for a Ph.D. from M.Sc. and 8 years from B.Sc. to graduate will have to meet the program committee with their major advisor to discuss the problems and find a solution together.

Table 19. Number of students of our Ph.D. Program in Botany and dropout rates during academic year 2016-2022.

Academic Year	Number of new admissions	Number of enrolled students				Number of dropouts during				Total number of students
		1 st year	2 nd year	3 rd year	>3 rd year	1 st year	2 nd year	3 rd year	>3 rd year	
2022	1	1	0	1	15	-	-	-	-	17
2021	0	0	1	4	13	-	-	-	-	18
2020	1	1	4	2	11	-	-	-	-	18
2019	4	4	2	7	5	-	-	-	-	18
2018	2	2	7	5	-	-	-	-	-	14
2017	7	7	5	-	-	-	-	-	-	12
2016	6	6	-	-	-	1	-	-	-	5

Table 20. The average time to graduation is established, monitored, and benchmarked for improvement.

Academic Year	Number of Graduates	Academic Year-in	Academic Year-out	Study time to graduation
2022	2	2016/1 (Plan A) 2018/1 (Plant B)	2022/1 2022/2	6.5 yrs 5 yrs
2021	1	2016/2 (Plan A)	2021/1	5 yrs
2020	1	2016/1 (Plan A)	2020/2	5 yrs

Note: Plant A: M.Sc. to Ph.D.; Plant B: B.Sc. to Ph.D.

8.2 Employability as well as self-employment, entrepreneurship, and advancement to further studies, are shown to be established, monitored, and benchmarked for improvement.

The results from the survey of studying and employment of students graduated from the Program revealed that the employment rate is satisfactory. For example, of the total 2 graduates from the classes of 2020-2021, both (100 %) provided the information. They got their job. None of graduates are unemployed or in the process of applying for a job. The results from the survey regarding careers of the graduates are shown in Table 21.

Table 21. Example of survey on alumni about continuing careers (Data collected from students graduated in 2020-2021).

Working institution	Graduated in 2020 (1 student)	Graduated in 2021 (1 student)	Graduated in 2022 (2 students)
Lecturer at Universities/Colleges Public: Private:	- -	- -	- -
Research Institutes Government Institute	-	1	-
Other - Public company - Cooperated with international institution	1 -	- -	- -
Seeking jobs and/or Post-doc scholarships	-	-	2

8.3 Research and creative work output and activities carried out by the academic staff and students, are shown to be established, monitored, and benchmarked for improvement

MU, MUSC, and the MU-SCPL have always devoted attention to student research activities, as evident from the annual increase in research funding. All students in the first year start to work in laboratories and take part in scientific research guided by the department staff. Through solving practical problems during their thesis research, students acquire hands-on experience and research skills and mature into confident and well-prepared scientists after graduating from the program. This helps prepare the graduating students for the demands of their future career by equipping them with skills in systematic planning, quick problem solving, and effective communication. With their accomplishments in scientific research and theses, our students are strong candidates for job applications and scholarships for higher education, both domestic and international.

To earn a Ph.D. from our graduate program, students must have at least 1 research article published in international journal indexed by reputable databases such as ISI and Scopus. Table 22 summarize the number of research output in terms of publications/proceedings from our doctoral degree students. Research activities including attending national and international conferences have also been encouraged.

Research internships can be a valuable experience for Ph.D. students, providing them with opportunities to gain hands-on research experience, expand their knowledge and skills, build professional networks, and enhance their career prospects. During the academic year 2021-2023, there are three students who have been granted an internship for 5 months to 1 year abroad.

Table 22. Research publications by Ph.D. students.

Academic year	Number of national proceedings	Number of international proceedings	Number of national journals	Number of international journals
2023	-	-	-	1
2022	-	2	-	2
2021	-	-	1	4
2020	-	2	4	5
2019	-	-	1	-
2018	-	-	-	1
2017	-	1	-	2

Table 23. Research internship of Ph.D. students.

Academic year	Number of Students	Institute
2022-2023	2	- Jodrell Laboratory, Royal botanic garden, Kew (1 year) - Royal Botanic Gardens, Kew (5 months)
2021-2022	2	- University of Oxford, UK (1 year) - Royal Botanic Gardens, Kew (5 months)

8.4 Satisfaction levels of the various stakeholders are shown to be established, monitored, and benchmarked for improvement

Stakeholders' satisfactions toward our Ph.D. program are monitored by many channels depending on the different stakeholders.

- *Academic Staff within the Department of Plant Science*

Concerns, feedbacks, opinions, happiness toward the operation of our program and of the department as a whole are discussed regularly at the department meeting. The final solution to any problem is made per a verdict from the meeting. Accordingly, discussions/solution include allocation of budgets and criteria for staff to attend national/international scientific meeting, teaching assignments, staff's performance evaluation criteria, equipment needs and maintenance, student intakes and admission criteria, students' problems, etc.

- *Current Students*

We are in a preliminary stage of developing a systematic approach on students' satisfaction survey. Current students have many channels to express their dissatisfaction. First, all students have a chance to anonymously evaluate teaching and learning processes conducted in each course online (<http://www.grad.mahidol.ac.th/Evaluation-index/>) and by program survey questionnaire. Second, they can consult with their major advisor, program director and/or internal examiner (appointed by program director to observe with respect to the quality of the thesis) who can immediately help solve the problem or, in turn, report the situation to the monthly department meeting for solution seeking. The third, but perhaps the most effective channel for hearing of students' satisfaction/dissatisfaction is by the interview during the brainstorming event at the annual SCPL activity (Exhibit 8.1).

According to the responses, students felt that the courses in the program sufficiently provided fundamental and specialized knowledge, giving them an overview and details about plant sciences and related fields. The students were satisfied with the teaching methods in which lecturers instruct and direct students in self-study and literature research. The program helps students develop active and independent attitudes towards learning and improve their time management skills.

- *Alumni*

We try to come up with a systematic approach to gather the alumni feedback including degree of their satisfaction/dissatisfaction toward Ph.D. program based on two criteria, including ELOs and Structure of the Program.

- *Employers*

Once the graduates from the program are employed, the satisfaction level of the employers regarding their quality as employees is surveyed. On a scale of 1 to 5, the employers rate their satisfaction with the former students regarding their general and specialized knowledge, communication skills, problem-solving skills, teamwork, professional ethics, cooperative attitude at work, professional responsibility, and progressive attitude. From the results, the employers felt satisfied with the professional quality, manners, and morality of the students (Exhibit 8.2).

SELF-ASSESSMENT SUMMARY

Criteria 1 – Checklist

1	Expected learning outcomes	1	2	3	4	5	6	7
1.1	The program to show that the expected learning outcomes are appropriately formulated in accordance with an established learning taxonomy, are aligned to the vision and mission of the university and are known to all stakeholders.			X				
1.2	The program to show that the expected learning outcomes for all courses are appropriately formulated and are aligned to the expected learning outcomes of the program.			X				
1.3	The program to show that the expected learning outcomes consist of both generic outcomes (related to written and oral communication, problem-solving, information technology, teambuilding skills, etc) and subject specific outcomes (related to knowledge and skills of the study discipline).			X				
1.4	The program to show that the requirements of the stakeholders, especially the external stakeholders, are gathered, and that these are reflected in the expected learning outcomes.			X				
1.5	The program to show that the expected learning outcomes are achieved by the students by the time they graduate.			X				
Overall opinion				X				

Criteria 2 – Checklist

2	Program Specification	1	2	3	4	5	6	7
2.1	The specifications of the program and all its courses are shown to be comprehensive, up-to-date, and made available and communicated to all stakeholders			X				
2.2	The design of the curriculum is shown to be constructive aligned with achieving the expected learning outcomes.			X				
2.3	The design of the curriculum is shown to include feedback from stakeholders, especially external stakeholders.			X				
2.4	The contribution made by each course in achieving the expected learning outcomes is shown to be clear.			X				
2.5	The curriculum made by each course are logically structured, properly sequenced (progression from basic to intermediate to specialized courses) and are integrated.			X				
2.6	The curriculum to have option(s) for students to pursue major and/or minor specializations.			X				
2.7	The program to show that the curriculum is reviewed periodically following an established procedure and that it remains up-to-date and relevant to industry.			X				
Overall opinion				X				

Criteria 3 – Checklist

3	Teaching and Learning Approach	1	2	3	4	5	6	7
3.1	The educational philosophy is shown to be articulated and communicated to all stakeholders. It is also shown to be reflected in the teaching and learning activities.			X				
3.2	Teaching and learning activities are shown to allow students to participate responsibly in the learning process.			X				

3	Teaching and Learning Approach	1	2	3	4	5	6	7
3.3	Teaching and learning activities are shown to allow students to participate responsibly in the learning process.			X				
3.4	The teaching and learning activities are shown to promote learning, learning how to learn, and instilling in students a commitment for life-long learning (e.g., commitment to critical inquiry, information-processing skills, and a willingness to experiment with new ideas and practices).			X				
3.5	The teaching and learning activities are shown to inculcate in students, new ideas, creative thought, innovation, and an entrepreneurial mindset.			X				
3.6	The teaching and learning processes are shown to be continuously improved to ensure their relevance to the needs of industry and are aligned to the expected learning outcomes.			X				
Overall opinion				X				

Criteria 4 - Checklist

4	Student Assessment	1	2	3	4	5	6	7
4.1	A variety of assessment methods are shown to be used and are shown to be constructively aligned to achieving the expected learning outcomes and the teaching and learning objectives.			X				
4.2	The assessments and assessment-appeal policies are shown to be explicit, communicated to students, and applied consistently.			X				
4.3	The assessment standard procedures for student progression and degree completion, are shown to be explicit, communicated to students, and applied consistently.			X				
4.4	The assessments methods are shown to include rubrics, marking schemes, timelines, and regulations, and these are shown to ensure validity, reliability, and fairness in assessment.			X				
4.5	The assessment methods are shown to measure the achievement of the expected learning outcomes of the program and its courses.			X				
4.6	Feedback of student assessment is shown to be provided in a timely manner.			X				
4.7	The student assessment and its processes are shown to be continuously reviewed and improved to ensure their relevance to the needs of industry and alignment to the expected learning outcomes.			X				
Overall opinion				X				

Criteria 5 - Checklist

5	Academic Staff Quality	1	2	3	4	5	6	7
5.1	The program to show that academic staff planning (including succession, promotion, re-deployment, termination, and retirement plans) is carried out to ensure that the quality and quantity of the academic staff fulfil the needs for education, research, and service.			X				
5.2	The program to show that staff workload is measured and monitored to improve the quality of education, research, and service.			X				
5.3	The program to show that the competences of the academic staff are determined, evaluated, and communicated.			X				
5.4	The program to show that the duties allocated to the academic staff are appropriate to qualifications, experience, and aptitude.			X				
5.5	The program to show that promotion of the academic staff is			X				

5	Academic Staff Quality	1	2	3	4	5	6	7
	based on a merit system which accounts for teaching, research, and service.							
5.6	The program to show that the rights and privileges, benefits, roles and relationships, and accountability of the academic staff, taking into account professional ethics and their academic freedom, are well defined and understood.			X				
5.7	The program to show that the training and developmental needs of the academic staff are systematically identified, and that appropriate training and development activities are implemented to fulfil the identified needs.			X				
5.8	The program to show that performance management including reward and recognition is implemented to assess academic staff teaching and research quality.			X				
Overall opinion				X				

Criteria 6 - Checklist

6	Student Quality and Support	1	2	3	4	5	6	7
6.1	The student intake policy, admission criteria, and admission procedures to the program are shown to be clearly defined, communicated, published, and up-to-date.			X				
6.2	Both short-term and long-term planning of academic and non-academic support services are shown to be carried out to ensure sufficiency and quality of support services for teaching, research, and community service.			X				
6.3	An adequate system is shown to exist for student progress, academic performance, and workload monitoring. Student progress, academic performance, and workload are shown to be systematically recorded and monitored. Feedback to students and corrective actions are made where necessary.			X				
6.4	Co-curricular activities, student competition, and other student support services are shown to be available to improve learning experience and employability.			X				
6.5	The competences of the support staff rendering student services are shown to be identified for recruitment and deployment. These competences are shown to be evaluated to ensure their continued relevance to stakeholders needs. Roles and relationship are shown to be well-defined to ensure smooth delivery of the services.			X				
6.6	Student support services are shown to be subjected to evaluation, benchmarking, and enhancement.			X				
Overall opinion				X				

Criteria 7 - Checklist

7	Facilities and Infrastructure	1	2	3	4	5	6	7
7.1	The physical resources to deliver the curriculum. Including equipment, material. And information technology, are shown to be sufficient.			X				
7.2	The laboratories and equipment are shown to be up-to-date, readily available, and effectively deployed.			X				
7.3	A digital library is shown to be set-up, in keeping with progress in information and communication technology.			X				
7.4	The information technology systems are shown to be set up to meet the needs of staff and students.			X				
7.5	The university is shown to provide a highly accessible computer and network infrastructure that enables the campus community to fully exploit information technology for teaching, research, service, and administration.			X				

7	Facilities and Infrastructure	1	2	3	4	5	6	7
7.6	The environmental, health, and safety standards and access for people with special needs are shown to be defined and implemented.			X				
7.7	The university is shown to provide a physical, social, and psychological environment that is conducive for education, research, and personal well-being.			X				
7.8	The competences of support staff rendering services related to facilities are shown to be identified and evaluated to ensure that their skills remain relevant to stakeholder needs.			X				
7.9	The quality of the facilities (library, laboratory, IT, and student services) is shown to be subjected to evaluation and enhancement.			X				
Overall opinion				X				

Criteria 8 - Checklist

8	Output	1	2	3	4	5	6	7
8.1	The pass rates, dropout rates, and average time to graduate are shown to be established, monitored, and benchmarked for improvement			X				
8.2	Employability as well as self-employment, entrepreneurship, and advancement to further studies, are shown to be established, monitored, and benchmarked for improvement			X				
8.3	Research and creative work output and activities carried out by the academic staff and students, are shown to be established, monitored, and benchmarked for improvement.			X				
8.4	Satisfaction levels of the various stakeholders are shown to be established, monitored, and benchmarked for improvement			X				
Overall opinion				X				

The assessment of the quality of a program is done on a 7-point scale as follows:

- 1 = absolutely inadequate; immediate improvements must be made
- 2 = inadequate, improvements necessary
- 3 = inadequate, but with minor improvements will make it adequate
- 4 = adequate as expected
- 5 = better than adequate
- 6 = example of good practice
- 7 = excellent

III STRENGTH AND WEAKNESS ANALYSIS

Upon Program's view finding, strengths, weakness and improvement plans could be:

Summary of Strengths

1. The Program is well equipped with facilities for research and teaching compared with the most equivalent graduated program in other university in Thailand.
2. The faculty members of the Program have long experiences in teaching and doing research in the area of Botany and Plant Science (mostly more than 15 years).
3. The faculty members of the Program are active in research and mostly publish their research in the national and international journals every year.
4. Coursework was delivered by using the online platform during university closure due to the COVID-19 pandemic.

Summary of Weaknesses

1. The “international environment” of the program still needs to be improved in terms of the English language skills of students and supporting staffs and number of international students.
2. Delay and difficulties to carry out thesis research work during university closure due to the COVID-19 pandemic. Under this situation, it also causes damage on living plant materials prepared for analysis.
3. Program adjustment was in the process; therefore, admission was not allowed in the academic year 2021.

Improvement Plans

1. In term of increase number of international students – Mahidol University and the Faculty of Graduate Studies have recently announced a policy to increase number of international students. Various supporting mechanisms are being planned such as increased international student grant.
2. The English language skill of students might be improved by encouraging them communicate in English and providing them more English training courses.
3. According to supporting staff English competency, English communication training will be arranged regularly by the Faculty of Science.
4. The program communicated and provided support and facilitate students to overcome difficulties under the restricted period after university re-opened according to COVID pandemic.

IV. APPENDICES

Exhibit 1.1	The program's ELOs as well as program specification were drafted by taking into consideration all feedback from stakeholders
Exhibit 2.1	The official TQF2 document
Exhibit 2.2	Ph.D. Botany Student Guide (short English version of program specification)
Exhibit 2.3	TQF 3
Exhibit 2.4	TQF 5
Exhibit 4.1	Course Specifications / Course syllabus
Exhibit 4.2	Timeline as well as guidelines for non-coursework assessments
Exhibit 5.1	FTE calculation: Academic Staff and students
Exhibit 6.1	A rubric scale
Exhibit 8.1	Students' satisfaction survey
Exhibit 8.2	Employers' satisfaction survey